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MARKET POWER AND INCOME TAXATION

Louis Kaplow

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1050 Massachusetts Avenue

Cambridge, MA 02138

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**ABSTRACT**

Does significant market power or the presence of large rents affect optimal income taxation, calling for greater redistribution due to tainted gains? Or perhaps less because of an additional wedge that distorts labor effort? Do concerns about inequality have implications for antitrust, regulation, trade, and other policies that influence market power, which contributes to inequality? This article addresses these questions in a model with heterogeneous abilities and hence a concern for distribution, markups, multiple sectors, ownership that is a function of income, allowance for any share of profits to be recovered of investments (including rent-seeking efforts), endogenous labor supply, and a nonlinear income tax. In this model, proportional markups with no profit dissipation have no effect on the economy, and a policy that reduces a nonproportional markup raises (lowers) welfare when it is higher (lower) than a weighted average of other markups. With proportional (partial or full) profit dissipation, proportional markups are equivalent to a downward shift of the distribution of abilities, and the welfare effect of correcting nonproportional markups associated with nonproportional profit dissipation now depends also on the degree of dissipation and how that is affected by the policy. In all cases, optimal policies maximize consumer plus producer surplus, without regard to a policy's distributive effects on consumers and profits or how markups and income taxation distort labor effort.

Louis Kaplow  
Harvard University  
Hauser 322  
Cambridge, MA 02138  
and NBER  
meskridge@law.harvard.edu

## 1. Introduction

Market power has long been a subject of economic analysis and plays a central role in a range of public policies including antitrust, intellectual property, and regulation. Pertinent literatures often use models that examine a single industry, ignore income distribution through the use of a representative agent, and do not focus on labor supply. In contrast, analysis of optimal income taxation typically assumes perfect competition when addressing the tradeoff of distribution and labor supply distortion. It is natural to extend both sets of analysis by exploring the interaction of market power and income taxation in a model in which all of these considerations are in play.

Growing concerns for inequality and about the extent of market power magnify the importance of this subject.<sup>1</sup> If a large slice of the profits that contribute to inequality constitutes tainted gains from monopoly or rent-seeking, might the case for greater redistribution be magnified? Conversely, if inequality is a substantial concern and is partly attributable to market power, should the broad range of policies influencing the state of competition be toughened and perhaps also tilted toward the maximization of consumer surplus rather than total surplus? Such issues were the subject of earlier literatures—for example, Robinson (1933) and Comanor and Smiley (1975)—and have recently received increasing attention, such as in OECD (2017) and World Bank and OECD (2017).

On the other hand, might the presence of compound distortions cut in the opposite direction, as some other literatures suggest? After all, markups in product markets raise prices, thereby reducing the real wage, and quantity reductions by sellers with market power are associated with reduced input demands, notably, for labor. As a consequence, the quantity of labor supplied is below the optimal level. Moreover, labor income taxes—and consumption taxes, such as a VAT, along with payroll taxes and income-based phaseouts of transfer payments—also create a substantial wedge that distorts labor supply downward. If each distortion was of a similar magnitude, the aggregate distortion would be on the order of four times that of each considered alone, and the marginal contribution of taxation to total distortion would be three times as high in the presence of the preexisting distortion created by market power (and vice versa). Does this interaction imply that the optimal degree of redistribution is significantly lower? And does it suggest that all manner of policies aimed to enhance competition should be pursued more aggressively than otherwise would seem efficient?

Finally, we should ask how the answers to these questions change if the corresponding profits from the exercise of market power constitute returns to prior investments in fixed costs or R&D. And what if instead markups are generated by rent-seeking activity wherein profits are dissipated by real, unproductive resource costs?

This article addresses these issues by analyzing a model with market power and income taxation. As will emerge, each of the foregoing ideas viewed in isolation captures a piece of the story, but examination of the system as a whole reveals them to be incomplete and even misleading. When taking an integrated view of market power and income taxation that accounts for labor effort, distributive concerns relating to both consumer surplus and profits, and the inefficiencies of imperfect competition, it turns out that some of the competing considerations in a sense cancel each other out. Perhaps surprisingly, the overall result is to leave largely intact

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<sup>1</sup> Studies finding large average markups include Domowitz, Hubbard, and Petersen (1988), Rognlie (2015), Feenstra and Weinstein (2017), De Loecker, Eeckhout, and Unger (2018), and Hall (2018); see also the discussion in Syverson (2019).

standard competition policy prescriptions that ignore distribution, labor supply distortion, and income taxation, and also to preserve familiar formulations for the optimal degree of redistributive income taxation that are predicated on models with no market power.

Section 2 begins by introducing the model. Individuals of different abilities choose labor effort and a vector of goods to maximize utility. Their budget constraint is given by labor income net of payments under a nonlinear labor income tax schedule, plus an ownership share of the economy's profits. These shares are taken to be some function of income, allowing for higher-income individuals to hold larger portfolios and to have access to higher-return investments (none of which is explicitly modeled). Following a number of literatures, each good is produced at constant marginal cost but sold at a some markup. The government uses income tax revenues to purchase a vector of goods at the markup-inclusive prices.

As a benchmark for thinking, the analysis begins with the case of proportional markups. It is demonstrated that such an economy is equivalent to an otherwise-identical economy with no markups. The definition of equivalence is that, for any income tax schedule that balances the government's budget in one economy, there exists what is referred to as a corresponding income tax schedule in the other economy such that individuals of every type choose the same labor effort, purchase the same vector of goods, and therefore achieve the same level of utility, while the government's tax revenue is just sufficient to purchase the same vector of goods at the prices prevailing in that economy. A further implication is that the optimal income tax for the economy with markups corresponds to that for the economy with no markups, which means that it achieves the same distribution of utilities and thus social welfare (for any social welfare function), although its stated marginal tax rates differ, perhaps substantially.

To explore the more realistic case of nonproportional markups, the section analyzes marginal reforms that change a single markup. It uses the methodology employed in Kaplow (2008) and other work of analyzing policy experiments that include an offsetting (in aggregate, distribution-neutral) adjustment to the income tax schedule that enables Pareto assessments and, relatedly, does not require that the income tax be optimal. Reducing a markup raises (lowers) everyone's utility if the markup is above (below) a particular weighted average of the other markups in the economy. As will be explained, this average differs for each markup that might be changed (both because different other markups are averaged and because the weights are different), so there does not in general exist a single level of markup for which it is optimal to reduce all higher markups and raise all lower markups. The fact that reducing low markups tends to decrease welfare runs counter to much conventional policy in antitrust, regulation, and other realms in which interventions often focus on an industry in isolation. Although the conventional approach could be rationalized if all markups but the targeted one equaled zero, that assumption is contrary to empirical evidence.

Section 3 extends the model to the case in which some or all of the profits produced by markups constitute recoveries for investments—which may be thought of as fixed costs, entry or search costs, R&D, rent-seeking, or anything else. See, for example, Schumpeter (1947) and Demsetz (1973), and, on rent-seeking in particular, Tullock (1967), Krueger (1974), and Posner (1975). Importantly, the analysis is qualitatively the same regardless of the social desirability of the investment and the degree to which profits are thereby dissipated. Of particular interest is the case of full dissipation, as in a wide range of models with free entry in which expected profits equal zero in equilibrium. See, for example, Dixit and Stiglitz (1977), Mankiw and Whinston (1986), Aghion and Howitt (1992), Hopenhayn (1992), Ericson and Pakes (1995), and Melitz

(2003).<sup>2</sup> But the analysis also covers partial dissipation and no dissipation as well as negative dissipation (positive spillovers) and more than full dissipation (negative spillovers beyond the creation of the markup itself).

When markups are proportional and the degree to which profits constitute returns for real resource use is also proportional across all goods, the economy is equivalent to an otherwise identical economy with no markups (and no dissipation) in which the distribution of individuals' abilities is shifted downward to a degree that reflects the portion of profits in the original economy that constitute the recovery of real resource costs. An economy's production possibility frontier can be thought of as a combination of the production technology (including the nature of investments that produce markups) and the distribution of abilities. With proportionality, we can equate any economy to one with the same marginal costs for goods but with all other costs embedded, in a sense, in the ability distribution. This equivalence is useful because the optimal income tax problem and others have been extensively analyzed for models that assume perfect competition. As a consequence, familiar results can be translated mechanically to an economy with markups and profit dissipation.

For the general case in which markups or profit dissipation are not proportional, marginal reforms are again assessed using offsetting adjustments to the income tax schedule to enable Pareto comparisons. Section 2's results are amended to reflect that only the undissipated portion of markups is relevant to allocative efficiency. In addition, most actual policies (antitrust, regulation, and so forth) that affect markups also affect resource use related to the generation of the markups, so a full policy assessment incorporates these productive efficiency effects as well. Policy rules are derived for general reforms that involve any relationship between effects on allocative and productive efficiency. These rules, like all others in this article, can be stated as involving the maximization of consumer plus producer surplus, regardless of the distributive effects of the reform on either one and independently of how markups and income taxation distort labor effort.

Throughout the analysis and in the conclusion, a number of qualifications and potential extensions are noted. The model explored here offers a preliminary but expanded view of the intersection of market power and income taxation. A byproduct is the illumination of a number of related literatures that are largely complementary to this investigation in both the questions they address and, relatedly, the models they employ.

The closest prior discussion, which pertains to the analysis in section 2, is Lerner's (1934) brief but insightful suggestion that what matters is not the difference between price and marginal cost but the dispersion of markups, a perspective that grounds some modern work in international trade. See, for example, Epifani and Gancia (2011) and Holmes, Hsu, and Lee (2014).<sup>3</sup> Of particular interest, Lerner stated that, in a world in which every good was subject to proportional markups—noting parenthetically “including leisure”—there would be no distortion.<sup>4</sup> For that qualification to hold would require a tax on leisure, which some literature (for example, Bilbiie, Gironi, and Melitz (forthcoming)) implements, in a representative-agent model, with a flat-rate subsidy (negative tax) on labor income funded by a lump-sum tax. Of

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<sup>2</sup> Relatedly, empirical analysis by Hall and Woodward (2010) suggests that entrepreneurs funded by venture capital approximately break even on an ex ante, risk-adjusted basis.

<sup>3</sup> Weyl and Fabinger's (2013) analysis of pass-through also examines the case in which there are positive markups in multiple industries.

<sup>4</sup> Given the era, it is not surprising that Lerner did not consider heterogeneous types, which would have introduced concerns for income distribution, or income taxation.

course, we generally see the opposite: a positive tax on labor income, some of which funds transfers that resemble a lump-sum grant, which also accords with the prescriptions of the optimal income taxation literature.

Taking this latter point further, some writing, such as Hart (1982) and World Bank Group and OECD (2017), has discussed market power as involving a labor wedge, and Browning (1994), Kaplow (1998), and Jonsson (2007) suggest that the combination of the labor wedge due to monopoly markups and that due to income taxation involves the sort of magnification of deadweight loss noted above. Some of this latter work, however, is informal, and it all operates in a representative-agent setting that does not allow for a flexible income tax schedule or address the distributive incidence of markups or profits.

Traditional work in industrial organization and that considering competition policy in particular typically focuses on a single industry and implicitly is in the setting of representative-agent models with no concern for distribution and no income taxation. See, for example, Tirole (1988), Motta (2004), Whinston (2006), Kaplow and Shapiro (2007). Earlier work that focuses on distributive effects, such as Robinson (1933) and Comanor and Smiley (1975), does not analyze or even refer implicitly to heterogeneous ability, labor supply, and income taxation. Some modern informal commentaries—for example, Baker and Salop (2015) and OECD (2017)—and government policy statements—such as the U.S. Horizontal Merger Guidelines (2010) and the EU Guidelines on Horizontal Mergers (2004)—endorse a consumer surplus test, often motivated by the difference in the distributive incidence of markups and profits.

Seminal work in public economics on income taxation (Mirrlees (1971)) and various extensions (for example, Atkinson and Stiglitz (1976)) assume perfect competition. Two literatures have straddled public economics and industrial organization. One line, surveyed in Myles (1995) and Auerbach and Hines (2002), considers the use of corrective taxes (subsidies) to offset markups in a representative-agent setting without distributive concerns or an income tax. Another, starting with Barro and Sala-i-Martin (1992), is pursued by Judd (1997, 2002), who considers markups with representative, infinitely-lived agents in a dynamic model, wherein a capital subsidy can offset the input market wedge on capital.

None of these varied literatures focus on the intersection of market power and income taxation, specifically in a world with heterogeneous abilities, concerns for distribution, ownership shares that may depend on income, multiple sectors, and markups. Nor is there an assessment of policy experiments or a consideration of how the analysis differs if some or all of the markups constitute returns to investment, whether in fixed costs, R&D, or rent-seeking.

## 2. Analysis

### 2.1. Model

There are  $n$  goods  $x_i$ ,  $i = 1, \dots, n$ , and  $X_i$  denotes the total quantity of good  $x_i$  in the economy. Each good  $x_i$  is produced at constant marginal cost  $c_i$  and sold at price  $p_i = c_i + \mu_i$ , where the  $\mu_i$  are exogenously given markups (expressed for convenience as amounts rather than as fractions of marginal cost). It will also be convenient to employ the Lerner index,  $\lambda_i \equiv \mu_i/p_i$ . Total profits in selling good  $x_i$  are  $\pi_i = \mu_i X_i$ , and economy-wide profits are  $\Pi = \sum_{i=1}^n \pi_i$ .

Individuals' abilities (wage rates) are denoted by  $w$ , distributed according to the density function  $f(w)$ , which is positive on  $[0, \infty)$ . Each individual chooses a nonnegative level of labor

supply,  $l$ , earning income  $y = wl$ , and quantities of each of the  $x_i$ . It will sometimes be useful to refer to the total income earned in the economy,  $Y = \int y(w)f(w)dw$ , where the notation  $y(w)$  refers to the level of income that an individual of type  $w$  optimally chooses to earn. (Similar notation expressing the optimally chosen level of a variable as a function of the type  $w$  will be employed below without further comment.)

Individuals' utility functions,  $u(x_1, \dots, x_n, l, w)$ , are increasing in each  $x_i$  and decreasing in  $l$ . Individuals maximize utility subject to the budget constraint

$$(1) \quad \sum_{i=1}^n p_i x_i = y - T(y) + \theta(y)\Pi.$$

In this expression,  $T(y)$  is the nonlinear income tax schedule (which may be negative, indicating transfers), and  $\theta(y)$  is the share of profits received by individuals who earn  $y$ . The latter is a reduced form that incorporates, for example, the possibility that individuals with higher income have greater ownership positions or access to higher-return investments. (It includes the case in which  $\theta(y) = 1$  for all  $y$ , as assumed in many literatures, typically in the context of representative-agent models.)

The government's revenue from the income tax is used to provide public goods (taken to be outside the model and given) using quantities of each private good in the economy, denoted  $x_i^G$ . Its budget constraint is

$$(2) \quad \sum_{i=1}^n p_i x_i^G = \int T(y(w))f(w)dw.$$

When the budget constraints of all individuals and the government hold, an economy-wide resource constraint will also be satisfied:  $\sum_{i=1}^n c_i X_i = Y$ , where  $X_i = \int x_i(w)f(w)dw + x_i^G$ . The markups paid by individuals and the government for goods are ultimately received by individuals as profits, and what individuals pay in taxes is received by the government, leaving only the production costs for goods and the total income produced by labor.

## 2.2. Proportional Markups

This section will establish that in an important sense proportional markups are of no consequence in this setting. Define an *economy*  $E$  as the set of  $n$  private goods  $x_i$ , the government's consumption of those goods (the  $x_i^G$ ), production costs  $c_i$ , markups  $\mu_i$ , utility functions  $u$ , a density function for types  $f(w)$ , and an ownership distribution function  $\theta(y)$ . Note that the nonlinear income tax schedule  $T(y)$  is not part of the definition of  $E$ . We will wish to compare such an economy to another economy,  $\hat{E}$ , that may differ in its markups,  $\hat{\mu}_i$ , and, in section 3's extension, in its density function for types,  $\hat{f}(w)$ . Now we can define:

*Equivalent Economies:* Economy  $E$  is equivalent to economy  $\hat{E}$  if and only if, for every admissible income tax schedule  $T$  in economy  $E$ , there exists a corresponding income tax schedule  $\hat{T}$  in economy  $\hat{E}$  such that:

(a) Individuals of every type  $w$  have the same budget sets in both economies. Specifically, when choosing any level of labor  $l$ , any choice of the goods  $x_i$  that satisfies the budget constraint (1) in economy  $E$  with income tax schedule  $T$  also satisfies the budget constraint in economy  $\hat{E}$  with income tax schedule  $\hat{T}$ .

(b) Individuals of every type  $w$  make the same choices of labor effort,  $l$ , and the goods,  $x_i$ , in both economies, and achieve the same level of utility,  $u$ .

(c) The government's budget constraint (2) is satisfied in economy  $\hat{E}$  with corresponding income tax schedule  $\hat{T}$ .

A few remarks on this definition are in order. An admissible tax schedule  $T$  refers to one that satisfies the government's budget constraint (2) in economy  $E$  when individuals in that economy maximize their utility subject to their own budget constraints (1). Requirement (a), that individuals have the same opportunity sets in both economies, implies that each type  $w$  will choose the same  $l$  and  $x_i$ 's in both economies and achieve the same level of utility  $u$  (assuming throughout that, in cases of indifference, the same choices will be made). Hence, requirement (b) is implied by requirement (a), but it is stated separately for clarity. Requirement (c), concerning satisfaction of the government's budget constraint, assumes that individuals' behavior is indeed the same, as just stated. (Of course, this does not in itself imply that the condition is met because the income tax schedule, and thus tax revenue, as well as the prices the government pays for goods, in general differ.) Finally, it will sometimes be useful to refer to  $T$  and its associated  $\hat{T}$  as *corresponding income tax schedules*.

We are now ready to state:

*Proposition 1: If the markups in economy  $E$  are proportional (i.e., there exists  $\lambda$  such that  $\lambda_i = \lambda$  for all  $i$ ), then the otherwise identical economy  $\hat{E}$ , except with no markups (i.e.,  $\hat{\lambda}_i = 0$  for all  $i$ ), is an equivalent economy.<sup>5</sup>*

*Proof:* We will begin with economy  $E$  and an (otherwise arbitrary) admissible tax schedule  $T$  and construct a tax schedule  $\hat{T}$  for economy  $\hat{E}$  that satisfies the definition. Start with individuals' budget constraints (1) in economy  $E$ . They can be restated using the proposition's assumption of proportional markups—and the fact that, from the definition of the Lerner index,  $p_i = c_i/(1 - \lambda)$ —as follows:

$$(3) \quad \sum_{i=1}^n \frac{c_i}{1 - \lambda} x_i = y - T(y) + \theta(y)\Pi.$$

Multiplying both sides of equation (3) by  $1 - \lambda$ , this can be expressed as

$$(4) \quad \sum_{i=1}^n c_i x_i = y - \lambda y - (1 - \lambda)(T(y) - \theta(y)\Pi).$$

Let us now define the corresponding income tax schedule as

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<sup>5</sup> Note that Proposition 1 implies that any two economies with proportional markups are equivalent.



$$(5) \hat{T}(y) \equiv \lambda y + (1 - \lambda)(T(y) - \theta(y)\Pi).$$

Substituting definition (5) into equation (4), we have

$$(6) \sum_{i=1}^n c_i x_i = y - \hat{T}(y).$$

Finally, observe that  $\hat{\Pi} = 0$  because, with a zero markup on every good, there are no profits in  $\hat{E}$ . Therefore, equation (6) is individuals' budget constraint in economy  $\hat{E}$ . Moreover, this derivation shows that it is equivalent to the budget constraint (1) in economy  $E$ : for any level of labor effort  $l$ , which earns the same before-tax income  $y$  in each economy (for any given type  $w$ ), individuals can afford precisely the same bundles of the goods  $x_i$  in both economies. This establishes that the hypothesized corresponding income tax schedule  $\hat{T}$  meets requirement (a) of the definition for equivalent economies, which, as already explained, implies requirement (b).

It remains to demonstrate requirement (c): that, when individuals behave the same way (regarding both labor effort and purchases of goods), the government's budget constraint (2) is satisfied in economy  $\hat{E}$  with income tax schedule  $\hat{T}$ . Beginning with this constraint, which is assumed to be satisfied in economy  $E$  with income tax schedule  $T$ , we can, as with individuals' budget constraints, make the substitution on the left side,  $p_i = c_i/(1 - \lambda)$ , to yield

$$(7) \sum_{i=1}^n \frac{c_i}{1 - \lambda} x_i^G = \int T(y(w))f(w)dw.$$

Next, we can rearrange terms in expression (5) for the corresponding income tax schedule to isolate  $T(y)$  and then integrate both sides over  $w$ , which yields

$$(8) \int T(y(w))f(w)dw = \int \frac{\hat{T}(y(w)) - \lambda y(w)}{1 - \lambda} f(w)dw + \Pi.$$

Using equation (8) to substitute on the right side of equation (7) and multiplying both sides by  $1 - \lambda$  gives us

$$(9) \sum_{i=1}^n c_i x_i^G = \int (\hat{T}(y(w)) - \lambda y(w)) f(w)dw + (1 - \lambda)\Pi.$$

Using the expression for total income earned in the economy,  $Y$ , we have

$$(10) \sum_{i=1}^n c_i x_i^G = \int \hat{T}(y(w))f(w)dw - \lambda Y + (1 - \lambda)\Pi.$$

The economy-wide resource constraint in  $E$  is

$$(11) \quad Y = \sum_{i=1}^n c_i X_i.$$

Furthermore, another manipulation of the Lerner index shows that  $c_i = ((1 - \lambda)/\lambda)\mu_i$ . Substituting this in equation (11) allows us to state

$$(12) \quad Y = \sum_{i=1}^n \frac{1 - \lambda}{\lambda} \mu_i X_i = \frac{1 - \lambda}{\lambda} \sum_{i=1}^n \pi_i = \frac{1 - \lambda}{\lambda} \Pi,$$

where the latter two equalities follow from the definitions of  $\pi_i$  and  $\Pi$ , respectively. Finally, using expression (12) to substitute for  $Y$  in expression (10) and simplifying, we have

$$(13) \quad \sum_{i=1}^n c_i x_i^G = \int \hat{T}(y(w)) f(w) dw.$$

Expression (13) indicates that, under income tax schedule  $\hat{T}$ , the government's budget constraint holds in economy  $\hat{E}$  (which, recall, has no markups, so prices for private goods,  $p_i$ , are given by  $c_i$ ). ■

Return now to Lerner's (1934) suggestion that markups do not matter if all prices are elevated proportionally above respective marginal costs. In his first (of two) statements of this claim, he noted parenthetically that this conclusion supposes that the proportionality of markups holds with respect to leisure as well, that is, a reciprocal *markdown* on labor. As the introduction mentions, some subsequent literature, in the context of representative-agent models, instantiates this idea by postulating a negative linear tax (a constant subsidy) on labor income financed by a lump-sum tax.

In actual fact, of course, most modern economies instead have a positive marginal tax on labor income—through income taxes as well as payroll taxes and consumption taxes, and also due to phaseouts of transfer programs. Relatedly, we are interested in economies in which individuals have different income-earning abilities, so the notion of financing a negative tax on labor with a positive lump-sum tax is the opposite of what is usually contemplated. Also, to close the model, explicit attention must be paid to the ultimate distribution of profits to different individuals, which compounds distributive concerns because higher-income individuals tend to receive greater shares of profits. The foregoing derivation shows that, when one incorporates all of these features, which may have been thought to cut against or at least complicate Lerner's claim, one nevertheless obtains equivalence.

As the introduction notes, this conclusion also runs contrary to a suggestion in some literature that, when we take the negative wedge on labor supply required to offset the distortion due to markups and combine it with a preexisting positive labor income tax (as allowed for here), the result is a compound distortion. One might have thought that the labor wedge due to markups reduced the optimal degree of income redistribution. Proposition 1 shows that, in the present setting, this is not the case.

To put this point more precisely, consider explicitly the implications of proportional markups for optimal income taxation. An *optimal income tax schedule*,  $T^*(y)$ , in economy  $E$  is

defined as the admissible income tax schedule that maximizes an individualistic social welfare function of the standard form (that is, a positive function of all individuals' utilities). The following corollary is immediate from the fact that Proposition 1 holds with respect to any admissible income tax schedule.

*Corollary 1.1.  $T^*$  is the optimal income tax schedule for economy  $E$  with proportional markups if and only if the corresponding income tax schedule  $\hat{T}^*$  is the optimal income tax schedule for the otherwise identical economy  $\hat{E}$ , except with no markups.*

Reflection on the definition of an equivalent economy, particularly requirement (b)'s statement that all individuals have the same utility levels, explains why this result follows. The derivation of an optimal income tax schedule for economy  $\hat{E}$  with no markups is, of course, the standard optimal nonlinear income tax exercise. In an economy that instead has proportional markups, the optimal income tax schedule can be seen in two ways. First, in a substantive sense, there is no difference: the degree of redistribution will be the same and, indeed, all real activity in the economy is the same—everyone's labor effort and choices of goods are the same, their utilities are the same, and the government's purchases are the same. Second, the actual (nominal) income tax schedule is different, in a manner that is mechanical, as determined by expression (5) that defines the relationship between  $T$  and the corresponding income tax schedule  $\hat{T}$ . For example, if  $\theta(y)/y$  rises with  $y$ , the average tax rate under  $T$  (that is, in the economy with proportional markups) will rise more quickly with income (in real terms) than under  $\hat{T}$ .

It aids intuition to restate expression (5) as follows:

$$(14) \quad \hat{T}(y) \equiv (1 - \lambda)T(y) + \lambda y - (1 - \lambda)\theta(y)\Pi.$$

The first term on the right side of expression (14) scales down the original income tax (or the transfer, if negative) so that it is denominated in what may be viewed as the new currency (price index) of economy  $\hat{E}$ , reflecting that everything is correspondingly cheaper when the markups are removed. The second term taxes away the portion of an individual's labor income that went to covering the markups that are no longer charged. The third term is a subsidy to reimburse individuals for the profits they no longer receive, scaled (like the first term) to reflect the new currency of economy  $\hat{E}$ . This explains why the construction in the proof results in individuals having the same budget sets in the two economies and hence making the same choices and achieving the same utility.

Finally, the fact that the income tax schedule that produces this equivalence for all individuals also produces equivalence for the government can best be understood from the economy's total resource constraint (as used in the proof). Once we know that all real behavior is the same—individuals, as just explained, behave the same, and we are further supposing that the government's purchases of goods are the same—the resource constraint will likewise be satisfied in  $\hat{E}$ . When examining the real resources in the economy, we can ignore profits (which are transfers from individuals and the government, as consumers, to producers, who in turn distribute those profits in some manner to the individuals) and income taxes (which are transfers between individuals and the government). In all, individuals' labor produces the same quantum of goods, and individuals' and the government's consumption of these goods is the same.

### 2.3. General Markups

In this section, which examines more practically relevant settings in which markups are not proportional, our interest is in how to evaluate reforms rather than to state equivalences.<sup>6</sup> Clearly, much competition and trade policy as well as regulatory revision aims, at least in significant part, to reduce markups in the economy. In order to undertake policy evaluation, it is convenient to restrict the utility function so that it can be expressed as  $u(v(x_1, \dots, x_n), l, w)$ , where  $v$  is a subutility function that depends only on the goods consumed (and the functions are now taken to be differentiable). This weak separability implies that changing the consumption bundle in a manner that generates the same amount of subutility  $v$  from goods does not alter the attractiveness of labor effort.<sup>7</sup>

A reform will be understood as a change in the exogenous markups.<sup>8</sup> Due to the presence of a nonlinear income tax that we are assuming may be adjusted, it will be possible to compare regimes using the Pareto principle, drawing on the method used extensively in Kaplow (2008) and some other work. Specifically, it is possible to demonstrate:

*Proposition 2:* Given any economy  $E$  with markups  $\mu_i$  and admissible income tax schedule  $T$ , for a marginal increase (decrease) in any  $\mu_j$ , it is possible to adjust the income tax schedule  $T$  in a manner that, taken together, generates a strict Pareto improvement if and only if  $\lambda_j < \bar{\lambda}_j$  ( $\lambda_j > \bar{\lambda}_j$ )—where  $\bar{\lambda}_j$  is the weighted average of the  $\lambda_i$ 's,  $i \neq j$ , defined in expression (25).

*Proof:* Consider a reform parameterized by  $\gamma$ : in economy  $E$ , set  $\gamma = 1$  and restate the markup on good  $j$  as  $\gamma\mu_j$  (so we now have  $p_j = c_j + \gamma\mu_j$ ). In the reform to be evaluated—a marginal increase in  $\gamma$ —we will construct a marginal adjustment to the income tax schedule  $T(y)$  (that is, at each  $y$ ), now denoted  $T(y, \gamma)$ .  $T(y, 1)$  is the income tax schedule in our original economy  $E$ , and the specific adjustment to the income tax schedule that we will analyze is given by

$$(15) \quad \frac{dT(y, \gamma)}{d\gamma} = -\mu_j x_j(y) + \theta(y) \frac{d\Pi}{d\gamma}.$$

This income tax schedule adjustment is chosen because, under it, an individual who continues to earn income  $y$  is (just) able to continue to purchase the same goods as in the original (unadjusted) economy  $E$ . This claim follows immediately if one differentiates the individual's budget constraint (1) with respect to  $\gamma$  (holding  $y$  and the  $x_i$  constant), and substitutes for  $dT(y, \gamma)/d\gamma$  using expression (15). To see the underlying intuition, note that the first term on the right side is the degree to which income taxes must fall to compensate for the fact that

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<sup>6</sup> That said, analysis similar to that employed in the proof of Proposition 1 can be used to show that, with general (nonproportional) markups, two economies will be equivalent if and only if they have the same price ratios (which occurs when the markups are such that the ratios  $(1 - \lambda_i)/(1 - \lambda_j)$ , for all  $i, j$ , are the same in the two economies).

<sup>7</sup> The weak separability assumption is familiar in public economics (e.g., Atkinson and Stiglitz (1976)). If relaxed, then reforms that increase the relative consumption of goods that are leisure substitutes (complements) result in an increase (decrease) in labor supply, thereby generating an increase (decrease) in income tax revenue. Because such effects are familiar and are orthogonal to this article's focus, they are set aside for ease of exposition.

<sup>8</sup> The analysis is best understood as a comparison of two economies in long-run steady state because no account is taken of transitions and associated implicit capital levies or conferrals of windfall gains.

purchases of  $x_j$  are more expensive due to the marginally higher markup (the increase in  $\gamma\mu_j$ ). Offsetting this compensation, the second term taxes away the individual's share of the increase in profits due to the change—which, if profits fall, is negative and hence a source of further compensation.

Of course, because of the increase in  $p_j$  (with all of the other  $p_i$  taken to be unaffected), individuals will consume different bundles of goods. However, by the envelope theorem, individuals' subutility,  $v(x_1, \dots, x_n)$ , will not change.

Moreover, because each level of before-tax income  $y$  generated by the corresponding choice of labor effort  $l$  therefore yields the same level of subutility  $v$ , it follows that individuals' choices of labor effort will be the same and their overall utility will be the same. To prove this, begin by defining the indirect subutility function

$$(16) \quad V(y, T, \Pi, p_1, \dots, p_n) \equiv \max_{x_1, \dots, x_n} v(x_1, \dots, x_n),$$

where the maximization of  $v$  is subject to the budget constraint (1). Each individual chooses a level of labor effort  $l$  to maximize  $u(V(y, T, \Pi, p_1, \dots, p_n), l, w)$ . Because we have defined the income tax schedule adjustment  $dT(y, \gamma)/d\gamma$  such that  $dV(y, T, \Pi, p_1, \dots, p_n)/d\gamma = 0$  for all  $y$  and, furthermore, an individual of type  $w$  determines  $y$  solely by a choice of labor effort  $l$ , it is possible to write a reduced-form utility function  $U(l, w, \gamma)$  which has the property that, for any given  $l$ ,  $\partial U(l, w, \gamma)/\partial \gamma = 0$ . Hence, whatever  $l$  maximizes utility for a given type  $w$  in the initial economy  $E$  (with  $\gamma = 1$ ) continues to maximize utility as  $\gamma$  is increased. That is,  $dl/d\gamma = 0$  for all individuals. A further consequence is that, since each individual chooses the same  $l$  and utility is unchanged for any given  $l$ , all individuals' utilities are unchanged as well.

Next, consider the impact of increasing  $\gamma$  on the government's budget. Using expression (2), we can define the budget surplus (or deficit, if negative) under the economy parameterized by  $\gamma$  as

$$(17) \quad \sigma(\gamma) = \int T(y(w), \gamma) f(w) dw - \sum_{i=1}^n p_i(\gamma) x_i^G,$$

where, regarding the prices, now denoted by  $p_i(\gamma)$ , only  $p_j(\gamma)$  in fact changes with  $\gamma$ . Making use of expression (15) for  $dT(y, \gamma)/d\gamma$ , the effect of the reform on the budget surplus (which equals 0 when  $\gamma = 1$ ) is given by

$$(18) \quad \frac{d\sigma(\gamma)}{d\gamma} = - \int \mu_j x_j(y(w)) f(w) dw + \frac{d\Pi}{d\gamma} - \mu_j x_j^G.$$

(Throughout, these derivatives and others are evaluated at  $\gamma = 1$ , with explicit notation to this effect omitted.) Combining the first and third terms on the right side and recalling the definition of  $X_j$ , we have

$$(19) \quad \frac{d\sigma(\gamma)}{d\gamma} = \frac{d\Pi}{d\gamma} - \mu_j X_j.$$

Note that expression (19) carries the interpretation that the change in the government's *budget* surplus is given by the change in total *economic* surplus: the increase in profits (producer surplus) minus the reduction in consumer surplus (where, here, the government is regarded as a consumer with respect to its purchases). This intermediate result, which will be elaborated below, arises because of the manner in which the income tax adjustment in expression (15) was constructed, specifically, by compensating individuals for their reduction in consumer surplus and taxing away their increase in income attributable to profits.

Differentiating the earlier expression for total profits,  $\Pi$ , we have

$$(20) \quad \frac{d\Pi}{d\gamma} = \sum_{i=1}^n \mu_i \frac{dX_i}{d\gamma} + \mu_j X_j.$$

The first term indicates how profits change as a consequence of individuals' changes in their consumption bundles on account of the change in the price ratios. (The  $X_i$ , being economy wide, include the government's purchases, but since they are taken as given they do not contribute to these derivatives.) The second term is the mechanical effect of raising the markup on  $x_j$ . Combining equations (19) and (20) yields a simple expression for the change in the government's surplus:

$$(21) \quad \frac{d\sigma(\gamma)}{d\gamma} = \sum_{i=1}^n \mu_i \frac{dX_i}{d\gamma}.$$

Note that the right side indicates the total change in profits (producer surplus) net of the mechanical effect, which effect in turn equals the reduction in consumer surplus. Because the adjustment to the income tax schedule, as mentioned, moves all effects on consumer and producer surplus to the government, the change in the government's budget surplus unsurprisingly equals this net change in total economic surplus.

In examining expression (21), it is helpful to use the fact that  $\mu_i = \lambda_i p_i$  (from the definition of the Lerner index) and to separately state the  $j^{\text{th}}$  term:

$$(22) \quad \frac{d\sigma(\gamma)}{d\gamma} = \lambda_j p_j \frac{dX_j}{d\gamma} + \sum_{i \neq j} \lambda_i p_i \frac{dX_i}{d\gamma}.$$

Next, define the weights

$$(23) \quad \beta_i \equiv - \frac{p_i \frac{dX_i}{d\gamma}}{p_j \frac{dX_j}{d\gamma}}.$$

In interpreting this definition, keep in mind that the  $dX_i/d\gamma$  (which equal the integral of individuals'  $dx_i/d\gamma$ ) are compensated derivatives given how the income tax adjustment is defined in expression (15). Hence, the denominator is negative (it is the compensated change in purchases of  $X_j$  as its price increases), so a given  $\beta_i$  will be positive (negative) when good  $x_i$  is a

Hicksian substitute (complement) for  $x_j$ , interpreting these notions as weighted averages over the population. Furthermore, it is straightforward to demonstrate (using individuals' budget constraints) that  $\sum_{i \neq j} \beta_i = 1$ , so indeed the  $\beta_i$  carry the interpretation of weights.

Using expression (23), we can restate expression (22) as

$$(24) \quad \frac{d\sigma(\gamma)}{d\gamma} = p_j \frac{dX_j}{d\gamma} \left( \lambda_j - \sum_{i \neq j} \lambda_i \beta_i \right).$$

Furthermore, define

$$(25) \quad \bar{\lambda}_{\setminus j} \equiv \sum_{i \neq j} \lambda_i \beta_i,$$

which allows us to rewrite expression (24) as

$$(26) \quad \frac{d\sigma(\gamma)}{d\gamma} = p_j \frac{dX_j}{d\gamma} (\lambda_j - \bar{\lambda}_{\setminus j}).$$

To interpret expression (26), recall that  $dX_j/d\gamma$  is negative. Therefore, the sign of the change in government surplus is the opposite of the sign of  $(\lambda_j - \bar{\lambda}_{\setminus j})$ , so there will be a surplus if and only if  $\lambda_j < \bar{\lambda}_{\setminus j}$ . To complete the argument, we can rebate this surplus by making a further adjustment to the income tax schedule  $T(y, \gamma)$  (such that it is lower for all  $y$ ), in an amount that the government's budget balances.<sup>9</sup> Before this rebate, all individuals' utilities were unchanged, so with the rebate all enjoy higher utility. ■

Proposition 2 tells us, roughly speaking, that it is desirable to reduce high  $\lambda_j$ 's and increase low  $\lambda_j$ 's.<sup>10</sup> The intuition is that, because the resulting price vector thereby involves less distortion, the induced reallocation of consumption increases efficiency. This statement is only rough because the  $\bar{\lambda}_{\setminus j}$  defined in expression (25) are not in general the same for each good  $j$ .<sup>11</sup> Hence, there may not exist a  $\lambda^*$  such that it is optimal to reduce (increase) any  $\lambda_j$  that is greater

<sup>9</sup> Alternatively, recalling that the government's purchases of private goods are used to create public goods that are outside the model, one could suppose that the surplus is expended to increase public goods that generate utility to all individuals.

<sup>10</sup> Proposition 2 therefore loosely supports Lerner's (1934) statement, followed in some of the trade literature, that what matters is the dispersion of markups; Lerner specifically suggested the standard deviation. As the text that follows makes clear, no simple measure of dispersion will in general be a sufficient statistic for the welfare cost of markups. It can be demonstrated, however, that a proportional reduction in all markups, combined with an offsetting adjustment to the income tax schedule, is Pareto improving, which does entail a reduction in dispersion. (It also reduces the mean, but it follows from Proposition 1 that this is not necessarily meaningful. For example, after proportionally reducing all markups, one could then scale them up in a manner that keeps all price ratios the same and restores the original mean, and adjust the income tax accordingly, without having any further effect on social welfare.)

<sup>11</sup> Note further that there are not simple and appealing sufficient conditions, consistent with nonproportional markups, that would result in the  $\bar{\lambda}_{\setminus j}$ 's being identical, because the omitted  $\lambda_j$  in expression (25) is different for each  $j$  and the derivatives underlying the  $\beta_i$  in expression (23) depend on  $j$ .

(less) than  $\lambda^*$ . To illustrate this point, suppose that two goods,  $x_j$  and  $x_k$ , are close substitutes for each other but not for any of the other goods, and assume further that both have particularly high relative markups; then, raising the lower of the two markups—suppose that is  $\mu_j$ —might improve welfare. (In expression (25) for  $\bar{\lambda}_{\setminus j}$ , most of the weight would be on the relative markup that was even higher,  $\lambda_k$ , so we could have  $\lambda_j < \bar{\lambda}_{\setminus j}$ .)

The foregoing intuition and interpretation can be expressed in another, closely related manner. Noting from expression (23) that  $\beta_j = -1$  (which refers to the marginal dollar no longer spent on good  $x_j$  that is reallocated to all of the other goods,  $i \neq j$ ), we can use expression (26) to restate the requirement for a Pareto improvement as

$$(27) \quad \sum_{i=1}^n \beta_i \lambda_i > 0.$$

Expression (27) indicates that a Pareto improvement is possible when the increase in markup  $\mu_j$  reallocates consumption expenditures to goods with higher relative markups, on a weighted average basis (note that  $\sum_{i=1}^n \beta_i = 0$ ). Nonproportional markups distort behavior by discouraging (encouraging) consumption of goods with relatively high (low) markups, so efficient reforms are those that, on net, counter this tendency.<sup>12</sup>

Much policy analysis, such as in the antitrust realm, focuses on a single firm or sector and operates on the assumption that a reduction in markups is desirable. Proposition 2 shows that this is problematic. One might attempt to rationalize the standard approach by viewing the rest of the economy as approximately competitive and, moreover, supposing that distributive issues (including impacts on profits) are addressed through the income tax. This workaday view can be stated more precisely in the world of this model as follows:

*Corollary 2.1: In an economy  $E$  in which  $\mu_i = 0$  for all  $i \neq j$  and  $\mu_j > 0$ , there exists an adjustment to the income tax schedule  $T$  that, when combined with a marginal decrease in  $\mu_j$ , generates a strict Pareto improvement.*

The demonstration is immediate from expression (25), where we can see that  $\bar{\lambda}_{\setminus j} = 0$ . As mentioned in the introduction, however, this corollary's predicate is contrary to empirical evidence. Interestingly, a feature of modern merger guidelines that has not previously been well rationalized is an apparent requirement that a proxy for total price elevation (that is, inclusive of the pre-merger elevation) be reasonably high, suggesting that anticompetitive effects may need to be in highly distorted sectors to support a challenge.<sup>13</sup>

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<sup>12</sup> Observe that, unlike with Proposition 1, which held for any admissible income tax schedule  $T$ , Proposition 2 begins not just with the economy  $E$  but also with a particular (but it can be any) admissible income tax schedule  $T$ . The reason is that aggregate demands, the  $X_i$ , generally depend on the distribution of income, so the  $\beta_i$  defined in expression (23) depend on the original choice of  $T$ . Therefore, it is in general possible that a reform would be Pareto improving from one starting point but not from another. This possibility is an instance of the familiar notion (associated with the second fundamental theorem of welfare economics) that what constitutes an efficient outcome generally depends on the distribution of income.

<sup>13</sup> For example, the U.S. Horizontal Merger Guidelines (2010) provide targets stated not only in terms of how much a merger raises the Herfindahl-Hirschman Index (HHI), a proxy related to the predicted price increase, but also by



Before proceeding, it is also useful to remark briefly on the interpretation of equation (19). As explained, this expression indicates that there will be a government *budget* surplus (enabling the funding of a Pareto-improving reduction in the income tax schedule at all levels of income) if and only if the effect of the reform is to increase the sum of consumer surplus and profits (producer surplus). This point is notable with regard to debates about whether competition policy should aim to maximize total surplus or just consumer surplus, with many government policy statements and much commentary advocating the latter, as noted in the introduction. One of the main arguments for this preference invokes distributive concerns, notably, that the economy's profits are allocated disproportionately to high-income individuals relative to the allocation of consumer surplus. In the present construction, the adjustment to the income tax schedule eliminates all distributive effects, whatever they might be, which follows from expression (15) for the offsetting adjustment to the income tax schedule.

More broadly, unlike many analyses that employ representative-agent models, we are in a setting where distribution matters, profits are present and may have any distributive incidence, and we are concerned as well with possible compound distortions of labor supply that depend on the economy's markups as well as on the income tax schedule. The corresponding (adjusted) income tax schedule is constructed in such a manner that the reform as a whole is distribution neutral (regardless of the incidence of the change in markups on consumption expenditures and on profits) and, as demonstrated, labor supply is unchanged. All that remains is the pure, direct effect on the efficiency of resource use.<sup>14</sup>

### 3. Investment and Rent Dissipation

Section 2 implicitly assumes that no resources were expended in creating the market circumstances in which markups can be charged, generating profits that in turn accrue to individuals in proportion to their ownership interests. This section extends the model to allow for such expenditures. Specifically, it is now assumed that  $\pi_i = (1 - \alpha_i)\mu_i X_i$ , for all  $i$ . That is, the portion  $\alpha_i$  of the markup associated with good  $x_i$  is taken to be the return to an investment of real resources. (Section 2 analyzed the special case in which  $\alpha_i = 0$  for all  $i$ .) These investments can variously be interpreted as expenditures on fixed costs, entry, search, research and development, or rent seeking. Here, it is sufficient to suppose that the costs reduce net profits. As a consequence, the economy-wide resource constraint is no longer given by expression (11) but instead is

$$(28) \quad Y = \sum_{i=1}^n (c_i + \alpha_i \mu_i) X_i.$$

The structure of this section parallels that in section 2. For the proportional case, we will focus on equivalent economies and use the unrestricted utility function  $u$  introduced in section

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reference to the *level* of the HHI, a proxy for the overall degree of price elevation. Nevertheless, other statements in the Merger Guidelines contradict this requirement, and it is unclear the extent to which actual practice reflects it.

<sup>14</sup> The present model, like many in these fields, has only final goods. With intermediate goods and concomitant double (multiple) marginalization, the analysis is more complex and the conditions for markup irrelevance are much more stringent. Nevertheless, in the present setup, distributive effects and labor supply distortion remain separate and competition policy rules continue to be efficiency tests that reflect total welfare.

2.1. For the general case, we will undertake Pareto assessments of marginal reforms using an offsetting adjustment to the income tax schedule and use the differentiable utility function exhibiting weak separability (via the subutility function  $v$ ) employed in section 2.3.

### 3.1. Proportional Case

Assume that the economy  $E$  has proportional markups, as in section 2.2, and, moreover, that the fraction of these markups that constitutes real resource costs is the same for all goods, that is,  $\alpha_i = \alpha$  for all  $i$ . The main result is:

*Proposition 3: If the markups in economy  $E$  are proportional (i.e., there exists  $\lambda$  such that  $\lambda_i = \lambda$  for all  $i$ ) and the fraction of markups that constitutes real resource costs is the same for all goods (i.e., there exists  $\alpha$  such that  $\alpha_i = \alpha$  for all  $i$ ), then the otherwise identical economy  $\hat{E}$ , except with no markups (i.e.,  $\hat{\lambda}_i = 0$  for all  $i$ ) and with a density function for abilities given by  $\hat{f}$ , as defined in expression (43), is an equivalent economy.*

This proposition states that the only effect of proportional markups concerns the common fraction that corresponds to real resource costs, any remainder being irrelevant in the manner associated with Proposition 1. Moreover, because we are assuming that the same fraction of markups on all goods is so consumed, we can state that, to this degree, the economy is equivalent to one with no such markups but in which labor is less productive to that extent. This reduction, in turn, can be depicted as a downward shift of the original density function for abilities,  $f$ , as will emerge in the proof's construction of  $\hat{f}$ .

*Proof:* The proof will proceed in two steps. In the first, the portion  $1 - \alpha$  of the markups that constitutes true profits will be eliminated, using a variation of the proof of Proposition 1, with the resulting intermediate economy, denoted  $\check{E}$ , being equivalent to economy  $E$ . Second, the portion  $\alpha$  of the markups that constitutes real resource costs will be eliminated, with the ultimately resulting economy  $\hat{E}$  being the one referred to in the proposition.

To begin, define economy  $\check{E}$  as identical to economy  $E$  except for the markups, which are now given by  $\check{\mu}_i = \alpha\mu_i$ ; moreover, in  $\check{E}$ ,  $\check{\alpha} = 1$ , which is to say that all of the remaining markups involve the return to real investments. We can further state that  $\check{p}_i = c_i + \check{\mu}_i$  and  $\check{\lambda} = \check{\mu}_i/\check{p}_i$ , for all  $i$ . It will also sometimes be useful to make reference to an expression for  $\check{\lambda}$  in terms of  $\lambda$  (which can be derived by manipulating the definitions of these Lerner indexes):<sup>15</sup>

$$(29) \quad \check{\lambda} = \frac{\alpha\lambda}{1 - (1 - \alpha)\lambda}.$$

Turning to the budget constraint (1), taken to hold in economy  $E$ , we can multiply both sides by  $(1 - \lambda)/(1 - \check{\lambda})$ , making use of the definitions of the Lerner indexes and expression (29), as appropriate, to yield the following analogue to expression (4):

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<sup>15</sup> The interpretation of  $\lambda$  and  $\check{\lambda}$  as Lerner indexes when some of the former and all of the latter constitute the recovery of prior investments is often employed, viewing the rents as quasi-rents.

$$(30) \quad \sum_{i=1}^n \check{p}_i x_i = y - (1 - \alpha)\lambda y - (1 - (1 - \alpha)\lambda)(T(y) - \theta(y)\Pi).$$

Paralleling expression (5), we can define the corresponding income tax schedule for economy  $\check{E}$  as

$$(31) \quad \check{T}(y) \equiv (1 - \alpha)\lambda y + (1 - (1 - \alpha)\lambda)(T(y) - \theta(y)\Pi).$$

Therefore,

$$(32) \quad \sum_{i=1}^n \check{p}_i x_i = y - \check{T}(y).$$

Note that, from the above definition of profits and the definition of economy  $\check{E}$ , it is also true that  $\check{\Pi} = 0$  in  $\check{E}$ , so expression (32) indicates that individuals' have the same budget sets and, as explained previously, will make the same choices and achieve the same utility.

Next, we need to show that the government's budget constraint holds. Here, we will multiply both sides of expression (2) by  $(1 - \lambda)/(1 - \check{\lambda})$  and make use of the Lerner index definitions and expression (29) to yield

$$(33) \quad \sum_{i=1}^n \check{p}_i x_i^G = (1 - (1 - \alpha)\lambda) \int T(y(w))f(w)dw.$$

We can use definition (31) for  $\check{T}(y)$  to solve for  $T(y)$  and then integrate accordingly to yield

$$(34) \quad \sum_{i=1}^n \check{p}_i x_i^G = \int \check{T}(y(w))f(w)dw - (1 - \alpha)\lambda Y + (1 - (1 - \alpha)\lambda)\Pi.$$

Using expression (28) for  $Y$  (the resource constraint for economy  $E$  in this version of the model) and the pertinent definition of  $\Pi$ , and making appropriate substitutions using manipulations of the Lerner index definitions and expression (29), it is possible to show that the last two terms are equal. Accordingly, we have budget balance in economy  $\check{E}$ :

$$(35) \quad \sum_{i=1}^n \check{p}_i x_i^G = \int \check{T}(y(w))f(w)dw.$$

This completes the proof that economy  $E$  is equivalent to the otherwise identical economy  $\check{E}$ , except that  $\check{\mu}_i = \alpha\mu_i$  and  $\check{\alpha} = 1$ .

In step 2, we now show that this economy  $\check{E}$  is, in turn, equivalent to the economy  $\hat{E}$  described in the proposition. An individual's budget constraint in economy  $\check{E}$  is given above, in

expression (32). Using the fact (from the definition of the Lerner index) that  $\check{p}_i = c_i/(1 - \check{\lambda})$ , multiplying both sides by  $1 - \check{\lambda}$ , and recalling that  $y = wl$  yields:

$$(36) \quad \sum_{i=1}^n c_i x_i = (1 - \check{\lambda})wl - (1 - \check{\lambda})\check{T}(wl).$$

Next, define  $\hat{w} \equiv (1 - \check{\lambda})w$ , so we can restate equation (36) as

$$(37) \quad \sum_{i=1}^n c_i x_i = \hat{w}l - (1 - \check{\lambda})\check{T}\left(\frac{\hat{w}l}{1 - \check{\lambda}}\right).$$

Now, starting with the income tax schedule  $\check{T}$  for economy  $\check{E}$ , we can define the corresponding income tax schedule  $\hat{T}$  for economy  $\hat{E}$  as

$$(38) \quad \hat{T}(\hat{w}l) \equiv (1 - \check{\lambda})\check{T}\left(\frac{\hat{w}l}{1 - \check{\lambda}}\right).$$

Inserting definition (38) into equation (37) yields

$$(39) \quad \sum_{i=1}^n c_i x_i = \hat{w}l - \hat{T}(\hat{w}l),$$

confirming that individuals' budget constraints continue to hold in economy  $\hat{E}$ . Specifically, individuals choosing any  $l$  can just afford the same consumption bundles, the  $x_i$ . A further implication, discussed in connection with Proposition 1, is that individuals will indeed make the same choices and thereby achieve the same utility.

The government's budget constraint in economy  $\check{E}$  is given by expression (35). Here too we can use the fact that  $\check{p}_i = c_i/(1 - \check{\lambda})$ , multiply both sides by  $1 - \check{\lambda}$ , and recall that  $y = wl$  to yield

$$(40) \quad \sum_{i=1}^n c_i x_i^G = (1 - \check{\lambda}) \int \check{T}(wl(w))f(w)dw.$$

Now, define  $\hat{f}(\hat{w}) \equiv f(\hat{w}/(1 - \check{\lambda}))$ . That is, we take a grossed-up magnitude for the original ability distribution in order to determine the density for a particular ability level in the new distribution. Running in the opposite direction may be more intuitive: for any ability level in the original distribution for equivalent economies  $E$  and  $\check{E}$ , we consider a scaled down ability level (wage) in the distribution for economy  $\hat{E}$  (recalling that  $\hat{w} = (1 - \check{\lambda})w$ ), reflecting that a fraction of everything that labor produces is paying for the investment costs associated with the markups in  $\check{E}$  (or  $\alpha$  of the markup in  $E$ ) and thus is not available to pay the costs  $c_i$  associated with the  $x_i$ .

We can use this definition of  $\hat{f}(\hat{w})$ , the definition of  $\hat{w}$ , and expression (38) to restate the integrand on the right side of equation (40):

$$(41) \quad \check{T}(wl(w))f(w) = \check{T}\left(\frac{\hat{w}l(\hat{w})}{1-\check{\lambda}}\right)f\left(\frac{\hat{w}}{1-\check{\lambda}}\right) = \frac{\hat{T}(\hat{w}l(\hat{w}))}{1-\check{\lambda}}\hat{f}(\hat{w}),$$

where the first equality makes use of the fact that  $l(w) = l(\hat{w})$ , as discussed after expression (39). Substituting into equation (40), and returning to the definition of labor income  $y$ , gives us

$$(42) \quad \sum_{i=1}^n c_i x_i^G = \int \hat{T}(y(\hat{w}))\hat{f}(\hat{w})d\hat{w}.$$

Therefore, the government's budget constraint holds in economy  $\hat{E}$ , which completes the proof of equivalence.

Finally, it is useful to restate the definition  $\hat{f}(\hat{w}) \equiv f(\hat{w}/(1-\check{\lambda}))$  more in the notation of the original economy  $E$ . Substituting from expression (29) for  $\check{\lambda}$  yields

$$(43) \quad \hat{f}(\hat{w}) = f\left(\frac{1-(1-\alpha)\lambda}{1-\lambda}\hat{w}\right),$$

which indicates that, in scaling the ability level (wage) between our original economy  $E$  and our final, equivalent economy  $\hat{E}$ , we wish to account for only the portion of the markup that recovers for real resource use, retaining in a sense that which produces actual net profits that ultimately are enjoyed by individuals in their role as owners. ■

By analogy to Proposition 1, this equivalence result has immediate implications for optimal income taxation.

*Corollary 3.1.  $T^*$  is the optimal income tax schedule for economy  $E$  with proportional markups and a constant (across goods) fraction of markups that constitutes real resource costs if and only if the corresponding income tax schedule  $\hat{T}^*$  is the optimal income tax schedule for the otherwise identical economy  $\hat{E}$ , except with no markups and with a density function for types given by  $\hat{f}$ , as defined in expression (43).*

Proposition 3 and Corollary 3.1 tell us that, as in section 2, the fraction of markups that corresponds to profits that are ultimately received by individuals does not matter in a substantive sense, whereas we now can add that the fraction that corresponds to real resource costs is equivalent to a downward shift in the economy's production possibility frontier, here indicated by a simple downward shift in the distribution of abilities (wages). The actual optimal income tax schedule is influenced by both of these features. (For an explicit statement of the corresponding income tax schedules for economies  $E$  and  $\hat{E}$ , combine expressions (31) and (38).) Note that the optimal income tax problem for economy  $\hat{E}$  is precisely the standard one (with no markups); hence, determining the optimal income tax for economy  $E$  is a mechanical exercise.

Interestingly and importantly, with regard to neither of these two portions of markups is there what might be viewed as a second wedge that reduces the optimal degree of income redistribution. The former portion was discussed previously, and the latter, because it involves a real resource cost—essentially indicating that the economy has a less advantageous production possibility frontier—does not constitute a “wedge” as that term is ordinarily used. Note that this is true regardless of whether the actual investments involve research or building facilities on one hand or pure rent seeking on the other hand. Potential policy implications may differ but, taking the state of the economy  $E$  as given, the nature of those investments does not affect equivalence.

These results hold for any value of  $\alpha$ . Section 2 assumed that  $\alpha = 0$ , so all of the markups involved profits that individuals received without any involving the recovery of prior investments. Another special case of interest is  $\alpha = 1$ , which holds in a wide range of models used in many literatures noted in the introduction, such as when there is free entry with fixed costs, investment in information about opportunities, or rent seeking that dissipates all rents. Then all markups might be referred to as quasi-rents. In this case, the first segment of the proof of Proposition 3 is moot (it applies to  $1 - \alpha$  of the markups, which is to say, none of them; note from expression (29) that, in this case,  $\check{\lambda} = \lambda$ ). Obviously, the results cover intermediate cases, with  $\alpha \in (0,1)$ . Finally, note that nothing in the proof restricted  $\alpha$  to be in the interval  $[0,1]$ : perhaps some investments generate positive spillovers, in which case the production possibility frontier is expanded rather than contracted, or negative externalities beyond the industry itself, further contracting the frontier.

### 3.2. General Case

This section extends the results from section 2.3 regarding which marginal reforms generate Pareto improvements, now taking into account that, in addition to nonproportional markups, there may also be nonproportional fractions of each markup that involve real resource costs rather than profits. Because of this difference, it is useful to state profits explicitly for this economy:

$$(44) \quad \Pi = \sum_{i=1}^n (1 - \alpha_i) \mu_i X_i.$$

Focus again on reforms that pertain to a single good,  $x_j$ , which are here taken to affect its markup  $\mu_j$  and also the resource use portion  $\alpha_j$ —with the latter permitted to change in either direction and to any degree for a specified increase in the former. We can state:

*Proposition 4:* *Given any economy  $E$  with markups  $\mu_i$ , resource use portions  $\alpha_i$ , and admissible income tax schedule  $T$ , for a marginal increase in any  $\mu_j$  and any accompanying marginal change in the associated  $\alpha_j$ , it is possible to adjust the income tax schedule  $T$  in a manner that, taken together, generates a strict Pareto improvement if and only if inequality (49) holds.*

*Proof:* We will parameterize the reform by  $\gamma$  as was done in the proof of Proposition 2, with the addition that we will now take the resource use portion for good  $j$  to be  $\rho(\gamma)\alpha_j$ , where  $\rho(1) = 1$ . The steps of the proof and pertinent equations are the same until we reach expression (20) for  $d\Pi/d\gamma$ , reflecting that in this section’s model profits are now given by expression (44),

taking into account as well that, for this parameterized reform, the  $j^{\text{th}}$  element of that summation is now  $(1 - \rho(\gamma)\alpha_j)\gamma\mu_j X_j$ . The resulting analogue to expression (20), evaluated at  $\gamma = 1$ , is

$$(45) \quad \frac{d\Pi}{d\gamma} = (1 - \alpha_j)\mu_j \frac{dX_j}{d\gamma} + \sum_{i \neq j} (1 - \alpha_i)\mu_i \frac{dX_i}{d\gamma} + \left(1 - \alpha_j - \frac{d\rho(\gamma)}{d\gamma}\alpha_j\right)\mu_j X_j.$$

Substituting this derivative into expression (19) for the effect of the reform on the government's budget surplus and cancelling terms yields

$$(46) \quad \frac{d\sigma(\gamma)}{d\gamma} = (1 - \alpha_j)\mu_j \frac{dX_j}{d\gamma} + \sum_{i \neq j} (1 - \alpha_i)\mu_i \frac{dX_i}{d\gamma} - \alpha_j \left(1 + \frac{d\rho(\gamma)}{d\gamma}\right)\mu_j X_j.$$

Using the fact that  $\mu_i = \lambda_i p_i$ , we have

$$(47) \quad \frac{d\sigma(\gamma)}{d\gamma} = (1 - \alpha_j)\lambda_j p_j \frac{dX_j}{d\gamma} + \sum_{i \neq j} (1 - \alpha_i)\lambda_i p_i \frac{dX_i}{d\gamma} - \alpha_j \left(1 + \frac{d\rho(\gamma)}{d\gamma}\right)\lambda_j p_j X_j.$$

For this economy, it is useful to define modified Lerner indexes,  $\lambda_i^\alpha \equiv (1 - \alpha_i)\lambda_i$ , which indicate the portion of the markup that involves true profits rather than resource use, and use these to define

$$(48) \quad \bar{\lambda}_j^\alpha \equiv \sum_{i \neq j} \lambda_i^\alpha \beta_i,$$

where the  $\beta_i$  are defined in expression (23). We can now restate expression (47) as indicating the presence of a government budget surplus if and only if

$$(49) \quad p_j \frac{dX_j}{d\gamma} (\lambda_j^\alpha - \bar{\lambda}_j^\alpha) > \alpha_j \left(1 + \frac{d\rho(\gamma)}{d\gamma}\right)\lambda_j p_j X_j.$$

As with Proposition 2, if this inequality holds, it is possible to further adjust the income tax schedule to rebate the budget surplus so as to generate a strict Pareto improvement. ■

The left side of expression (49) is analogous to the right side of expression (26) in Proposition 2, indicating the effect of the reform on allocative efficiency. The difference is that the  $\lambda_i$  are now replaced by the  $\lambda_i^\alpha$ , indicating that only the portions of the markups that involve pure profits rather than resource use are pertinent. Hence, we now have two corrections relative to conventional analysis: for the presence of markups on other goods and for the fact that a portion of a markup may reimburse resource use rather than constitute true profits.

The right side is new. It captures the change in productive efficiency due to the reform. This, in turn, has two components. The "1" in the parentheses is a mechanical effect reflecting that, as this model is stated, the portion  $\alpha_j$  of the increase in  $\mu_j$  is taken to involve real resource use. The  $d\rho(\gamma)/d\gamma$  component indicates how  $\alpha_j$  changes with the reform.

Interpreting the right side as a whole for particular values of  $d\rho(\gamma)/d\gamma$  is helpful. First, suppose that  $d\rho(\gamma)/d\gamma = -1$ . Then the right side of expression (49) equals zero. Here, all of the increase in  $\mu_j$  constitutes pure profit. The portion  $\alpha_j$  falls just enough that the total resource use per unit of  $x_j$  remains the same. (In this special case, this aspect of the result is the same as under Proposition 2.) When  $d\rho(\gamma)/d\gamma > -1$ , therefore, there is at least some increase in resource use. (When  $d\rho(\gamma)/d\gamma = 0$ , of course, the *portion* of resource use is constant, leaving the full mechanical effect.) When  $d\rho(\gamma)/d\gamma < -1$ , there is a reduction in the resource use involved in producing  $x_j$ , that is, an increase in productive efficiency.

Taken as a whole, expression (49) indicates that the effect on the government's budget surplus is given by the change in allocative efficiency (defined appropriately for this economy) and the change in productive efficiency (resource use) with respect to the good (sector) subject to the reform. Because expression (19) from Proposition 2's proof applies here as well, the test can also be stated as the effect of the reform on the sum of consumer and producer surplus. This tests governs even though the price change affects the distribution of consumer surplus; the price change and the change in production costs affect profits that may be distributed as any function of income; and we are also concerned with labor supply distortion in the presence of both markups and income taxation, each of which affects the labor wedge. As a consequence of the corresponding adjustment to the income tax schedule, the net impact of all of these other effects (on individuals' behavior, including their choices of labor effort, and on achieved utility) is fully offset, leaving only the efficiency effects captured in expression (49).

To round out the discussion, consider again the case with a markup on only a single good.

*Corollary 4.1:* *In an economy  $E$  in which  $\mu_i = 0$  for all  $i \neq j$  and  $\mu_j > 0$ , for a marginal increase in  $\mu_j$  and any accompanying marginal change in the associated  $\alpha_j$ , it is possible to adjust the income tax schedule  $T$  in a manner that, taken together, generates a strict Pareto improvement if and only if inequality (50) holds.*

In this economy, expression (49) simplifies to

$$(50) \quad p_j \frac{dX_j}{d\gamma} \lambda_j^\alpha > \alpha_j \left( 1 + \frac{d\rho(\gamma)}{d\gamma} \right) \lambda_j p_j X_j,$$

which compares the changes in allocative efficiency and productive efficiency. In interpreting expressions (49) and (50), keep in mind that the experiment parameterized by  $\gamma$  involves an increase in  $\mu_j$ ,  $dX_j/d\gamma$  on the left side is negative (so the left side of (50) is positive when  $\mu_j$  is reduced), and the right side measures the increase in resources used in producing  $x_j$ .

Consider cases that involve tradeoffs. Suppose, for example, that allocative efficiency increases, which here (still) occurs when  $\mu_j$  falls (although the magnitude of this gain is smaller than in section 2 by the proportion  $\alpha_j$ , as reflected in  $\lambda_j^\alpha$ ), and that productive efficiency decreases. This might arise, for example, from the application of antitrust rules that prohibit some joint ventures or exclusionary practices that raise prices but also generate some efficiencies. In the reverse case, allocative efficiency falls but productive efficiency increases. This might occur when a rule permits mergers that raise price because of reduced competition and also generate efficiencies, the latter not being sufficiently passed through to consumers to eliminate the price increase. Expression (50) states that in both cases a total surplus test



indicates when the rule, if implemented along with an offsetting adjustment to the income tax schedule, generates a Pareto improvement.

Finally, returning to economies with multiple markups, covered by Proposition 4 and the policy rule of expression (49), consider the special case in which  $\alpha_i = 1$  for all  $i$  (and  $\rho = 1$ , which is to say, constant). The left side of (49) now equals zero, regardless of how relatively high or low is the markup that is changing, and the right side indicates that reducing any markup is associated with a rise in productive efficiency. When all profits are dissipated, there is no producer surplus, so total surplus equals consumer surplus and policies that directly influence only a single sector can aim simply at reducing that sector's markup.

#### 4. Conclusion

This article examines a model that features market power in multiple sectors, different degrees to which the resulting profits may reflect the recovery of real resource costs involved in investment (including in rent-seeking), different abilities and hence a concern for distribution, endogenous labor supply, ownership that may be any function of income, and income taxation. Although the model is simplified in a number of respects, it sheds substantial new light on analysis and policies concerned with market power and also with income taxation and the familiar tradeoff of redistribution and labor supply distortion.

Proportional markups that generate undissipated profits have no effect on an economy in the sense that eliminating them does not alter what budget sets are feasible, the level of utility that can be achieved, or the optimal income tax problem. If the profits are dissipated in whole or in part (also in a proportional manner), the economy is equivalent to one with no markups (or profit dissipation) and a downward-shifted distribution of individuals' abilities. Standard optimal income tax analysis for an economy with perfect competition in every sector can, therefore, be directly translated to these settings with proportional markups.

For markups or profit dissipations that are not proportional, marginal reforms that affect a single good (industry) are analyzed using the technique of an offsetting (in aggregate, distribution-neutral) adjustment to the income tax schedule that enables Pareto assessments. Reducing a markup, *ceteris paribus*, raises (reduces) welfare when the markup is above (below) a specified weighted average of the undissipated portion of other markups in the economy. When such a reform—whether of antitrust policy, intellectual property protection, trade policy, or other regulation—also influences productive efficiency, as is often the case, a total surplus test indicates which policies are Pareto superior.<sup>16</sup> This efficiency test, which sums allocative and productive efficiency—equivalently, consumer and producer surplus—applies regardless of the distributive consequences of the changes in markups and profits and of any impact on labor supply, which is subject to preexisting distortions due to both markups and income taxation. The reason is that the contemplated policy experiment's adjustment to the income tax schedule neutralizes all distributive effects and precisely offsets all effects on labor supply (assuming

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<sup>16</sup> The problem of optimal public sector pricing, which has its own literature surveyed in Bös (1985), is similarly covered by the present analysis; hence, those results change substantially with heterogeneous individuals and an income tax. Note also that, in considering international trade policy, one would need to modify the implicit closed-economy setting employed here if national rather than global welfare is taken to be the social objective; for example, one might consider only the consumer and producer surplus that accrues to citizens or residents.

weak separability of labor in the utility function), leaving only the traditional efficiency consequences of the reform.

Future work could extend this analysis in a number of ways. Most important is to consider particular models of ex ante investment in the present setting—that is, with heterogeneous abilities and an income tax—wherein resulting markups, ownership shares, and the degree to which profits constitute recoveries for prior expenditures are all endogenous. The results derived here may well hold because they pertain fairly generally to economies and to policies that are associated with various results of such ex ante behavior. The markups, ownership portions, and dissipation functions (along with familiar fundamentals) are sufficient statistics for the present characterizations of the optimal policy. Nevertheless, a direct analysis is necessary for policy evaluation because these statistics must be derived. Moreover, endogenizing key features in certain ways may violate some of this model’s assumptions, in which event the results would need to be modified accordingly.

It also seems fruitful to devote more refined attention to labor supply and to investment. Some recent work considers different dimensions of earning ability with a focus on entrepreneurship, which seems particularly relevant when addressing ex ante activity that generates future markups.<sup>17</sup> Investments typically involve the supply of capital, which was not modeled here but has been examined in other work in different settings.<sup>18</sup> On both dimensions dynamic modeling is appropriate with particular attention to the role of uncertainty because we wish to understand the most successful firms that are able to charge significant markups as well as the individuals, often founders, who end up owning large stakes in these firms as a consequence of their prior labor efforts and financial investments.<sup>19</sup>

In contemplating these and other extensions, it is important to keep in mind that the present analysis shows how misleading it can be to examine industries in isolation, to employ representative-agent models in which distributive concerns do not arise, to fail to consider that profits due to markups are often attributable to prior investments, to take labor supply as exogenous, and to ignore the important role of income taxation. Multiple factors that contribute to redistribution and to labor supply distortion can act in synergy, thereby magnifying each other, or, as was often true here, can be largely offsetting. Models that exclude closely related considerations can produce results that are not only incomplete but misleading. Many of the core lessons developed here require substantial amendments to current thinking and to results obtained in models that examine only some of the pertinent phenomena in isolation.

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<sup>17</sup> See, for example Rothschild and Scheuer (2013) for a theoretical exploration and Smith et al. (2019) for empirical evidence that most of the recent increase in top incomes in the United States involves labor earnings of small business owners. See also Rothschild and Scheuer (2016) and Lockwood, Nathanson, and Weyl (2017), who examine externalities due to labor effort.

<sup>18</sup> See Judd (1997, 2002), and for further refinements of the analysis of that type of dynamic model, see Straub and Werning (2018) and Chari, Nicolini, and Teles (2018). Such analysis also introduces a tax (which may be negative, a subsidy) on capital income, from which point one could perform an extended version of the policy experiment employed here that adjusts this tax so as to hold the capital wedge fixed, thereby separating the analysis of distortions of capital.

<sup>19</sup> Optimal income taxation of uncertain labor income is surveyed by Golosov, Tsyvinski, and Werning (2007). Work on income taxation of uncertain capital income includes Gordon (1985) and Kaplow (1994), but they focus on market risk whereas founders often make undiversified investments due to information asymmetries.

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