Optimal capital and labor income taxation in small and developing countries

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1 March 2018

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First Version: January 30, 2017

This Version: March 1, 2018

Abstract

This paper argues that smaller and poorer countries have lower optimal tax rates on capital and labor income than their larger and richer counterparts. It further provides an alternative explanation for such empirically observed differences in tax rates. The model focuses on a closed economy, but is extended by introducing mobile capital. The difference in tax rates here is efficient and not due to tax competition. For the result, less than perfect competition is necessary. The intuition is that monopolistic markups distort markets in a similar way as taxes. Hence, optimal tax rates are inversely related to markups and I show theoretically that smaller and poorer countries have larger markups. Therefore, these countries have lower optimal tax rates. Since smaller and poorer countries face larger competition distortions, there is less space for tax distortions. Hence, a smaller tax rate itself is insufficient to conclude a country is engaging in tax competition. Empirical analysis of the banking industry also shows that smaller and poorer countries have larger markups.

Keywords: Optimal Taxation, Monopolistic Competition, Developing Countries, International Fiscal Issues, Tax Competition

JEL Classification: D43, H21, O23

*I would like to thank Alfons Weichenrieder, Ctirad Slavik, Dirk Schindler, Etienne Lehmann, Sylwia Bialek, as well as seminar participants at the University of Frankfurt and participants of the 16th Journées Louis-André Gérard-Varet and 73rd annual congress of the International Institute of Public Finance.

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1 Introduction

Taxation in developing countries remains an immensely important topic. A striking feature of developing countries is that they seem to tax very little in terms of GDP (Besley and Persson 2014). Furthermore, Gordon and Li (2009) provide calculations showing that statutory corporate and personal income tax rates are somewhat smaller and the effective tax rates are substantially smaller for developing countries. Much attention has been given to explaining this difference in effective tax rates. The various explanations[1] have included institutional, political and cultural constraints, as well as reliance on resources and foreign aid. Further, the larger informal economy in developing countries, has been a prominent explanation[2]. More recently, third-party reporting (e.g. Kleven et al., 2016) as well as enforcement incentives (Chen, 2017) have emerged as important factors. Such considerations, however, largely remain silent on issues of optimal tax rates for developing countries.

When it comes to capital tax rates in particular, we also observe that smaller countries have on average lower tax rates, which is often attributed to inefficient tax competition[3]. For corporate taxes, Haufler and Wooton (2010) for example present some calculations, showing that smaller OECD countries have lower corporate tax rates. Similarly, Dharmapala and Hines (2009) find that tax havens tend to be smaller.

The issue of how optimal taxation may differ in smaller and poorer countries, however, has not yet received much attention. I will argue that it is in fact optimal for a smaller or poorer country to have a smaller labor and capital income tax rate, even without tax competition, as long as there is not perfect competition. The intuition for the result is that monopolistic markups distort markets in a similar way as taxes. This makes the optimal tax rates inversely related to markups. The model presented here further argues that smaller and poorer countries have larger markups. Using cross-country data on the banking industry I also find empirical support for these implied markup differences. Hence, the lower (effective) tax rates in developing countries may be rationalized as being closer to the optimum. As smaller and poorer countries already have larger market power distortions, their policymakers have less space to introduce tax distortions. Hence, optimal tax recommendations given to these countries should not follow those designed for developed ones. Furthermore, it implies that a smaller tax rate itself is insufficient to conclude a country is deliberately acting as a tax haven. If taxes decrease as a result of a market expansion that lowers markups, however, this cannot be interpreted as efficient here and would imply tax competition.

[1] For a summary see Besley and Persson (2014).
[2] See e.g. Gordon and Li (2009), Auriol and Warlters (2005).
[3] See e.g. Baldwin et al. (2003, pp. 365-372)

So far, the main explanation for the lower capital tax rates in smaller countries has been inefficient tax competition. For corporate tax rates, Davies and Eckel (2010) through a framework of monopolistic competition with heterogeneous firms, also show that in a tax competition equilibrium, smaller countries will have lower tax rates, which is inefficient. Nevertheless, they (implicitly) do not allow the monopolistic markups to differ across countries of different sizes. By introducing agglomeration effects in tax competition models, Baldwin and Krugman (2004) also show that larger countries have higher capital tax rates in equilibrium. Interestingly, their equilibrium tax rates are not inefficiently low. Nevertheless, they assume that the preference for taxation increases with wealth, such that without tax competition richer countries would choose higher tax rates. I will argue that even in the absence of tax competition it is simply optimal to have higher tax rates as wealth increases, regardless of preferences. This is because a larger market reduces markups, thereby increasing optimal tax rates.

Optimal labor and capital income taxation models with perfect competition cannot come to the conclusions presented here. Deviating from perfect competition appears realistic, since as Judd (2002) puts it, imperfect competition is a key feature of modern economies. Indeed, considering capital taxation with imperfect competition has been recently regaining importance[4]. The literature on dynamic taxation with imperfect competition (see Judd, 2002 and Coto-Martinez et al., 2007) argues that optimal capital income tax rates should depend negatively on the monopolistic markup.[5] These models, however, do not allow markups to vary with country size. It is nevertheless intuitive that markups should decrease with market size. That is indeed the case in monopolistic competition models without the so-called "large group assumption" (see e.g. Baldwin et al., 2003, p. 40). This assumption imposes an (almost) infinitely large number of firms, which especially for small and developing countries may not be realistic. The model presented here will extend the dynamic optimal labor and capital income taxation literature by allowing markups to vary with country size. Furthermore, I extend this literature by examining optimal tax rates outside of steady state and consider the implications of an open economy.

The rest of this paper is structured as follows. Section 2 introduces the model, examines the production side of the closed economy, where the results will stem from and gives the market equilibrium conditions. Section 3 is concerned with the Pareto optimal tax rates, whereas section 4 analyzes optimal tax rates when lump sum transfers are impossible. In both cases, the found tax rates on capital and labor will be lower for small and developing countries. Section 5 relaxes the assumption of a closed economy. Section 6 provides some empirical support for the model and section 7 concludes.

[4]For a recent paper see Brekke et al. (2017).

[5]Although Coto-Martinez et al. (2007) show this is the case only if the number of optimal firms can be implemented without using the capital income tax to do so.

2 The Model

One of the first papers to study the issue of dynamic capital taxation with monopolistic competition is Judd (1997), subsequently published in condensed form as Judd (2002). His framework, however, features an exogenous and constant number of firms. Coto-Martinez et al. (2007) extend this model by endogenizing the number of firms. These papers are primarily concerned with whether the optimal capital tax rate is negative in the long run. Although this is not the research question investigated here, I will use their insight that optimal tax rates depend negatively on monopolistic markups. I extend Coto-Martinez et al. (2007) by introducing market size into the model and allowing the markups to differ across countries. The latter is achieved by simply not making the "large group assumption", which amounts to assuming the number of firms tends to infinity and is often made in these models. Following this literature, the economy will be closed. Implications of an open economy are discussed in section 5.

There is a final good Y, which is produced under perfect competition, as in Coto-Martinez et al. (2007). Production inputs are the intermediate goods x_i, each produced under monopolistic competition, similarly to Dixit and Stiglitz (1977) with the following technology:

$$Y = \left(\sum_{i=1}^{N} x_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{1}$$

Here N represents the number of firms producing intermediate goods and σ represents the elasticity of substitution among varieties. As is standard, each firm N optimally produces a single variety, hence $i \in [1, N]$. This specification of the production function corresponds exactly to the original Dixit-Stiglitz (1977) specification for preferences. For production it has been used in many papers, such as Judd (2002) and Blanchard and Kiyotaki (1987). Coto-Martinez et al. (2007) use a more general specification, which allows for aggregate returns to specialization in the number of firms. As this study is not concerned with returns to specialization, I maintain the Dixit-Stiglitz (1977) specification. Moreover, if the number of firms is a continuum, then the large group assumption implicitly arises. To avoid this, I take a discrete number of firms.

I introduce market size following Mas-Colell et. al. (1995, p. 412) by having demand for Y of a country of size α correspond to $Y_\alpha = \alpha Y$. A higher value of α is equivalent to a higher demand at all prices. Hence, I interpret a higher α as corresponding to a richer, larger society. While most papers mean population or labor force when referring to size, here size represents both wealth and population. In their analysis of low taxation in developing countries, Auriol and Warlters (2005) would interpret α in the same way[6]. Hence, a low α would be a feature of small developing countries. The final good producer solves:

$$\max_{\{x_i\}_i} P_y \alpha Y - \sum_{i=1}^{N} p_i x_i \tag{2}$$

where P_y is the price of the final good and p_i the price of the intermediate good x_i. Here, Y represents a baseline demand for the final good for an economy of "size 1". As discussed, α can be interpreted directly as increased demand through a larger or richer population. Alternatively, a larger α could also be interpreted as a more productive technology for producing Y, which would make the country with the larger α richer. Size will not vary over time in this model.

From solving the final good producer's problem we obtain the demand functions for each intermediate good and the relationship between the prices of the final and intermediate goods:

$$x_i = Y p_i^{-\sigma} P_y^{\sigma} \alpha^{\sigma} \tag{3}$$

$$P_y = \alpha^{-1} \left(\sum_{i=1}^{N} p_i^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \tag{4}$$

Intermediate goods x_i are produced with constant returns to scale as follows:

$$x_i = F(k_i, l_i) \tag{5}$$

where l_i and k_i represent labor and capital input for each firm i. Following Coto-Martinez et al. (2007), the firms must pay a fixed cost $P_y \phi$, which is measured in terms of the final good. These firms also pay a tax τ^{π} on variable profits, which does not apply to the fixed cost. An alternative, but equivalent option, would be to have different tax rates apply to variable profits and to the fixed cost as in Coto-Martinez et al. (2007). In both cases it is ensured that the fixed costs cannot be fully deducted from the tax burden. In this model, it would also be equivalent to have a fixed licensing fee instead of the tax on variable profits. All these options allow the government to have control over the number of firms in the economy to make sure it

[6]They use a linear demand function of the form $p(Q) = A - B * Q$, where Q denotes quantity and p the price. Applying α as above yields: $Q = \alpha A B^{-1} - \alpha B^{-1} p$. They interpret a higher A as a higher population and a smaller B as higher wealth. Clearly, a higher α in their model would capture both of these.

is not inefficiently high or low. The intermediate firms solve:

$$\max_{\{k_i,l_i\}} (1-\tau^{\pi})(p_i x_i - rk_i - wl_i) - P_y\phi \tag{6}$$

subject to the demand and production functions given by equations (3) and (5). Here r and w denote the rental price of capital and the wage rate respectively. The first-order conditions yield:

$$r = p_i F_k(k_i, l_i)\mu_i^{-1} \tag{7}$$

$$w = p_i F_l(k_i, l_i)\mu_i^{-1} \tag{8}$$

Here μ_i is the markup of firm i and is given by:

$$\mu_i = \frac{\epsilon_i}{\epsilon_i - 1} \tag{9}$$

where ϵ_i is the elasticity of demand for the intermediate good x_i and $\mu > 1$.

The familiar expression for the markup under the large group assumption is $\mu = \frac{\sigma}{\sigma-1}$, which can be found in many models. In the more general case taken here, it will also be a function of the number of firms N. This is a standard feature and can be found for example in Baldwin et al. (2003, p. 40). The exact expression will depend on ϵ_i, which is given by lemma 1. Note, that the markup causes capital and labor to be paid below their marginal productivities, hence causing a distortion similar to a tax.

Lemma 1. *The elasticity of demand in a symmetric equilibrium is given by* $\epsilon = \sigma[1 - N^{-1}]$.

Proof. Inserting equation (4) into equation (3) yields:

$$x_i = Y p_i^{-\sigma} \left(\sum_{i=1}^{N} p_i^{1-\sigma} \right)^{\frac{\sigma}{1-\sigma}}$$

As typically assumed in dynamic models, the producer of the final good commits to producing what is demanded. Hence Y will depend on the demand by consumers and is independent of x_i. The derivative of x_i with respect to p_i is:

$$\frac{\partial x_i}{\partial p_i} = -\sigma Y p_i^{-\sigma-1} \left(\sum_{i=1}^{N} p_i^{1-\sigma} \right)^{\frac{\sigma}{1-\sigma}} + \sigma Y \left(\sum_{i=1}^{N} p_i^{1-\sigma} \right)^{\frac{\sigma}{1-\sigma}-1} p_i^{-2\sigma}$$

Multiplying the last expression by p_i and factoring yields:

$$\frac{\partial x_i}{\partial p_i} p_i = -Y\sigma p_i^{-\sigma}\left(\sum_{i=1}^{N} p_i^{1-\sigma}\right)^{\frac{\sigma}{1-\sigma}}\left[1 - p_i^{1-\sigma}\left(\sum_{i=1}^{N} p_i^{1-\sigma}\right)^{-1}\right] = -\sigma x_i\left[1 - p_i^{1-\sigma}\left(\sum_{i=1}^{N} p_i^{1-\sigma}\right)^{-1}\right]$$

Multiplying by $-x_i^{-1}$ yields:

$$\epsilon_i = -\frac{\partial x_i}{\partial p_i}\frac{p_i}{x_i} = \sigma\left[1 - p_i^{1-\sigma}\left(\sum_{i=1}^{N} p_i^{1-\sigma}\right)^{-1}\right]$$

Applying symmetry of p_i and simplifying yields $\epsilon = \sigma[1 - N^{-1}]$. □

This expression is the main difference between this paper and the previous literature. Under the large group assumption, i.e. for $N \to \infty$, we have $\epsilon = \sigma$ and we then obtain the well known expression for the markup, $\mu = \frac{\sigma}{\sigma-1}$. The elasticity computed here corresponds to Bertrand competition, as the firms choose prices. Computing the elasticity using the inverse of the derivative of p_i with respect to x_i instead, would correspond to Cournot competition. The expression obtained is slightly different, but is a similar function of σ and N. Note that ϵ is an increasing function of N, which implies that the markup decreases as competition increases.

Throughout this paper, I make the implicit assumption of Coto-Martinez et al. (2007) that $\sigma > 2$.[7] Otherwise, their implication, as well as the implication here, would be that an increase in the fixed costs would increase the number of firms, which cannot be the case.

In order to ensure a positive markup, we must ensure that $\epsilon > 1$, as can be seen from equation (9). This is standard for monopolists, as they always optimally operate in the inelastic region of the demand curve. From lemma 1 we see that this holds for any $N > \frac{\sigma}{\sigma-1}$. As $\sigma > 2$, it suffices that $N \geq 2$. Hence, $\epsilon > 1$ as long as there is not a pure monopoly. This also ensures $\mu > 1$, as required by definition.

I consider a symmetric equilibrium, in which case all intermediate firms produce the same amount $x_i = x$, employ the same amount of capital and labor $k_i = k$, $l_i = l$, make the same profits $\pi_i = \pi$ and charge the same price $p_i = p$. Aggregate employment is the $L = Nl$ and the aggregate capital stock $K = Nk$. Hence, we can write the rental price of capital and wage rate as a function of aggregate capital and labor as follows:

$$r = pF_k(K, L)\mu^{-1} \tag{10}$$

[7] To see this, note that in their equation (13) they must assume that $\frac{1}{1-v} > 0$ in order to correctly interpret their results. The expression $\frac{1}{1-v}$ is equal to $\frac{1-\sigma}{2-\sigma}$ in the notation used here. As usual, they assume $\sigma > 1$. Otherwise, their markup would be negative. For $\frac{1-\sigma}{2-\sigma} > 0$ to be true there, we must have $\sigma > 2$.

$$w = pF_l(K,L)\mu^{-1} \tag{11}$$

The final output and final price in the symmetric equilibrium are given by:

$$Y = N^{\frac{\sigma}{\sigma-1}}\, x \tag{12}$$

$$P_y = \alpha^{-1}\, N^{\frac{1}{1-\sigma}}\, p \tag{13}$$

The equilibrium number of firms is determined by the zero profit condition. After substituting in equations (5), (10), (11), (13) this condition is given by:

$$(1-\tau^{\pi})P_y \alpha F(K,L) N^{-\frac{2-\sigma}{1-\sigma}}(1-\mu^{-1}) = P_y \phi \tag{14}$$

Plugging in the expression for the markup and rearranging yields:

$$N = \left[\frac{(1-\tau^{\pi})\alpha F(K,L)}{\sigma\phi} + N^{\frac{1}{1-\sigma}}\right]^{\frac{1-\sigma}{2-\sigma}} = G(N) \tag{15}$$

It is difficult to obtain an explicit expression for N as the number of firms depends on the markup through the profits, while the markup itself is reduced by entry. It is, however, still possible to guarantee a unique positive solution for N as the following lemma shows.

Lemma 2. *A unique positive solution for N exists.*

Proof. The value of N is given by the intersection of the left hand and right hand side of equation (15). The left hand side, being the 45 degree line, starts at the origin and is strictly increasing. To guarantee a unique positive solution exists it remains to be shown that the right hand side has a positive value for N=0 and is strictly decreasing. The first condition is clearly fulfilled. For the second, note that the derivative of the right hand side is given by:

$$\frac{dG(N)}{dN} = (2-\sigma)^{-1}(N)^{\frac{\sigma}{1-\sigma}}\left[\frac{(1-\tau^{\pi})\alpha F(K,L)}{\sigma\phi} + N^{\frac{1}{1-\sigma}}\right]^{\frac{-1}{2-\sigma}}$$

As $\sigma > 2$ and all other terms are positive, we have $\frac{dG(N)}{dN} < 0$. □

I now turn to analyzing the differences in markups across different market sizes. As markups fall with competition, which increases with market size, we will have that larger markets feature lower markups.

Lemma 3. *The number of firms is increasing in the market size α.*

Proof. The number of firms is determined by equation (15). From the implicit function theorem:

$$\frac{dN}{d\alpha} = \frac{\partial G(N)}{\partial \alpha}\left(1 - \frac{\partial G(N)}{\partial N}\right)^{-1}$$

Clearly $\frac{\partial G(N)}{\partial \alpha} > 0$ and from the previous proof we know $\frac{\partial G(N)}{\partial N} < 0$. Hence $\frac{dN}{d\alpha} > 0$

□

Lemma 4. *The monopolistic markup is decreasing in the number of firms.*

Proof. Inserting the expression for the elasticity from lemma 1 into equation (9) and taking the derivative of μ with respect to N shows the result. □

Proposition 1. *Smaller and poorer countries have larger markups.*

Proof. $\frac{d\mu}{\alpha} < 0$ is required. From lemma 4 it follows that the markup is decreasing in the number of firms. From lemma 3 it follows that the number of firms is increasing in the market size α. □

It now remains to replicate the argument in the literature that the optimal tax rate depends negatively on the markup. Certainly, under any conditions in which that argument holds, the implication will be that smaller and poorer countries should have lower tax rates. While the existing literature has focused on capital income taxes in steady state, the result here will also hold outside of steady state and for labor income taxes as well.

Having laid out the economy's production side, I now turn to the consumer side and characterize the market equilibrium with taxes. I consider a representative consumer with one unit of time endowment each period, which can be used for labor L_t. The agent consumes an amount c_t and saves by investing in capital K_t. The consumer problem is given by:

$$V(K_0) = \max_{\{c_t, L_t, K_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t U(c_t, L_t), \text{ subject to:} \tag{16}$$

$$c_t + K_{t+1} = w_t(1 - \tau_t^l)L_t + K_t[1 - \delta + r_t(1 - \tau_t^k)] + T_t^c + \Pi_t \tag{17}$$

$$c_t \geq 0, K_{t+1} \geq -B, \; L_t \in [0, 1] \tag{18}$$

Here τ_t^l and τ_t^k are taxes on labor and capital income, while δ is depreciation. Π_t represents profits net of tax and T_t^c denotes possible lump-sum transfers from the government to the consumer. As is standard in such models, the government levies taxes to finance exogenous purchases of the final good. Profits are zero in equilibrium due to free entry and B is constant, positive and sufficiently large to rule out Ponzi schemes. The utility function is strictly concave and the Inada conditions hold. I also impose a standard transversality condition for capital and government debt. The consumer's first-order conditions are:

$$\frac{U_{c_t}}{\beta U_{c_{t+1}}} = 1 - \delta + r_{t+1}(1 - \tau_{t+1}^k) \tag{19}$$

$$-\frac{U_{L_t}}{U_{c_t}} = w_t(1 - \tau_t^l) \tag{20}$$

The market clearing condition is given by:

$$c_t + G_t + K_{t+1} - (1 - \delta)K_t + \phi N_t = Y_\alpha = \alpha N^{\frac{1}{\sigma - 1}} F(K_t, L_t) \tag{21}$$

where G_t denotes government expenditure each period. The government budget constraint can be derived using the consumer budget constraint, the aggregate resource constraint and the free entry condition. As it will not play an explicit role in the model, I omit this equation here. The definition of market equilibrium in this model is given by the next definition.

Definition 1. *A market equilibrium is given by an allocation $a = \{c_t, L_t, K_{t+1}, N_t\}_{t=0}^{\infty}$, a sequence of tax rates $\{\tau_{t+1}^k, \tau_t^l, \tau_t^\pi\}_{t=0}^{\infty}$, government expenditure $\{G_t\}_{t=0}^{\infty}$, government transfers T_t^c and the initial condition K_0 , such that: (i) the consumer problem is solved, (ii) the producer problems are solved, (iii) the government budget constraint is satisfied and (iv) the market clearing condition holds.*

I treat the final good as the numeraire and normalize $P_y = 1$. Combining the household first-order conditions with the expression for r_t and w_t from the producer side, i.e. equations (10), (11) and (13), gives us the following market equilibrium conditions:

$$\frac{U_{c_t}}{\beta U_{c_{t+1}}} = 1 - \delta + \mu_{t+1}^{-1}(1 - \tau_{t+1}^k)\alpha N_{t+1}^{\frac{1}{\sigma-1}} F_k(K_{t+1}, L_{t+1}) \tag{22}$$

$$-\frac{U_{L_t}}{U_{c_t}} = \alpha N_{t+1}^{\frac{1}{\sigma-1}} F_l(K_t, L_t)(1 - \tau_t^l)\mu_t^{-1} \tag{23}$$

These two equations together with the market clearing condition (21), free entry condition (15) and government budget constraint characterize the market equilibrium.

3 Pareto Optimum

The market equilibrium with taxes is typically not Pareto optimal in these models. Nevertheless, as is well-known, if lump sum taxes are available then Pareto optimality can be achieved. I examine this case before considering the optimal tax problem without lump sum taxation.

The social planner solves:

$$V(K_0) = \max_{\{c_t, L_t, K_{t+1}, N_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t U(c_t, L_t), \text{ subject to:} \tag{24}$$

$$c_t + G_t + K_{t+1} - (1 - \delta)K_t + \phi N_t = \alpha N^{\frac{1}{\sigma-1}} F(K_t, L_t)\ \forall t, \tag{25}$$

$$c_t \geq 0, L_t \in [0, 1] \tag{26}$$

The first-order conditions for consumption and labor are given by:

$$\frac{U_{c_t}}{\beta U_{c_{t+1}}} = 1 - \delta + \alpha N_{t+1}^{\frac{1}{\sigma-1}} F_k(K_{t+1}, L_{t+1}) \tag{27}$$

$$-\frac{U_{L_t}}{\beta U_{c_t}} = \alpha N_{t+1}^{\frac{1}{\sigma-1}} F_k(K_t, L_t) \tag{28}$$

As already discussed μ is a factor on the marginal costs larger than one. It can also be written as $\mu = 1 + m$, where m is the difference between the equilibrium price and marginal costs. Comparing the social planner's first best allocation to the market equilibrium, i.e. comparing equations (22) and (23) to equations (27) and (28) we see that the Pareto efficient tax rates are:

$$\tau_t^k = \tau_t^l = 1 - \mu_t = -m_t \tag{29}$$

Hence the Pareto efficient tax rate is negatively related to and completely offsets the markup.

Proposition 2. *The Pareto efficient tax rates on capital income and labor are lower for poorer and smaller countries.*

Proof. The tax rates are negatively related to the markup: $\frac{d\tau_t^k}{d\mu} = \frac{d\tau_t^l}{d\mu} = -1$. From proposition 1 we know markups are smaller for larger values of α. Hence $\frac{d\tau_t^k}{d\alpha}, \frac{d\tau_t^l}{d\alpha} > 0$. □

From equations (22) and (23) we notice that a positive tax rate would introduce a wedge in the marginal utilities, thereby being Pareto inefficient. The monopolistic markup μ also introduces the exact same kind of wedge. Pareto optimality, however, requires these wedges to disappear. Hence, a negative tax which offsets the markup is optimal. As markups vary with market size, smaller and poorer countries have lower Pareto optimal tax rates. These subsidies are then paid for by lump-sum taxes.

The first-order condition for the optimal number of firms is given by:

$$U_{c_t}[\alpha \frac{1}{\sigma - 1} N^{\left(\frac{1}{\sigma-1}-1\right)} F(K_t, L_t) - \phi] = 0 \tag{30}$$

The tax rate on variable profits τ^π is used here only to be able to influence the number of firms. By comparing equations (30) and (15) we can infer the Pareto efficient tax rate on variable profits. The nature of this tax rate will largely depend on the specification chosen for the technology used to produce the final good. In the conventional formulation of Dixit-Stiglitz (1977) used here, monopolistic competition models typically produce insufficient entry, in which case the optimal tax rate is likely to be a subsidy. It is well known that under different conditions there could be excessive entry under monopolistic competition[8]. In that case the optimal tax rate would be positive. As it is unclear which parametrization will be the case across

[8] For a discussion of this literature see Brakman and Heijdra (2004).

different countries, I do not comment on the optimal variable profit tax rate any further. The argument that the Pareto efficient tax rate on capital and labor income depends negatively on the markup, however, does not depend on the parametrization. It is nevertheless important for the model that the government can influence the number of firms. Otherwise, the capital income tax rate has an influence on distortions from insufficient or excessive entry as well, which muddles the analysis. Here τ^{π} is the only instrument that can be used by the government to influence the number of firms. In reality, however, the number of firms can be influenced by the government in other ways as well, e.g. through regulation. For the model, τ^{π} could also be replaced by a licensing fee or bureaucratic cost.

Having discussed the equilibrium number of firms, lemma 5 shows that the optimal number of firms also increases with market size α. This result will be important later on.

Lemma 5. *The optimal number of firms increases with the market size.*

Proof. From equation (30) we see that the optimal number of firms is given by:

$$N^{opt} = \left(\frac{\alpha \frac{1}{\sigma - 1} F(K_t, L_t)}{\phi} \right)^{\frac{\sigma-2}{\sigma-1}}$$

As $\sigma > 2$ the derivative with respect to α is positive. □

4 Optimal Taxation

I now turn to finding the optimal tax rate when lump sum taxes are impossible, using the popular approach proposed by Atkinson and Stiglitz (1980). This involves finding the allocations which the government can implement with its given tax instruments. The set of these allocations (called the set of implementable allocations) is determined by the resource constraint, the market entry condition and the implementability constraint. The resulting first-order conditions are then compared to the market equilibrium to derive the optimal tax rates. The implementability constraint consists of the household's budget constraint with the first-order conditions of the firm and consumer problems plugged in and is derived in the appendix. The equivalence between the implementable allocation and the market allocation with taxes is proven in the appendix following Chari and Kehoe (1999) and Coto-Martinez et al. (2007).

Definition 2. *Taking as given government expenditures $\{G_t\}_{t=0}^{\infty}$ and the initial conditions $\{\tau_0^k, K_0\}$, the optimal tax rates $\{\tau_{t+1}^k, \tau_t^l, \tau_t^{\pi}\}_{t=0}^{\infty}$ are given by maximizing utility subject to the implementability and resource constraints as follows:*

$$V(K_0, \tau_0^k) = \max_{\{c_t, L_t, K_{t+1}, N_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t U(c_t, L_t), \textit{ subject to:} \tag{31}$$

$$\sum_{t=0}^{\infty} \beta^t (c_t U_{c_t} + L_t U_{L_t}) = U_{c_0}(K_0)[1 - \delta + N_0^{\frac{1}{\sigma-1}} \mu^{-1} \alpha F_k(K_0, L_0)(1 - \tau_{k_0})], \tag{32}$$

$$c_t + K_{t+1} - (1-\delta)K_t + G_t + \phi N_t = \alpha N_t^{\frac{1}{\sigma-1}} F(K, L). \tag{33}$$

The Lagrange multipliers of the implementability (equation 32) and resource constraint (equation 33) are denoted with λ and γ respectively. The first-order condition for the number of firms is:

$$\alpha \frac{1}{\sigma - 1} N_t^{\left(\frac{1}{\sigma-1} - 1\right)} F(K_t, L_t) - \phi = 0 \tag{34}$$

By comparing this equation to equation (30) we see that optimality requires implementing the Pareto efficient number of firms. As the government can choose the number of firms through τ^{π}, without introducing any (further) distortions, the free entry condition does not represent a binding constraint when choosing the other tax rates. From lemma 5 it follows that a country with a larger market size will have a larger number of firms.

The first-order conditions of consumption, capital and labor are respectively given by:

$$\beta^t [U_{c_t} + \lambda_t (U_{c_t} + c_t U_{c_t c_t} + L_t U_{L_t c_t})] - \gamma_t = 0 \tag{35}$$

$$-\gamma_t + \gamma_{t+1} [1 - \delta + \alpha N_{t+1}^{\frac{1}{\sigma-1}} F_K(K_{t+1}, L_{t+1})] = 0 \tag{36}$$

$$\beta^t [U_{L_t} + \lambda_t (U_{L_t} + L_t U_{L_t L_t} + c_t U_{c_t L_t})] + \gamma_t \alpha N^{\frac{1}{\sigma-1}} F_L(K_t, L_t) = 0 \tag{37}$$

First consider the optimal capital income tax rate in steady state. Dividing equation (35) for period t+1 by the expression for period t yields an expression equal to $\frac{\gamma_t}{\gamma_{t+1}}$. Then plugging in the ratio of gammas from equation (36) it follows that:

$$\frac{U_{c_t} + \lambda_t(U_{c_t} + c_t U_{c_t c_t} + L_t U_{L_t c_t})}{\beta[U_{c_{t+1}} + \lambda_{t+1}(U_{c_{t+1}} + c_{t+1} U_{c_{t+1} c_{t+1}} + L_{t+1} U_{L_{t+1} c_{t+1}})]} = 1 - \delta + \alpha N_{t+1}^{\frac{1}{\sigma-1}} F_K(K_{t+1}, L_{t+1}) \qquad (38)$$

In steady state this boils down to:

$$\beta^{-1} = 1 - \delta + \alpha N^{\frac{1}{\sigma-1}} F_k(K, L) \qquad (39)$$

Comparing this optimality condition to the equilibrium equation (22) in steady state[9] yields:

$$\tau_{SS}^{k^*} = 1 - \mu \qquad (40)$$

Here the optimal tax rate is a subsidy as in Judd (2002) and Coto-Martinez et al. (2007). The optimal tax rate on capital income in steady state depends negatively on the markup. Moreover, this is also true outside of steady state, in which case the optimal tax rate may be positive. To show this, I first consider the optimal tax rate in the presence of perfect competition. By comparing equation (38) with the equilibrium equation (22) in perfect competition, i.e. for $\mu = 1$, we can find the following expression for the optimal capital tax rate under perfect competition:

$$\tau_{t+1}^{k^{PC}} = 1 - \frac{\frac{U_{c_t}}{\beta U_{c_{t+1}}} - 1 + \delta}{h - 1 + \delta} \qquad (41)$$

where h denotes the left hand side of equation (38). Note that τ_{t+1}^{kPC} does not depend on α. Hence, market size does not seem to play a role under perfect competition and imperfect competition is crucial to our conclusion that size matters for taxation. This is unsurprising, as perfect competition already implicitly assumes a large enough market. Proceeding similarly for the case with markups we have:

$$\tau_{t+1}^{k^*} = 1 - \mu_{t+1}\,(1 - \tau_{t+1}^{k^{PC}}) \qquad (42)$$

As a tax rate of larger than 100% under perfect competition is not sensible, we have that the optimal tax rate on capital income depends negatively on the markup and therefore positively on the market size

[9]Meaning for $U_{c_t} = U_{c_{t+1}}$.

α.[10] Under perfect competition here, the optimal tax rate on capital in steady state is 0 (the Chamley-Judd result[11]) in which case we again obtain expression (40). In steady state with imperfect competition the optimal tax rate would be negative as in Judd (2002). Out of steady state, however, the tax rate may very well be positive, yet still depend negatively on the markup. Hence, this result does not rely on capital subsidies being optimal.

Proceeding similarly for labor taxes we have:

$$\tau_t^{l^*} = 1 - \mu_t \left(1 - \tau_t^{l^{PC}}\right) \tag{43}$$

where $(1 - \tau_t^{l^{PC}})$ denotes the optimal labor tax outside of steady state under perfect competition. Again, we see that the optimal tax rate on labor depends negatively on the markup and in turn positively on the market size α.

The results of this section are summarized in the following proposition.

Proposition 3. *The optimal tax rates on capital income and labor are lower for poorer and smaller countries.*

The intuition for these results is simple. Taxes on labor and capital income are inefficient because they distort inter- and intratemporal margins. Monopolistic markups, however, also cause similar distortions for the same reasons. This can also already be seen from equations (10) and (11). In choosing the optimal tax rate, the social planner is choosing the optimal amount of distortion to be allowed in the economy. As tax and markup distortions operate in the same way, if there is already more markup distortion in an economy, then there is less space for tax distortions. From lemmas 4 and 5 we know that markups will be larger for the smaller countries, which drives the main result. Nevertheless, as Coto-Martinez et al. (2007) show, for this result on capital income taxation to hold, the government must be able to influence the number of firms. This could be through τ^π or through some licensing fee or other regulation. Otherwise the optimal tax rate on capital income involves solving both the optimal entry problem and the optimal distortion on capital markets.

So far I have interpreted a higher α as more demand, which could arise from a larger population. Nevertheless, I did not allow the labor supply to vary with α. Nonetheless, this would not change the results.

[10]Since the optimal tax rate in perfect competition does not depend on α.

[11]Chamley (1986) and Judd (1985)

Bigger countries would have a larger labor supply, which in general lowers wages and would cause firms to produce more, thereby reducing markups. This channel would lead to even lower markups for countries with a larger α. As this was the conclusion that was made anyway, the implications for the optimal tax rates remain unchanged.

5 Mobile Capital and Open Economy

The results presented thus far have been shown for a closed economy. Opening the economy has two potential effects, namely the (free) trade of goods and mobile capital. In this model it would be difficult in a symmetric equilibrium to have foreign producers of intermediate goods competing with local ones and have local firms exist. This is because the local ones are already making zero profits. Free foreign entry in general may, however, be a concern for the model. If intermediate goods were perfectly tradable, then the markup differences would potentially not exist, as all firms worldwide have access to the same market size α. Nevertheless, the literature on international trade and economic geography does imply that location matters in terms of market access.[12] Many factors, such as legal trade barriers, transportation costs, tariffs, home bias in consumption, et cetera, do not allow markups to completely disappear or necessarily equalize across countries. Moreover, De Loecker et al. (2016) show that trade liberalization can actually increase markups. Ultimately, however, whether markups are larger in smaller and poorer countries is an empirical question. The validity of the expected markup differences proposed in this paper will be examined empirically in the next section.

Trade costs have also not been considered explicitly so far. With trade costs, markups would not be completely eliminated through trade. Decreasing trade barriers, however, may reduce markups as shown e.g. in Levinsohn (1993), Harrison (1994) and Feenstra and Weinstein (2017). In that case, optimal tax rates would be decreasing in trade barriers. As models of tax competition show, however, a decrease in trade barriers can lead to lower equilibrium tax rates.[13] Furthermore, Haufler and Stähler (2013) show that due to tax competition, larger markets can reduce corporate tax rates. I have argued here, that simply because a smaller country has a lower capital tax rate, it does not mean that it is engaging in tax competition. This paper does show, however, that in response to a larger market, optimal tax rates increase. Therefore, if tax rates fall after a market expansion or reduction of trade costs that lowers markups, then it is clear that a country is indeed engaging in tax competition.

[12] For a discussion, see Baldwin et al. (2003).

[13] Haufler and Wooton (2010) show tax rates initially decrease then increase in response to economic integration.

There are concerns, especially from the tax competition literature, that capital is very mobile and therefore difficult to tax. I now examine the case of mobile capital with two countries that are identical except for their market size α. Country 2 is assumed, without loss of generality, to be larger than Country 1. Time indices are suppressed. The social planer's goal is to choose tax rates on capital τ_k^1 and τ_k^2 such as to equalize the marginal products of capital in each country:

$$F_K^1 = F_K^2, \text{ where } \alpha^1 < \alpha^2 \tag{44}$$

For simplicity, suppose that the final good Y is freely traded, but intermediate goods x_i are not tradable, for example due to prohibitive transportation costs[14]. Then, normalizing the price of the final good in one country we have:

$$P_y^1 = P_y^2 = 1 \tag{45}$$

As Y was produced under perfect competition before, the free trade of this good does not change anything in the model. Furthermore, since x_i is still not tradable, there is no difference in the pricing equations to before. Hence from equation (13) we have:

$$p^j = \alpha^j \, N_j^{\frac{1}{\sigma-1}}, \; j \in \{1, 2\} \tag{46}$$

With mobile capital there can be no arbitrage in the post-tax rates of return on capital. Hence:

$$r^1 \, (1 - \tau_k^1) = r^2 \, (1 - \tau_k^2) \tag{47}$$

Recall that from equation (10) we have:

$$r^j = p^j \, F_K^j \mu_j^{-1}, \; j \in \{1, 2\} \tag{48}$$

Inserting equation (46) into equation (48) and plugging the resulting expression into the no arbitrage

[14] Haufler and Pflüger (2004), in analyzing international tax competition under monopolistic competition also assume intermediate goods are subject to transportation costs, while final goods are not.

condition (47) after setting $F_K^1 = F_K^2$ yields:

$$\frac{1-\tau_k^1}{1-\tau_k^2} = \frac{\alpha^2\,\mu^1\,N_2^{\frac{1}{\sigma-1}}}{\alpha^1\,\mu^2\,N_1^{\frac{1}{\sigma-1}}} \tag{49}$$

As we have $\alpha^2 > \alpha^1$ and already know from lemma 3 that this implies $N^2 > N^1$ and $\mu^2 < \mu^1$, the right hand side of condition (49) is larger than one, implying:

$$\tau_k^1 < \tau_k^2 \tag{50}$$

Hence, the smaller and/or poorer country 1 should have a lower capital income tax rate from the perspective of a global social planner under mobile capital.

6 Empirical Evidence

To summarize, this paper has shown that small and developing countries should have lower tax rates by relying on two arguments. The first is that optimal tax rates are negatively related to monopolistic markups. The second is that markups vary with market size. As we cannot observe optimal tax rates, I will focus on testing whether smaller and poorer countries do indeed have larger markups. Empirical literature already supports this claim. Campbell and Hopenhayn (2005) find for several industries that there is more competition in larger markets.[15] Collard-Wexler (2013) shows that bigger markets have more and larger production plants for ready-mix concrete. Schiff (2015) finds that larger and denser cities have a larger variety of restaurants, in line with the monopolistic competition model presented here. Using data on dentists and chiropractors, Dunne et al. (2013) also find that an increase in the market size increases the average number of firms, which reduces profits. Unlike these studies, however, I will look at markup differences across countries.

As the arguments presented here rely on markups in the intermediate goods sector, I use cross-country data from the banking industry, since their services are commonly used as intermediate inputs. Moreover, competition data for the banking industry is available for most countries, which is typically not the case for other industries. As seen, the argument in this paper is stronger when intermediate goods are not freely tradable. Since financial services are relatively easy to trade, the coefficients provided here could be seen as

[15] Using population as a baseline measure of market size.

underestimating the average effects across industries. Bikker and Haaf (2002) have also examined competition and concentration in the banking industry. Their analysis focuses on 23 countries and they find strong evidence for monopolistic competition. They also find that among banks operating in international markets competition is stronger than for small banks operating mainly in local markets. This points to the fact that market size can matter.

I use cross-country panel data and exclude countries identified in Hines and Rice (1994) as the big seven tax havens. This is because the demand for banking services in these countries is very high and not proxied well by local size, as they serve a very global market. However, the results are robust to excluding all tax havens identified in Hines and Rice (1994) and robust to not excluding any countries. The coefficients are then slightly higher in the former case and slightly smaller in the latter case, reflecting the bias introduced by tax havens. Nevertheless, the significance levels are largely the same. Markup data is not available, however, different measures of concentration are. These are suitable proxies, since markups are related the degree of competition and concentration.[16] The two measures used here are the three-bank and five-bank asset concentration ratios. Bikker and Haaf (2002) also use these ratios, as well as ten bank concentration. However, they raise the issue that concentration ratios may be overestimated for small countries. The data for the five-bank asset concentration comes from the World Bank's Global Financial Development Database[17] and covers the periods 1996-2014. The data for the three-bank asset concentration comes from the Financial Development and Structure Dataset, computed by Beck et al. (2009) and covers the period 1998-2011[18]. Both are given in percent.

Data on GDP and population comes from the World Development Indicators.[19] GDP is given in millions of current U.S. dollars (USD), GDP per capita is given in thousands of current USD. Total population is given in millions. In order to control for corruption, which may lead to lower GDP and less competition simultaneously, I include a measure of corruption from the World Bank's Worldwide Governance Indicators database, which covers the period 1996-2014.[20] The "Control of Corruption" variable is defined in this database as: "perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests". The variable gives each country a score and approximately ranges from -2.5 to 2.5.

[16] Bikker and Haaf (2002) find that competition in the banking industry decreases as market concentration increases. Campbell and Hopenhayn (2005) show empirically that markups are negatively related to the number of competitors in many industries. Lewis and Stevens (2015) estimate that desired markups in general are reduced by 0.17% following a 1% increase in the number of competitors. Schaumans and Verboven (2015) find that in most industries they analyze, the second entrant reduces markups by at least 30%, although higher entrants have smaller or insignificant effects.

[17] Last Updated: June 2016.

[18] Last updated: November 2013.

[19] Last updated: 19.07.2016.

[20] Last updated: 25.09.2015.

I first examine the degree of competition for the different World Bank income groups. Table 1 compares regressions on dummy variables representing the different World Bank income groups. In the first two columns the richest group, namely "High Income OECD Countries" is omitted and serves as the comparison group. In the next two columns both OECD and non-OECD high income countries are omitted. The results are very favorable. As expected, countries in the more developed groups have more competition. The lowest income countries have a three-bank concentration which is about 22 percentage points larger than the highest group. This is dramatic considering the maximum is 100 percent. Furthermore, all coefficients are significant at the 1% level. The magnitudes are also descending in order of income group. This shows that being in a higher income group reduces market power at all income groups monotonically, as the theory predicts. For the five-bank concentration ratio the results are similar. Hence, it appears that for developing countries, tax rates on capital income and labor should indeed be lower and that the optimal tax rate is positively correlated with each income group.

Table 1: Concentration by Development Group

	(1)	(2)	(3)	(4)
	3 Concentration	5 Concentration	3 Concentration	5 Concentration
Low Income	21.9***	15.7***	17.9***	11.4***
	(2.25)	(1.85)	(1.88)	(1.67)
Lower Middle Income	11.6***	8.46***	7.58***	4.15***
	(2.09)	(1.63)	(1.73)	(1.43)
Upper middle income	8.82***	7.93***	5.17***	4.08***
	(1.89)	(1.43)	(1.53)	(1.22)
High income: nonOECD	5.24***	5.76***		
	(1.63)	(1.24)		
Control of Corruption	5.65***	4.56***	4.61***	3.33***
	(0.81)	(0.62)	(0.76)	(0.61)
Constant	62.9***	74.9***	66.2***	78.3***
	(1.47)	(1.13)	(1.06)	(0.88)
Observations	1670	1768	1670	1768
Adjusted R^2	0.057	0.040	0.053	0.031

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

I now turn to testing the theory presented here more directly. The two main factors driving the model were income per capita and population size. In addition to these two variables, I also consider GDP in the regressions as a factor that may capture both of these together. The three-bank concentration ratio and the five-bank concentration ratio are used as dependent variables. I use country fixed effects in all regression and standard errors are clustered at the country level. Relevant constant characteristics addressed by the fixed effects model include differences in institutions or regulatory preferences, which are likely to be important for the banking industry. As this approach does not use (quasi-)experimental data, the estimates may not be causal. Nevertheless, for the implications on optimal tax rates, it does not matter why smaller and poorer countries have higher markups. The fact remains, that if they do exhibit higher markups, then they have lower optimal tax rates.

Table 2 shows the results for the GDP regressions. As the countries have large income differences, it is perhaps more informative to look at elasticities. The coefficients are all significant, indicating the theory presented here is correct. The magnitudes, however, are somewhat small. Nevertheless, as banking services are highly tradable, these small coefficients are not very surprising. The table shows that a 10% increase in GDP per capita decreases the three bank concentration ratio by 0.8 percent. Furthermore, a 10% increase in GDP decreases the three bank concentration ratio by 0.7%. The results for the five-bank concentration ratio are, however, smaller.

Table 2: GDP and Concentration

	(1) log(3 Concentration)	(2) log(3 Concentration)	(3) log(5 Concentration)	(4) log(5 Concentration)
log(GDP per capita)	-0.084***		-0.041**	
	(0.024)		(0.021)	
log(GDP)		-0.071***		-0.034*
		(0.021)		(0.018)
Control of Corruption	-0.062	-0.063	-0.013	-0.014
	(0.041)	(0.041)	(0.029)	(0.029)
Constant	4.34***	4.97***	4.44***	4.75***
	(0.031)	(0.22)	(0.032)	(0.20)
Observations	1646	1646	1749	1749
Country Fixed Effects	YES	YES	YES	YES

Standard errors clustered at country level in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

I now consider the results for the low income group of countries, which are shown in table 3. The statistical significance has increased somewhat, but the magnitudes have increased heavily. The coefficients are much closer for both concentration ratios now. A 10% increase in GDP per capita reduces both concentration ratios by around 2%, whereas a 10% increase in GDP reduces both concentration rations by 1,6%. It seems the poorest countries are more sensitive to market distortions due to limited size and the policy implications for optimal tax rates are most relevant for such countries.

Population is generally insignificant in the regressions with clustered errors and hence the table is not reported for parsimony. However, they are generally significant when using homoscedastic errors. Hence, their insignificance may be an artifact of conservative standard error estimates. In any event, the coefficients

Table 3: GDP and Concentration for the Low Income Group

	(1) log(3 Concentration)	(2) log(3 Concentration)	(3) log(5 Concentration)	(4) log(5 Concentration)
log(GDP per capita)	-0.20***		-0.21**	
	(0.063)		(0.094)	
log(GDP)		-0.16***		-0.16**
		(0.048)		(0.069)
Control of Corruption	-0.0061	-0.0061	0.035	0.037
	(0.079)	(0.083)	(0.086)	(0.088)
Constant	4.15***	5.69***	4.30***	5.88***
	(0.065)	(0.44)	(0.079)	(0.66)
Observations	224	224	172	172
Country Fixed Effects	YES	YES	YES	YES

Standard errors clustered at country level in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

are low. A population increase of ten million decreases three-bank concentration by 4.3 percentage points, whereas a 10% increase in population decreases three-bank concentration by 0.9%.

Population becomes much more important when considering the low income group of countries. The results are shown in table 4. I do not control for corruption here, as there is no expected relationship between population size and corruption. The results, however, are robust to controlling for corruption as well. A quadratic relationship offers a better fit and is hence reported. The linear model is also statistically significant, but with a slightly lower coefficient. A population increase of 1 million in a low income country with the mean population[21] reduces the three-bank concentration ratio by 1.6 percentage points, whereas a 10% increase in population would decrease three-bank concentration by 4.8%. The coefficients for the five-bank concentration ratio are very similar. The effects are much larger than when considering all countries, implying the poorest countries are more sensitive in this regard. This difference could be because in poorer countries population is likely to play a larger role in determining demand, than in rich countries with sufficient demand.

7 Conclusion

Optimal tax policy often does not consider features of small and developing countries, especially the limited market size. This paper has argued that optimal labor and capital income tax rates are lower in such countries. Hence, they would be ill-advised to follow the tax policies chosen in larger and richer countries.

[21]The mean population for this group is 37.18 million.

Table 4: Population and Concentration for the Low Income Group

	(1)	(2)	(3)	(4)
	3-Concentration	5-Concentration	ln(3-Concentration)	ln(5-Concentration)
Population	-2.65**	-2.46**		
	(1.06)	(1.01)		
sq(population)	0.014*	0.012*		
	(0.0075)	(0.0065)		
log(population)			-0.48***	-0.45**
			(0.16)	(0.20)
Constant	123.8***	136.8***	5.64***	5.77***
	(15.9)	(18.6)	(0.42)	(0.58)
Observations	252	185	252	185
Country Fixed Effects	YES	YES	YES	YES

Standard errors clustered at country level in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

One motivation of this paper has been the observation that developing countries appear to have somewhat lower statutory and much lower effective capital and labor tax rates. The literature suggests that institutional, political and cultural constraints may make it impossible for developing countries to have higher effective tax rates. Nevertheless, optimal statutory tax rates may also be lower in these countries. Furthermore, smaller countries also tend to have lower capital tax rates, which is certainly driven partially by tax competition.

This paper, has put forth an alternative explanation for these features. It may simply be optimal for poorer and smaller countries to have lower tax rates on capital and labor income. The intuition for this result consists of two arguments. First, taxes cause distortion, because they introduce wedges between marginal products and factor prices. In the presence of imperfect competition, however, monopolistic markups introduce the exact same distortions. Therefore, optimal labor and capital income tax rates are negatively related to the size of markups in an economy. This result goes back to Judd (1997) in a model with a fixed number of firms. Second, smaller and poorer countries have smaller market sizes, which restricts the amount of competition in these countries. Smaller markets cause larger monopolistic markups, which has also been empirically confirmed in several studies. Combining these two arguments produces the result that optimal capital and labor income tax rates are smaller for poorer and smaller countries. This implies that the observed tax differences are not necessarily a result of inefficient tax competition, even if capital is mobile. Furthermore, smaller tax rates are insufficient to conclude a country is deliberately acting as a tax haven. If, however, tax rates fall after a market expansion, then it is likely that a country is indeed engaging in tax competition.

Previous papers have been unable to produce similar conclusions for two main reasons. One is the assumption of perfect competition, which may not be very realistic, especially for small developing countries. Models that do feature markups, however, typically cannot allow these to vary across countries due to simplifying assumptions. If the model here is correct, then smaller and poorer countries should have larger markups. Previous empirical research does seem to show evidence in favor of this argument. Cross-country data was also shown here to generally support this idea, even in an industry with low expected markup differences, such as banking.

The policy recommendation of this paper is that small and developing countries should have lower capital and labor tax rates than their larger and richer counterparts. The empirical results seem especially strong among the group of low income countries, thereby making the policy recommendation especially relevant for them. Nevertheless, this does pose a problem for raising sufficient revenue in developing countries. Overcoming this issue remains a question for further research. A possible avenue could be a more explicit analysis of trade costs in this context. If their reduction reduces markups, tax revenues may benefit from trade integration.

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Appendix A: Theoretical Appendix

A.1. Derivation of Implementability Constraint

In this section I derive the implementability constraint, i.e. equation (32). Multiplying equation (20) by L_t yields:

$$-U_{c_t} L_t w_t (1 - \tau_t^l) = L_t U_{L_t} \tag{51}$$

Multiplying equation (17) by U_{c_t} and β^t, inserting equation (51), summing both sides from period zero to infinity and then inserting equation (19) we have:

$$\sum_{t=0}^{\infty} \beta^t (c_t U_{c_t} + L_t U_{L_t}) = U_{c_0}(K_0)[1 - \delta + r_0(1 - \tau_{k_0})] \tag{52}$$

Inserting equation (13) into (10), while noting that $P_y = 1$, gives the expression for r_0. Plugging this into equation (52) yields the implementability constraint.

A.2. Market and Implementable Allocation Equivalence

Claim: An allocation in the market equilibrium $a = \{c_t, L_t, K_{t+1}, N_t\}_{t=0}^{\infty}$ satisfies the set of implementable allocations. Furthermore, if an allocation a is implementable, then prices and tax rates $\{\tau_{t+1}^k, \tau_t^l, \tau_t^\pi\}_{t=0}^{\infty}$

can be constructed such that the allocation with the prices and tax rates establishes a market equilibrium.

Proof. The proof is standard and follows Chari and Kehoe (1999) and Coto-Martinez et al. (2007). The market equilibrium satisfies the set of implementable allocations, because any allocation in the market equilibrium must satisfy the zero profit condition and resource constraint. Furthermore, it must satisfy the implementability constraint, since this is derived from market equilibrium conditions. Hence, the first claim holds. Given an implementable allocation, market prices can be found using equations (10), (11) and (13). The tax rates can be found from equations (15), (19) and (20). Recall that the implementability constraint was found using the consumer budget constraint. Hence, the consumer budget constraint can be recovered from the implementability constraint, from which the level of debt can be found. As the consumer budget constraint is satisfied and the resource constraint holds for an implementable allocation by definition, the government budget constraint also holds. Hence we have a market equilibrium. □