

# The Poverty Effects of Market Concentration

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## Abstract

This paper contributes to the limited literature on the welfare impacts of market concentration by developing a simple model that shows how exogenous variations in market power affect poverty. Increased market power leads to economy-wide welfare losses, because it raises the prices of goods and services for all agents in an economy and thus reduces the relative incomes of households, particularly among the poor. Declines in poverty in this context are only possible in the case wherein the poor have access

to a share of oligopolistic rents. Although this scenario seems highly unlikely, this result has important implications for public policy, particularly for economies with less-than-perfect markets and social objectives of poverty eradication. This result suggests the possibility of taxing extranormal rents extracted by firms with market power and redistributing them through targeted *lump-sum* social transfers, thereby contributing to poverty reduction by mitigating welfare losses from the negative price effect.

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## 1 Introduction

This paper examines two important factors in the interaction between market concentration and welfare. First, colluded market power affects disproportionately the relative incomes of the poorest through higher prices because the poorest have fewer options to substitute within their consumption. Second, economic structures tend to be less competitive in developing countries, where well-functioning markets take time to evolve. These two factors suggest two crucial questions that few researchers have tried to answer and that are relevant for developing economies: What are the poverty effects of market concentration? And is there any scenario in which greater market power is consistent with poverty reduction? This paper contributes to the limited literature on this topic by providing a model for examining the relationship between poverty and market power and surveying the policy options for achieving redistribution under a second-best scenario of market concentration.

Dixit and Stern (1982) have been among the first to develop models of oligopoly that allow the empirical evaluation of welfare. In particular, they propose a unified sequence of models to examine the welfare loss in an industry with a homogeneous product and a small number of firms. They stress several distributional issues associated with such an approach. For instance, they maintain that, if a dollar of gain to consumers is seen as more valuable than a dollar of profit, this can be addressed by giving a weight of less than one to the surplus among producers in the summation. Analogously, the fact that an aggregate consumer surplus neglects the distribution of incomes among consumers can be dealt with through the use of similar weighting techniques across consumer groups. Other, closely related studies have been conducted by Cowling and Waterson (1976) and Stigler (1964), who examine the welfare implications of the price-cost margin and the Hirschmann-Herfindahl index, respectively.

A general finding in this literature is that a high concentration in specific markets is associated with higher prices (for example, see Evans and Kessides 1994; Weiss 1989). Other empirical studies dealing with the relationship between market concentration and commodity prices, such as Cotterill (1986), Lamm (1981), and Waterson (1993), have found that concentration does raise prices and that this phenomenon generates a welfare loss. In a similar vein, Dobson and Waterson (1997) conclude that prices are likely to rise because of concentration, but that prices might also fall as a result of greater efficiency.

Recently, several empirical papers have looked at the impact of greater competition (reduced market power) on welfare. Atkin, Faber, and Gonzalez-Navarro (2015), for instance, study the effect of the expansion of foreign retail chains on household welfare in Mexico. They find that the entry of foreign supermarkets in Mexico between 2002 and 2014 led to welfare gains, mainly driven by a reduction in the cost of living because of both the lower prices of foreign retailers and a drop in prices in domestic stores. Their results suggest there were declines in employment, labor income, and profits in the domestic retail sector, but include no evidence of changes in municipality-level incomes or employment given that the adverse nominal income effects are likely offset by declines in the cost of living. Busso and Galiani (2014) survey the effect of greater competition among retail stores on the prices of goods in the Dominican Republic. The results of their randomized experiment suggest that increased market entry led to a large and significant reduction in prices if product and service quality

are left unchanged. Their model highlights that the poor care about prices more than product quality or other factors. Urzúa (2013) discovers welfare losses because of the exercise of market power in Mexico. His results suggest that the welfare losses deriving from firms with market power are larger among the poor, in the rural sector, and in the southern (poorest) states. Meanwhile, Brummund (2013) analyzes the effects on poverty reduction that arise because firms are behaving in a monopsonistic way, that is, paying lower wages and hiring fewer workers. Using data on Indonesia, the author finds a substantial increase in wages and employment and a corresponding lower poverty rate if the labor market is perfectly competitive. Ghani and Reed (2015) study the economic relationship between a monopoly ice manufacturer and retailers in Sierra Leone, highlighting the importance of market entry in promoting growth and welfare. According to the paper, growing competition disrupts collusive arrangements, thereby leading to a reduction in prices and other positive effects such as the establishment of trade credit services.

To clarify the conceptual relationship between market concentration and poverty, this paper develops a simple model to study the welfare effects of market power. The model relies on equivalent income functions and the class of poverty measures defined by Foster, Greer, and Thorbecke (1984) to estimate the welfare effects. The analysis is based on specific functional forms so that the relevant poverty measure can be calculated explicitly. In particular, equivalent income functions associated with an oligopolistic equilibrium are computed directly to simplify the welfare analysis. Then, comparative statics are developed in terms of exogenous variations in the number of firms in a market for a homogeneous good to determine the effects of greater market concentration on poverty.

The first set of results that emerge from this model shows that in an economy in which consumers have homogeneous skills (productivity) and there are different degrees of firm ownership, the negative price effect of market concentration is greater than the positive profit effect of firm ownership so that greater market concentration increases the poverty index.

The second set of results shows how in an economy wherein consumers have heterogeneous skills, there is a range of market concentrations for which the positive profit effect offsets the negative price effect as long as the degree of firm ownership among low-income consumers is sufficiently large and there is a significant productivity gap between less and more highly skilled workers. This second set of results suggests that declines in poverty in this context are only possible in the case wherein the poor have access to a share of oligopolistic rents. Although this scenario seems highly unlikely, this result has important implications for public policy for economies with less-than-perfect markets and where the social welfare function is to eradicate poverty. Following the fundamentals of the second welfare theorem, this result suggests the possibility for governments of taxing extranormal rents extracted by firms with market power and redistributing them through targeted *lump-sum* social transfers, thereby contributing to poverty reduction by offsetting the welfare losses deriving from the price effect. The policy implications of these results follow Auriol and Warlters (2004), who find that raising the barriers to entry can be consistent with a deliberate government policy aimed at boosting tax revenue. Market entry fees, the authors argue, encourage the emergence of large taxpaying firms that collect rents and are easy to tax at low administrative cost through entry fees and profit taxes.

The remainder of this paper is organized as follows. Section 2 develops models to estimate the welfare effects of market concentration with exogenous and endogenous income. Section 3 presents a policy discussion. The last section concludes.

## 2 Modeling the effects of market concentration on poverty

The analysis relies on the Foster-Greer-Thorbecke (FGT) index, which consists of a class of poverty measures that satisfy the monotonicity and transfer axioms proposed by Sen (1976) and the decomposability property. In general, the FGT index (also known as the  $P_\alpha$  measure) has the property of subgroup decomposability and can represent several commonly used poverty metrics that take into account the intensity and severity of poverty.

The FGT index estimates the weighted sum of the poverty gap ratios of a group of observations under an arbitrary poverty line and includes a parameter,  $\alpha$ , that measures the sensitivity of the income distribution within these observations. Let  $y = (y^1, y^2, \dots, y^J)$  be the income vector of a population with  $J$  consumers, assuming that  $y^1 \leq y^2 \leq \dots \leq y^J \leq z \leq y^{J+1} \leq \dots \leq y^J$ . Also, let  $z$  be an arbitrary poverty line, and let  $q$  be the number of poor consumers. So, the FGT index is defined as follows:

$$P_\alpha = \frac{1}{n} \sum_{j=1}^q \left( \frac{z - y^j}{z} \right)^\alpha, \alpha \geq 0. \quad (1)$$

Assuming a continuous income distribution that lies between  $[0, \infty)$ , the FGT index can be represented as follows:

$$P_\alpha = \int_0^z \left( \frac{z - y}{z} \right)^\alpha f(y) dy, \alpha \geq 0. \quad (2)$$

In particular, if  $\alpha = 0$ , then the index becomes the headcount ratio. This metric represents the percentage of households under the poverty line, although it fails to capture the extent to which each household income falls below the poverty line. If  $\alpha = 1$ , then the index becomes the income-gap ratio for the mean poor household. This ratio measures the total shortfall of poor households with respect to the poverty line. However, the income-gap ratio is not sensitive to the distribution of income among the poor. If  $\alpha = 2$ , then the FGT index becomes the squared income-gap ratio. This index computes the severity of poverty more accurately because it represents the squared income-gap ratio for the mean poor income. In this way, the index incorporates information on both poverty and income inequality across poor households. Higher order classes of poverty indicators can be derived as  $\alpha$  becomes larger. Finally, as  $\alpha \rightarrow \infty$ , the FGT family of poverty measures tends toward a Rawlsian social welfare function, that is, the index depends solely on the welfare of the poorest household in the population.

### *The demand side*

There are  $I$  commodities in the economy,  $i = 1, 2, \dots, I$ , with an associated price vector  $P = (P_1, \dots, P_I)$ , and there are  $J$  consumers,  $j = 1, 2, \dots, J$ , each with a different fixed initial income  $\omega^j$ . Furthermore, consumers have a rational, continuous, and locally nonsatiated preference relation, which can be represented by means of the generalized Cobb-Douglas utility function given by

$$U(x) = \sum_{i=1}^I \beta_i \ln x_i^j, \quad (3)$$

with  $\sum_{i=1}^I \beta_i = 1$  and  $\beta_i \geq 0$ , so that the  $\beta_i$ 's (taste parameters) are similar among consumers.<sup>1</sup>

Consider the utility maximization problem, as follows:

$$\max_{\{x_i^j\}_{i=1}^I} U(x) = \sum_{i=1}^I \beta_i \ln x_i^j \quad (4)$$

$$s. t. \sum_{i=1}^I P_i x_i^j \leq \omega^j.$$

The demand function that solves (3) is

$$x_i^j(p, \omega^j) = \frac{\beta_i \omega^j}{P_i}, \quad (5)$$

and the corresponding aggregate demand function for the  $i$ th good can be expressed as follows:

$$X_i(p, \omega) = \sum_{j=1}^J x_i^j(p, \omega^j) = \frac{\beta_i \omega}{P_i}, \quad (6)$$

where  $\omega$  represents the aggregate income in the economy  $\omega = \sum_{j=1}^J \omega^j$ , and  $\beta_i$  is the taste parameter for good  $i$ ,  $0 < \beta_i < 1$ .

Consumer  $J$ 's indirect utility function,  $v^j(p, \omega^j)$ , is obtained by substituting demand function (5) into the generalized Cobb-Douglas utility function, as follows:

$$v^j(p, \omega^j) = \sum_{i=1}^I \beta_i \ln \left( \frac{\beta_i \omega^j}{P_i} \right) \Leftrightarrow v^j(p, \omega^j) = \ln \left[ \omega^j \prod_{i=1}^I \left( \frac{\beta_i}{P_i} \right)^{\beta_i} \right] \quad (7)$$

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<sup>1</sup> The demand function derived from this utility function can be aggregated. In particular, for any price vector,  $P$ , the aggregate demand depends on individual wealth only through the sum.

using  $\sum_{i=1}^I \beta_i = 1$ .

It is convenient to apply a monotonic transformation to the direct utility function, equivalent to  $U(x) = \prod_{i=1}^I x^{\beta_i}$ . Hence, (7) becomes

$$v^j(p, \omega^j) = \frac{\omega^j}{\prod_{i=1}^I p_i^{\beta_i}}. \quad (8)$$

This function is particularly useful in indicating the welfare change expressed in dollars for consumer  $j$  with respect to a vector of reference prices.

### *The supply side*

There are  $N$  identical firms that operate in the market for a homogeneous good ( $N \geq 2$ ).<sup>2</sup> Let the inverse demand function be denoted by  $P(Q) = \frac{\beta\omega}{Q}$ , where  $P(Q)$  is the price;  $Q$  is the total quantity produced in the market s.t.  $Q = \sum_{n=1}^N q_n$ ; and  $\beta$  and  $\omega$  are nonnegative parameters exogenously given. Throughout this paper, the  $n$ th firm's cost function  $c_n(q_n)$  is assumed to be a constant,  $c$ .

The strategic form for this game is as follows:

- $N = \{1, 2, \dots, N\}$  (Set of players)
- $S = \mathfrak{R}_+$  for player  $n \in N$  (Strategy set)
- $\pi_n(q_n, q_{-n}) = P(Q)q_n - c_n(q_n)q_n$  (Payoff function)

The  $n$ th firm's objective is to choose quantity ( $q_n$ ) while taking  $\sum_{m \neq n} q_m$  as given. So, deriving the best-response function of firm  $n$  gives the following:

$$\max_{q_n \in \mathfrak{R}_+} \pi_n = \left( \frac{\beta\omega}{\sum_{n=1}^N q_n} \right) q_n - c q_n \quad (9)$$

The first order condition is given by

$$\frac{\partial \pi_n}{\partial q_n} = \frac{\beta\omega}{\sum_{n=1}^N q_n} - \frac{\beta\omega q_n}{(\sum_{n=1}^N q_n)^2} - c = 0 \quad (10)$$

After rearranging terms, we find that the best-response function for firm  $n$  as a function of the output level of firm  $m \neq n$  is

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<sup>2</sup> This model does not allow for a monopolistic market structure. For  $N = 1$ , given the demand function, there are infinite solutions for the profit maximization problem (PMP). Therefore, it is assumed that  $N \geq 2$ .



$$p_n(q_{-n}) = q_n = \sqrt{\frac{\beta\omega \sum_{m \neq n} q_m}{c}} - \sum_{m \neq n} q_m \quad (11)$$

In a Cournot equilibrium, because it is assumed that all firms are identical, firms would produce the same output level  $q_1 = q_2 = \dots = q_N$ . Denoting the common output level by  $q$ , where  $q = q_n$  for all  $n = 1, 2, \dots, N$ , and substituting  $q$  in the best-response function, we obtain the following:

$$q_n = \frac{\beta\omega(N-1)}{cN^2} \Rightarrow Q = \sum_{n=1}^N q_n = \frac{\beta\omega(N-1)}{cN} \quad (12)$$

The equilibrium price, the profit of each firm, and the total profits of the market are as follows:

$$P = \frac{cN}{N-1}, \quad (13)$$

$$\pi_n = \frac{\beta\omega}{N^2} \quad (14)$$

$$\pi = \sum_{n=1}^N \pi_n = \frac{\beta\omega}{N} \quad (15)$$

### ***Model with exogenous income (partial equilibrium analysis)***

Assume an income distribution that lies at  $[\underline{\omega}, \bar{\omega}]$ , with  $\underline{\omega} > 0$ , and let  $f(\omega)$  be the associated density function. There are two goods in the economy. Good 1 is produced in an oligopolistic market, and the price is given by  $P_1 = \frac{cN}{N-1}$ , with  $c > 0$  and  $N \geq 2$ . Good 2 is produced in a perfectly competitive market and is considered as the numeraire (for example,  $P_2 = 1$ ). Hence, each consumer  $j$  faces prices  $p = (P_1, 1)$ , with a *lump-sum* income at  $\omega^j$ . Consider a reference price vector  $r = (R_1, R_2)$ . Denote consumer  $j$ 's money metric indirect utility function by  $v^j = (p, \omega^j) = \frac{\omega^j}{P_1^\beta P_2^{1-\beta}}$ , with  $\omega^j \geq 0$  and  $0 < \beta < 1$ . Finally, recall the FGT index  $P_\alpha = \int_0^z \left(\frac{z-\omega^j}{z}\right)^\alpha f(\omega) d\omega$ , with an arbitrary nonnegative income poverty line,  $z$ . Given these assumptions, the next proposition can be established, as follows:

**Proposition.** *In a setting with exogenous income and  $P_0 > 0$ , greater market concentration has a nondecreasing effect on the poverty index, so that  $\frac{\partial P_\alpha}{\partial N} \leq 0$ .*

This proposition appears intuitive because a reduction in the number of firms competing in a market would reduce the relative income of households by raising consumer prices and, thus, expanding poverty. In particular, in an economy with initial conditions of positive poverty rates, greater market power would have an effect on the depth of poverty, the severity of poverty, and other poverty indicators for which  $\alpha > 0$ . In the case of the poverty headcount ratio ( $\alpha = 0$ ), the potential negative effect of greater market concentration occurs if and only if it influences the relative incomes of households slightly above the poverty line sufficiently to move them below this threshold. However, this depends on the distribution of incomes in the economy around the poverty line.

To prove this proposition, following King (1983), we define consumer  $j$ 's equivalent income as the value of income,  $\omega_E^j$ , that, at some reference set of prices,  $r$ , gives the same utility as the actual income. In terms of the indirect utility function, we define  $\omega_E^j$  implicitly by the equation:

$$v^j(r, \omega_E^j) = v^j(p, \omega^j). \quad (16)$$

The expenditure function

$$\omega_E^j = e(r, v(p, \omega^j)) \quad (17)$$

is referred to as the equivalent income function. So, we derive  $\omega_E^j$  explicitly by substituting the money metric utility function derived in (8) into (17), yielding

$$\frac{\omega_E^j}{R_1^\beta R_2^{1-\beta}} = \frac{\omega^j}{\left(\frac{cN}{N-1}\right)^\beta} \Rightarrow \omega_E^j = \frac{\omega^j R_1^\beta R_2^{1-\beta}}{\left(\frac{cN}{N-1}\right)^\beta}, \quad (18)$$

where  $\omega_E^j$  can be interpreted as the income that the consumer  $j$  requires to be as well off under the reference set of prices in the new price structure as previously. Let  $R = \prod_{i=1}^I R_i^{\beta_i}$ , then (18) becomes the following:

$$\omega_E^j = \frac{\omega^j R}{\left(\frac{cN}{N-1}\right)^\beta}. \quad (19)$$

Now, let  $z_E$  be an arbitrary cutoff that is determined exogenously such that all those individuals with  $w_E \leq z_E$  are considered to be living in poverty. Because  $w_E$  is monotonically increasing in  $\omega$ , there is a cutoff in the  $\omega$  space corresponding to  $z_E$  that we call  $z$ , as follows:

$$z_E = w_E(r, p, z) \Leftrightarrow z = z(r, p, z_E). \quad (20)$$

Then, replacing (19) in the continuous  $P_\alpha$  measure described in (2), we obtain

$$P_\alpha = \int_0^z \left( \frac{z_E - \omega_E}{z_E} \right)^\alpha f(\omega) d\omega \Rightarrow P_\alpha = \int_0^z \left[ \frac{z_E - \frac{\omega R}{\left( \frac{cN}{N-1} \right)^\beta}}{z_E} \right]^\alpha f(\omega) d\omega. \quad (21)$$

We derive the comparative statics result by calculating the partial differentiation of (21) with respect to  $N$ , as follows:

$$\frac{\partial P_\alpha}{\partial N} = \left[ \frac{-\alpha R \beta}{z_E^\alpha \left( \frac{cN}{N-1} \right)^\beta} \right] \cdot \int_0^z \left[ \frac{z_E - \frac{\omega R}{\left( \frac{cN}{N-1} \right)^\beta}}{z_E} \right]^{\alpha-1} \cdot \left[ \frac{\omega}{N(N-1)} \right] f(\omega) d\omega + \int_0^z \left[ \frac{z_E - \frac{\omega R}{\left( \frac{cN}{N-1} \right)^\beta}}{z_E} \right]^\alpha f'(\omega) \frac{\partial \omega}{\partial N}, \quad (22)$$

where

$$\frac{\partial \omega}{\partial N} = \frac{-\beta \omega R}{(cN \cdot (N-1)^{-1})^{1+\beta}} \cdot c \left[ \frac{1}{N-1} - \frac{N}{(N-1)^2} \right] > 0. \quad (23)$$

Because  $f'(\omega) \leq 0$ , that is, a nonincreasing function of income, and  $\frac{\partial \omega}{\partial N} > 0$ , with  $\alpha = 0$ ,  $z_E > 0$ ,  $N \geq 2$ ,  $R > 0$ ,  $c > 0$ , and  $0 < \beta < 1$ , then, for  $\alpha = 0$ , we obtain  $\frac{\partial P_\alpha}{\partial N} \leq 0$ , showing that greater market concentration has a nondecreasing effect on the headcount ratio.

In the case of higher order classes of poverty indicators, that is,  $\alpha > 0$ , with  $z_E > 0$ ,  $N \geq 2$ ,  $R > 0$ ,  $c > 0$ , and  $0 < \beta < 1$ , it is true that  $\frac{\partial P_\alpha}{\partial N} < 0$ . Thus, we may conclude that greater concentration in the oligopolistic market has an increasing effect on the depth of poverty, the severity of poverty, and other, higher order poverty indicators. This is to be expected because all consumers in this economy are less well off, given the higher prices resulting from diminished competition.

### ***Model with endogenous income (general equilibrium analysis)***

Following up on the results of the exogenous income model, we present, in annex A, a model with endogenous income in the case of a labor market with homogeneous skills and, thus, a marginal product of labor. The results of this model show that, even with endogenous incomes, individuals with low or null shares of the total profits of firms in the oligopolistic market become less well off as concentration increases in this market. In other words, in an economy in which all consumers have a homogeneous level of productivity, oligopoly pricing inefficiency overcomes the positive income effect of firm ownership among the poor so that the poverty level rises. Based on the comparative statics result of the model with exogenous income, we observe only a negative price effect generated

by market concentration. Meanwhile, based on the comparative statics result of the model with endogenous income and a homogeneous level of productivity, we are able to separate the negative price effect of oligopoly from the positive profit effect of firm ownership. Given the values of the relevant parameters, the negative price effect of oligopoly will be greater than the positive profit effect in the case of higher order poverty indicators. In the case of the poverty headcount ratio, as in the model with exogenous income, the potential negative effect of market concentration will arise if and only if one or more households located slightly above the poverty line exhibit downward mobility.

In annex B, we present a model with endogenous income in which consumers exhibit heterogeneous levels of productivity. The results can be divided into two possible cases. First, in case 1, as the productivity gap between highly and less highly skilled workers narrows toward zero—similar to the case of a homogenous level of productivity—and the share of the oligopolistic profits of workers at low productivity approaches zero, the negative price effect of greater market concentration will dominate the positive profit effect of firm ownership, so that poverty rates may increase. Second, in case 2, if the share of the oligopolistic profits of low-income consumers is sufficiently large (close to half) and if there is a significant productivity gap between less highly and highly skilled workers so that the labor incomes of poor consumers are sufficiently small with respect to their incomes from firm ownership, a drop in the number of firms that compete in the market for a homogeneous good would lower poverty rates. As in the previous models, the impact of market concentration on the poverty headcount ( $\alpha = 0$ ) will occur only to the extent that it influences the relative position of households around the poverty line.

### 3 Policy discussion

What are some of the policy implications of these results? In the first case, if consumers exhibit a homogeneous level of productivity, but different degrees of firm ownership, we find that the negative price effect of market concentration is greater than the positive profit effect of firm ownership and that greater market concentration therefore leads to higher poverty rates. This means that policies aiming to foster market competition are appropriate. By reducing barriers to market entry through, for example, an enhanced investment climate and streamlined procedures for starting up in business, competition policies can lead to economic growth and benefit consumers through lower prices for goods and services and higher employment rates. There is ample evidence showing that a policy that encourages market entry ultimately benefits consumers through lower prices (see, for instance, Kitzmuller and Licetti 2012), and thus perfect competition represents the first-best economic policy.

The second case represents more out-of-the-ordinary implications for policy making. In this scenario, wherein consumers possess heterogeneous levels of productivity, there is a range of amounts of greater market concentration that may lead to a decline in the poverty index. Nonetheless, the familiar finding that economy-wide welfare losses are associated with greater market concentration still holds.

For economies that are in transition toward the long-term equilibrium of perfect competition, characterized by high levels of informality and in which new entrants into a market face steeper direct and indirect costs and few firms generate extranormal profits, governments may be able to identify readily the latter firms and tax the extranormal rents at a low administrative cost. The welfare losses deriving from the greater market concentration may be partially offset by a tax-and-transfer system that supports households at the bottom of the income distribution. Thus, oligopolistic power may be exploited temporally until the long-term equilibrium of perfect competition is achieved, and, through an effective fiscal system, governments may be able to redistribute efficiently the taxes obtained on extranormal profits. Following the fundamentals of the second welfare theorem, tax policies that capture oligopolistic rents to allocate *lump-sum* targeted transfers to poor individuals might thus function as temporary second-best economic policies to favor poverty reduction in a developing country until well-functioning markets are established.

These policy implications are meaningful also in light of a study by Auriol and Warlters (2004), who find that expanding the barriers to entry is consistent with deliberate policies aimed at raising tax revenue in developing economies, where informality is typically more widespread. Auriol and Warlters analyze the reason the costs to formalize, which are, for the most part, set by governments, are relatively higher in poorer countries. Using a sample of 63 countries, they discover that, because taxes are not easily generated through the informal sector, the need of governments for revenues creates incentives to limit competition in the formal sector, thereby creating rents that may be rendered revenue generating through fees on entry and taxes on profits. Indeed, Baer (2002) finds that a small number of taxpayers account for a large share of total tax collection in developing countries. For instance, 0.4 percent of tax payers account for 57 percent of total domestic tax collection in Colombia and 61 percent in Kenya. De Freitas (2012) points to the limits of using income tax revenue to finance redistribution in developing economies in the presence of an informal sector even if such taxes have been chosen through democratic processes.

In developing countries, where various market failures coexist and where well-functioning markets may take time to evolve, temporarily exploiting the extranormal profits produced by market power may not be such an unreasonable source of more extensive tax collection. Under this scenario, the government would extract rents from oligopolistic firms and redistribute this revenue to promote productive inclusion and, ultimately, poverty reduction along a path to long-term equilibrium. This scenario implies assumptions about the magnitude of the transfers and the efficiency with which the transfers are realized. Auriol and Picard (2006), for instance, look at the trade-off that governments in developing countries face between consumer surpluses and the fiscal benefits of the privatization of noncompetitive industries.

Keeping entry barriers high undoubtedly entails costs. In addition to welfare losses because of the higher prices, firms in the informal sector are more prone to risk (Auriol 2013). Meanwhile, taxing certain sectors over others generates distortions in resource allocation (Auriol and Warlters 2012). This all has an impact on growth and the ability to collect taxes in the medium to long term and ultimately affects the capacity to reduce poverty. Additional research, including on the specific role of

government within the model above, particularly in the provision of public goods, in the costs of entry, in revenue taxation, and in transfer programs, as well as the role of the strategic behavior of firms, can shed more light on these issues.

## 4 Conclusions

The purpose of this paper is to supply a structured analysis of models with exogenous and endogenous incomes to generate insights into the interactions between market concentration and poverty. The main results of the analysis are presented in terms of the parameters of a model that considers income as endogenous. The parameters include profit shares, productivity, the number of firms in specific markets, and individual preferences. One objective of the analysis is to produce explicit outcomes based on assumptions about particular functional forms and a widely accepted class of poverty measures so that the theoretical model can be easily interpreted. Another objective is to show how the underlying model can be extended through an examination of consumers showing heterogeneous levels of productivity.

The analysis indicates that, in an economy in which consumers exhibit a homogeneous level of productivity, but different shares of the profits from oligopolistic rents, the negative price effects on poverty of greater market concentration are always more significant than the positive income effects of extranormal profits deriving from firm ownership. However, if consumers exhibit heterogeneous levels of productivity, if the oligopolistic profit shares of low-productivity consumers are sufficiently large, and if there is a significant productivity gap between less and more highly skilled consumers, then poverty reduction is possible in a context of greater market concentration. So, beyond the first-best economic policy, which implies perfect competition, policies that tax oligopolistic rents and involve the implementation of *lump-sum* income transfers to the poor might work as a temporary second-best economic policy to alleviate poverty until economies can achieve an equilibrium with more competitive markets.

The analysis highlights the need for further study. A natural extension would be to assume more general functional forms. Another possible extension would involve the introduction into the model of a government role through a tax-and-transfer system focused on the provision of public goods (education, health care, basic services), on the costs of entry, on revenue taxation, and on targeted transfer programs. Yet another possible extension would allow for strategic behavior among firms. Finally, an examination of the dynamics associated with the issues, though complex, could yield revealing results.

## Annex A. The model with endogenous income and a labor market with a homogeneous level of productivity

There are  $J$  consumers in the economy. Each consumer has an endowment of  $L > 0$  units of time, which the consumer can allocate to earning income or to leisure.  $\bar{L}$  represents the total units of time available in the economy. There are three goods in the economy—two consumption goods and leisure—and an associated price vector  $p = (P_1, P_2, w)$ . Good 1 is a homogeneous good produced in an oligopolistic market, while good 2 is a composite good produced in a competitive market. Each consumption good,  $i = \{1, 2\}$ , is produced by labor that relies on a linear technology  $Q_i = l_i$ ; a unit of labor produces a unit of good,  $i$ .

Each consumer derives utility from consuming goods and leisure (good 3) according to the utility function  $U(x) = \sum_{i=1}^3 \beta_i \ln x_i$ , with  $\sum_{i=1}^3 \beta_i = 1$  and  $0 < \beta_i < 1$  for all  $i = 1, 2, 3$ ; so, the  $\beta_i$ 's (individual preferences) are equivalent across all consumers. Also, consumers are assumed to have a homogeneous level of productivity; so, they earn the same wage  $w$ ; and they own the firms. However, they have differing shares of the total profits, which are indexed by  $\theta^j$  (that is,  $0 \leq \theta^1 \leq \theta^2 \leq \dots \leq \theta^J$ ) and  $\sum_{j=1}^J \theta^j = 1$ . Finally, consider good 3 (leisure) as the numeraire.

Now, consider consumer  $j$ 's utility maximization problem, as follows:

$$\begin{aligned} \max_{\{x_i^j\}_{i=1}^3} U(x) &= \sum_{i=1}^3 \beta_i \ln x_i^j \\ \text{s.t. } \sum_{i=1}^3 (P_i x_i^j) &\leq w(L - x_3^j) + \theta^j \pi(N). \end{aligned} \quad (\text{A.1})$$

The corresponding demand functions for the  $i$ th consumption of goods and leisure are as follows:

$$x_i^j(p, w, \pi(N)) = \frac{\beta_i (wL + \theta^j \pi(N))}{P_i}, \quad (\text{A.2})$$

$$x_3^j(w, \pi(N)) = \frac{\beta_3 (wL + \theta^j \pi(N))}{w}, \quad (\text{A.3})$$

and the corresponding aggregate demand function for the  $i$ th good can be expressed as follows:

$$X_i(p, w, \pi(N)) = \sum_{j=1}^J x_i^j(p, w, \pi(N)) = \frac{\beta_i (w\bar{L} + \pi(N))}{P_i}, \text{ with } 0 < \beta_i < 1. \quad (\text{A.4})$$

Solving the profit maximization problem (PMP) for the good in a competitive market yields

$$\max_{l_2 \in \mathfrak{R}_+} \pi_2 = P_2 Q_2 - w l_2 \Rightarrow \max_{l_2 \in \mathfrak{R}_+} \pi_2 = (P_2 - w) l_2. \quad (\text{A.5})$$

The first order condition is given by

$$\frac{\partial \pi_2}{\partial l_2} = P_2 - w = 0, \quad (\text{A.6})$$

and, because leisure is the numeraire, we have

$$w = P_2 = 1 \Rightarrow \pi_2 = 0. \quad (\text{A.7})$$

We then solve for the PMP of good 1 of the  $n$ th firm produced in the oligopolistic market as follows.<sup>1</sup> Let  $Q_1 = \sum_{n=1}^N q_{1n}$ , and, based on  $c(Q_1) \cdot Q_1 = w l_1$ , it is true that  $w \cdot \sum_{n=1}^N q_{1n}$  represents the total cost of producing good 1 and  $w \cdot q_{1n}$  represents firm  $n$ 's total cost to produce good 1. We therefore have the following:

$$\max_{q_{1n} \in \mathfrak{R}_+} \pi_{1n}(N) = \left[ \frac{\beta_1(w\bar{L} + \pi_1(N))}{\sum_{n=1}^N q_{1n}} \right] q_{1n} - w q_{1n}. \quad (\text{A.8})$$

Let the total quantity of the good produced on the oligopolistic market  $Q_1(N, \pi_1)$  be a function of the number of firms and the level of profits in the oligopolistic market, and, conversely, define the total profits in the noncompetitive market,  $\pi_1(N, Q_1)$ , as a function of the total quantity of the good produced in the oligopolistic market,  $Q_1$ . Then  $\pi_1(N, Q_1)$  should be treated as a fixed amount equal to  $\hat{\pi}_1$ , such that (A.8) becomes<sup>2</sup>

$$\max_{q_{1n} \in \mathfrak{R}_+} \pi_{1n}(N) = \left[ \frac{\beta_1(w\bar{L} + \hat{\pi}_1)}{\sum_{n=1}^N q_{1n}} \right] q_{1n} - w q_{1n}. \quad (\text{A.9})$$

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<sup>1</sup> The objective of the  $n$ th firm is to choose quantity  $(q_n)$  while taking  $\sum_{m \neq n} q_m$  as given.

<sup>2</sup>  $\pi(N)$  represents the total profits in the market of good 1, so that, if we assume symmetry, the profit generated for each firm is equivalent to  $\pi_{1n}(N) = \pi_1(N) / N \Rightarrow \pi_1(N) = N \pi_{1n}(N)$ .



After solving for the Cournot equilibrium, we give the first order condition for firm  $n$  in the market of good 1 by

$$\frac{\partial \pi_{1n}}{\partial q_{1n}} = \frac{\beta_1(w\bar{L} + \hat{\pi}_1) \cdot \left( \sum_{n=1}^N q_{1n} \right) - \beta_1(w\bar{L} + \hat{\pi}_1) \cdot q_{1n}}{\left( \sum_{n=1}^N q_{1n} \right)^2} - w = 0. \quad (\text{A.10})$$

Because all firms are assumed to be identical,  $N$  firms would produce the same level of output  $q_1 = q_2 = \dots = q_N$ . So, denoting the common level of output by  $q_{1n}$  for all  $n=1,2,\dots,N$  and solving for  $q_{1n}$  in the best-response function (A.10), we obtain the following:

$$q_{1n}(N, \hat{\pi}_1) = \frac{\beta_1(w\bar{L} + \hat{\pi}_1)(N-1)}{wN^2} \Rightarrow Q_1(N, \hat{\pi}_1) = \sum_{n=1}^N q_{1n} = \frac{\beta_1(w\bar{L} + \hat{\pi}_1)(N-1)}{wN}. \quad (\text{A.11})$$

The equilibrium price, the profit of each firm, and the total profits of the market are given, respectively, by

$$P(N) = \frac{wN}{N-1}, \quad (\text{A.12})$$

$$\pi_{1n}(N, \hat{\pi}_1) = \frac{\beta_1(w\bar{L} + \hat{\pi}_1)}{N^2}, \quad (\text{A.13})$$

$$\pi_1(N, \hat{\pi}_1) = \sum_{n=1}^N \pi_{1n} = \frac{\beta_1(w\bar{L} + \hat{\pi}_1)}{N}. \quad (\text{A.14})$$

Equalizing  $\pi_1(N, \hat{\pi}_1) = \hat{\pi}_1$  and solving for  $\hat{\pi}_1$ , we have the following:

$$\hat{\pi}_1 = \frac{\beta_1 w \bar{L}}{N - \beta_1}, \quad (\text{A.15})$$

using  $w=1$ ,  $L>0$ ,  $N>1$  and  $0<\beta_1<1 \Rightarrow \hat{\pi}_1>0$ .

So, substituting (A.15) in (A.12)–(A.14), we obtain the equilibrium quantity as a function of  $N$  as follows:

$$q_{1n}(N) = \frac{\beta_1 \bar{L}(N-1)}{N(N-\beta_1)} \Rightarrow Q_1(N) = \sum_{n=1}^N q_{1n} = \frac{\beta_1 \bar{L}(N-1)}{(N-\beta_1)}, \quad (\text{A.16})$$

and the corresponding equilibrium price and profits as a function of  $N$  are as follows:

$$P(N) = \frac{wN}{N-1}, \quad (\text{A.17})$$

$$\pi_{1n}(N) = \frac{\beta_1 w \bar{L}}{N(N-\beta_1)}, \quad (\text{A.18})$$

$$\pi_1(N) = \sum_{n=1}^N \pi_{1n} = \frac{\beta_1 w \bar{L}}{(N-\beta_1)}. \quad (\text{A.19})$$

From these results, the next proposition can be claimed:

**Proposition A.1.** *In a setting with endogenous income where consumers have a homogeneous level of productivity and  $P_0 > 0$ , the negative price effects of greater market concentration overcome the positive profit effects of firm ownership. So, the effect on the poverty index is nondecreasing so that  $\frac{\partial P_\alpha}{\partial N} \leq 0$ .*

Using the same assumptions as in the setting with exogenous income and with a distribution of shares of oligopolistic profit  $F(\theta)$  that lie at  $[\underline{\theta}, \bar{\theta}]$ , with  $\underline{\theta} \geq 0$  and  $f(\theta)$  as the associated density function, we obtain consumer  $j$ 's equivalent income as follows:

$$\omega_E^j = \frac{\omega^j R}{\prod_{i=1}^I P_i^{\beta_i}} \text{ with } \omega^j = w(L - x_3^j(w, \pi_1(N))) + \theta^j \pi_1(N). \quad (\text{A.20})$$

Substituting the demand for the good produced in the noncompetitive market,  $x_3^j(w, \pi(N))$ , from (A.3) and the profit level in the noncompetitive market,  $\pi_1(N)$ , from (A.19), we obtain

$$\omega_E^j = \frac{wR \left( L + \frac{\beta_1 \theta^j \bar{L}}{N - \beta_1} \right) (1 - \beta_3)}{\prod_{i=1}^I P_i^{\beta_i}}. \quad (\text{A.21})$$

Because  $w = P_2 = 1$ ,  $P_1(N) = \frac{wN}{N-1}$ ,  $\sum_{i=1}^3 \beta_i = 1$ , and  $0 < \beta_i < 1 \quad \forall i = 1, 2, 3$  and letting  $(1 - \beta_3) = \gamma$ , we find that (A.21) becomes

$$\omega_E^j = \frac{\gamma R \left( L + \frac{\beta_1 \theta^j \bar{L}}{N - \beta_1} \right)}{\left( \frac{N}{N-1} \right)^{\beta_1}}, \quad (\text{A.22})$$

with  $0 < \gamma < 1$ ,  $0 < \beta_1 < 1$  and  $\int_0^1 f(\theta) d\theta = 1$ .

Recall the continuous FGT measure and let  $F(\omega)$  and  $f(\omega)$  be the cumulative distribution function and the density function of the variable  $\omega$  induced by the random variable  $\theta$ . Given the arbitrary cutoff  $\bar{z}$  (where  $\omega_E \leq z$  are classified as living in poverty) and because  $\omega_E$  is monotonically increasing in  $\theta$ , there is a cutoff in the  $\theta$  space corresponding to  $\bar{z}$  which we call  $\eta$ , such that

$$z = \omega_E(r, p, \eta) \Leftrightarrow \eta = \eta(r, p, z). \quad (\text{A.23})$$

Substituting (A.23) in the continuous  $P_\alpha$  measure, we have

$$P_\alpha = \int_0^\eta \left( \frac{z_E - \omega_E(r, p, \theta)}{z_E} \right)^\alpha f(\theta) d\theta \Rightarrow \int_0^\eta \frac{\left[ z_E - \frac{\gamma R (L + (\beta_1 \theta \bar{L}) / (N - \beta_1))}{(N / (N - 1))^{\beta_1}} \right]^\alpha}{z_E^\alpha} f(\theta) d\theta. \quad (\text{A.24})$$

Taking the partial differentiation of (A.24) with respect to  $N$ , we obtain

$$\begin{aligned} \frac{\partial P_\alpha}{\partial N} &= \left[ \frac{-\alpha \gamma R \beta_1}{z_E \cdot \left( \frac{N}{N-1} \right)^{\beta_1}} \right] \cdot \int_0^\eta \left[ z_E - \frac{\gamma R \left( L + \frac{\beta_1 \theta \bar{L}}{N - \beta_1} \right)}{\left( \frac{N}{N-1} \right)^\beta} \right]^{\alpha-1} \\ &\quad z_E^{1-\alpha} \left[ \frac{\left( L + \frac{\beta_1 \theta \bar{L}}{N - \beta_1} \right)}{\frac{1}{N(N-1)}} - \frac{\theta \bar{L}}{(N - \beta_1)^2} \right] f(\theta) d\theta + \int_0^\eta \left[ z_E - \frac{\gamma R \left( L + \frac{\beta_1 \theta \bar{L}}{N - \beta_1} \right)}{\left( \frac{N}{N-1} \right)^\beta} \right]^\alpha f'(\theta) \frac{\partial \theta}{\partial N}. \end{aligned} \quad (\text{A.25})$$

From (A.25), if

$$\left[ \left( L + \frac{\beta_1 \bar{\theta} \bar{L}}{N - \beta_1} \right) \cdot \left( \frac{1}{N(N-1)} \right) - \frac{\bar{\theta} \bar{L}}{(N - \beta_1)^2} \right] > 0, \quad (\text{A.26})$$

because  $f'(\theta) \leq 0$ , that is, a nonincreasing function of the share of oligopolistic shares,  $\frac{\partial \theta}{\partial N} < 0$ , with  $\alpha = 0$ ,  $z_E > 0$ ,  $N \geq 2$ ,  $R > 0$ ,  $0 < \gamma < 1$ ,  $0 < \beta_1 < 1$ ,  $L > 0$ ,  $\bar{L} > 0$ , then, for  $\alpha = 0$ , we obtain  $\frac{\partial P_\alpha}{\partial N} \leq 0$ , which implies that greater market concentration has a nondecreasing effect on the poverty headcount ratio. (See box A.1 for the proof.)

In the case of higher order classes of poverty indicators, that is,  $\alpha > 0$ , with  $z_E > 0$ ,  $N \geq 2$ ,  $R > 0$ ,  $0 < \gamma < 1$ ,  $0 < \beta_1 < 1$ ,  $L > 0$ ,  $\bar{L} > 0$ , it is true that  $\frac{\partial P_\alpha}{\partial N} \leq 0$ . Thus, we may conclude that an increase in market power has negative effects on the depth of poverty, the severity of poverty, and other, higher order poverty indicators.

This result implies that, even with endogenous income, individuals with low or null shares of the total profits of firms that produce in an oligopolistic market are less well off as concentration increases in this market. In other words, in an economy where all the consumers have a homogeneous level of productivity, oligopoly pricing inefficiency overcomes the positive income effects of firm ownership among the poor, so that the poverty level rises. Whether there is any negative effect on the poverty headcount ratio depends on the impacts of the variation in market power at the poverty threshold.

From the comparative statics result of the model with exogenous income given in expression (22), we are able to observe only a negative price effect generated by market concentration. Meanwhile, from the comparative statics result of the model with endogenous income expressed in (A.25), we are able to separate the negative price effect of oligopoly from the positive profit effect of firm ownership. Given the values of the parameters, we are able to show that the negative price effect is greater than the positive profit effect.

#### Box A.1. Proof of Proposition A.1

From expression (A.25)

$$\frac{\partial P_\alpha}{\partial N} = \left[ \frac{-\alpha \gamma R \beta_1}{z_E \cdot \left( \frac{N}{N-1} \right)^{\beta_1}} \right] \cdot \int_0^\eta \left[ z_E - \frac{\gamma R \left( L + \frac{\beta_1 \bar{\theta} \bar{L}}{N - \beta_1} \right)}{\left( \frac{N}{N-1} \right)^{\beta_1}} \right]^{\alpha-1} \cdot z_E^{1-\alpha} \cdot \left[ \frac{\left( L + \frac{\beta_1 \bar{\theta} \bar{L}}{N - \beta_1} \right)}{\left( \frac{1}{N(N-1)} \right)} - \frac{\bar{\theta} \bar{L}}{(N - \beta_1)^2} \right] f(\theta) d\theta. \quad (\text{BA.1.1})$$

we wish to show that

$$\left[ \left( L + \frac{\beta_1 \bar{\theta} L}{N - \beta_1} \right) \cdot \left( \frac{1}{N(N-1)} \right) - \frac{\bar{\theta} L}{(N - \beta_1)^2} \right] > 0. \quad (\text{BA.1.2})$$

This expression can be reduced to

$$N^2(L - \bar{\theta} L) + N(\beta_1 \bar{\theta} L + \bar{\theta} L - 2\beta_1 L) + \beta_1^2(L - \bar{\theta} L). \quad (\text{BA.1.3})$$

It is true that  $\bar{L} = nL$ , where  $n$  is the number of consumers in the economy and  $n \geq 2$ . Hence,

$$NL(N - nN\theta + n\beta_1\theta + n\theta - 2\beta_1) + \beta_1^2(L - n\theta L). \quad (\text{BA.1.4})$$

Because  $\theta \in (0, 1/n]$ , the argument  $\beta_1^2(L - n\theta L)$  is nonnegative. So, we need to show that

$$N - nN\theta + n\beta_1\theta + n\theta - 2\beta_1 > 0. \quad (\text{BA.1.5})$$

Let  $g(N, \theta, \beta_1) = N - nN\theta + n\beta_1\theta + n\theta - 2\beta_1$ . Because this is a nondecreasing function in  $N$  and

$N \geq 2$ , it must be true that, if  $g(N, \theta, \beta_1) > 0$  for  $N = 2$ , then  $g(N, \theta, \beta_1) > 0$  for all  $N \geq 2$ .

So, for  $N = 2$ ,  $g(2, \theta, \beta_1) = 2 - n\theta + n\beta_1\theta - 2\beta_1 \Leftrightarrow g(2, \theta, \beta_1) = (2 - n\theta)(1 - \beta_1) > 0$ , with

$\theta \in (0, 1/n]$ ,  $n \geq 2$  and  $0 < \beta_1 < 1$ .

## Annex B. The model with endogenous income and a labor market with heterogeneous levels of productivity

This model assumes there are two representative consumers in the economy,  $j \in \{l, h\}$ . Each consumer is endowed with  $L > 0$  units of time. There are two consumption goods and leisure for each consumer and an associated price vector  $p = P_1, P_2, w^l, w^h$ . As before, good 1 is a homogeneous good produced in an oligopolistic market, while good 2 is produced in a competitive market. Both consumption goods are produced using a linear technology  $Q_i^j = l_i^j$ , and a unit of labor produces a unit of good,  $i$ . The utility function is the same as the one used previously. Consumers have heterogeneous levels of productivity such that  $Q_i^j = a^j l_i^j$  with  $j \in \{l, h\}$  and with  $0 < a^l < a^h$ . They own the firms and have different shares of the total profits, which are indexed by  $\theta^h$  and  $\theta^l$ , with  $0 < \theta^l < \theta^h < 1$  and  $\theta^h + \theta^l = 1$ .

The demand function for consumer  $j \in \{l, h\}$  for the  $i$ th consumption good and the corresponding aggregate demand function are given by

$$x_i^j(p, w, \pi(N)) = \frac{\beta_i(Lw^j + \theta^j \pi(N))}{P_i}, \quad (\text{B.1})$$

$$X_i(p, w, \pi(N)) = \frac{\beta_i(L(w^l + w^h) + \pi(N))}{P_i}. \quad (\text{B.2})$$

The PMP for good 2, which is produced in a competitive market, can be expressed as

$$\max_{l_2^j \in [0, L]} \pi_2 = (P_2 a^l - w^l) l_2^l + (P_2 a^h - w^h) l_2^h. \quad (\text{B.3})$$

The corresponding first order conditions are

$$\frac{\partial \pi_2}{\partial l_2^l} = P_2 a^l - w^l = 0, \quad (\text{B.4})$$

$$\frac{\partial \pi_2}{\partial l_2^h} = P_2 a^h - w^h = 0. \quad (\text{B.5})$$

Taking good 2 as the numeraire, we have the following:

$$P_2 = 1 \Rightarrow w^l = a^l, w^h = a^h \Rightarrow \pi_2 = 0. \quad (\text{B.6})$$

The PMP for good 1 of the  $n$ th firm (produced in the oligopolistic market) is

$$\max_{q_{1n} \in \mathfrak{R}_+} \pi_{1n}(N) = P_1(q_{1n}^l + q_{1n}^h) - \frac{w^l}{a^l} q_{1n}^l - \frac{w^h}{a^h} q_{1n}^h \quad (\text{B.7})$$

because all firms are identical (that is,  $q_{1n}^l = \frac{Q_1^l}{N} = \frac{a^l l_1^l}{N}$ ,  $q_{1n}^h = \frac{Q_1^h}{N} = \frac{a^h l_1^h}{N}$ ).

From good 2's PMP, we know it is true that  $w^l = a^l$ ,  $w^h = a^h$  and  $q_{1n} = q_{1n}^l + q_{1n}^h$ , which implies that  $\sum_{n=1}^N q_{1n} = \sum_{n=1}^N q_{1n}^l + \sum_{n=1}^N q_{1n}^h$ . So, the PMP in (B.7) becomes

$$\max_{q_{1n} \in \mathfrak{R}_+} \pi_{1n}(N) = \left[ \frac{\beta_i(L(w^l + w^h) + \pi_1(N))}{\sum_{n=1}^N q_{1n}} - 1 \right] q_{1n}. \quad (\text{B.8})$$

Treating  $\pi_1(N, Q_1)$  as a fixed amount equal to  $\hat{\pi}_1$ , we find that good 1's PMP in (B.8) becomes

$$\max_{q_{1n} \in \mathfrak{R}_+} \pi_{1n}(N) = \left[ \frac{\beta_i(L(w^l + w^h) + \hat{\pi}_1)}{\sum_{n=1}^N q_{1n}} - 1 \right] q_{1n}. \quad (\text{B.9})$$

Solving for the Cournot equilibrium, we obtain the first order condition for the  $n$ th firm in the market of good 1 in the noncompetitive market as

$$\frac{\partial \pi_{1n}}{\partial q_{1n}} = \frac{\beta_1(L(w^l + w^h) + \hat{\pi}_1) \left( \sum_{n=1}^N q_{1n} \right) - \beta_1(L(w^l + w^h) + \hat{\pi}_1) q_{1n}}{\left( \sum_{n=1}^N q_{1n} \right)^2} - 1 = 0. \quad (\text{B.10})$$

Assuming a symmetric equilibrium, we find the quantity of good 1 produced by firm  $n$  and the total quantity of good 1 as a function of  $N$  are

$$q_{1n}(N, \hat{\pi}_1) = \frac{\beta_1(L(w^l + w^h) + \hat{\pi}_1)(N-1)}{N^2} \Rightarrow Q_1(N, \hat{\pi}_1) = \frac{\beta_1(L(w^l + w^h) + \hat{\pi}_1)(N-1)}{N}, \quad (\text{B.11})$$

and the corresponding equilibrium price and profits as a function of  $N$  are

$$P(N) = \frac{N}{N-1}, \quad (\text{B.12})$$

$$\pi_{1n}(N, \hat{\pi}_1) = \frac{\beta_1(L(w^l + w^h) + \hat{\pi}_1)}{N^2}, \quad (\text{B.13})$$

$$\pi_1(N, \hat{\pi}_1) = \frac{\beta_1(L(w^l + w^h) + \hat{\pi}_1)}{N}. \quad (\text{B.14})$$

Equalizing  $\pi_1(N, \hat{\pi}_1) = \hat{\pi}_1$ , we obtain

$$\hat{\pi}_1 = \frac{\beta_1(L(w^l + w^h) + \hat{\pi}_1)}{N}. \quad (\text{B.15})$$

Solving the above, we have

$$\hat{\pi}_1 = \frac{\beta_1 L(w^l + w^h)}{N - \beta_1} \quad (\text{B.16})$$

and using  $L > 0$ ,  $N > 1$  and  $0 < \beta_1 < 1 \Rightarrow \hat{\pi}_1 > 0$ .

Substituting (B.16) in (B.11)–(B.14), we obtain the equilibrium quantities, price, and profits as a function of  $N$  as follows:

$$q_{1n}(N) = \frac{\beta_1 L(w^l + w^h)(N-1)}{N(N-\beta_1)} \Rightarrow Q_1(N) = \frac{\beta_1 L(w^l + w^h)(N-1)}{(N-\beta_1)}, \quad (\text{B.17})$$

$$P(N) = \frac{N}{N-1}, \quad (\text{B.18})$$

$$\pi_{1n}(N) = \frac{\beta_1 L(w^l + w^h)}{N(N-\beta_1)}, \quad (\text{B.19})$$



$$\pi_1(N) = \sum_{n=1}^N \pi_{1n} = \frac{\beta_1 L(w^l + w^h)}{(N - \beta_1)}. \quad (\text{B.20})$$

From these results, we are able to establish the following proposition.

**Proposition B.1.** *In a setting with endogenous income where consumers exhibit heterogeneous levels of productivity and  $P_0 > 0$ , if the share of the oligopolistic profits of low-income consumers is sufficiently large and if there is a significant productivity gap between less and more highly skilled workers, then there is a range in market concentration for which the poverty index is nonincreasing as market concentration increases, so that  $\frac{\partial P_\alpha}{\partial N} \geq 0$ .*

Consumer  $j$ 's equivalent income is given by

$$\omega_E^j = \frac{R \left( w^j L + \frac{\beta_1 \theta^j L(w^l + w^h)}{N - \beta_1} \right) (1 - \beta_3)}{\prod_{i=1}^I P_i^{\beta_i}}, \quad (\text{B.21})$$

and, because  $w^l = a^l$ ,  $w^h = a^h$ ,  $P_2 = 1$ ,  $P_1(N) = \frac{N}{N-1}$ ,  $\sum_{i=1}^3 \beta_i = 1$  and  $0 < \beta_i < 1 \ \forall i$ , and, letting  $(1 - \beta_3) = \gamma$ , we find that (B.21) becomes

$$\omega_E^j = \frac{\gamma R L \left( w^j + \frac{\beta_1 (a^l + a^h) \theta^j}{N - \beta_1} \right)}{\left( \frac{N}{N-1} \right)^{\beta_1}}, \quad (\text{B.22})$$

with  $0 < \gamma < 1$ ,  $0 < \beta_1 < 1$ ,  $0 < \theta^l < \theta^h < 1$  and  $\theta^l + \theta^h = 1$ .

Substituting (B.22) into the discrete FGT index, we have

$$P_\alpha = \frac{1}{n} \sum_{j=1}^q \left( \frac{z_E - \omega_E^j}{z_E} \right)^\alpha \Rightarrow P_\alpha = \frac{\left[ z_E - \gamma R L \left( a^l + \frac{\beta_1 (a^l + a^h) \theta^l}{N - \beta_1} \right) \cdot \left( \frac{N}{N-1} \right)^{-\beta_1} \right]^\alpha}{2 z_E^\alpha}, \quad (\text{B.23})$$

where  $\omega_E^h > z_E > \omega_E^l$  for all  $N$ , and only the low-income consumer is living below the poverty line.

Taking the partial differentiation of (A2.23) with respect to  $N$ , we have

$$\frac{\partial P_\alpha}{\partial N} = \left( \frac{-\alpha \gamma L R \beta_1}{2z_E \cdot \left( \frac{N}{N-1} \right)^{\beta_1}} \right) \cdot \left[ z_E - \frac{\gamma R L \left( a^l + \frac{\beta_1(a^l + a^h)\theta^l}{N - \beta_1} \right)}{\left( \frac{N}{N-1} \right)^{\beta_1}} \right]^{\alpha-1} \cdot z_E^{1-\alpha} \cdot \left[ \frac{\left( a^l + \frac{\beta_1(a^l + a^h)\theta^l}{N - \beta_1} \right)}{\left( \frac{1}{N(N-1)} \right)} - \frac{(a^l + a^h)\theta^l}{(N - \beta_1)^2} \right] \quad (\text{B.24})$$

where the sign of  $\frac{\partial P_\alpha}{\partial N}$  depends on the sign of

$$\left[ \frac{\left( a^l + \frac{\beta_1(a^l + a^h)\theta^l}{N - \beta_1} \right)}{\left( \frac{1}{N(N-1)} \right)} - \frac{(a^l + a^h)\theta^l}{(N - \beta_1)^2} \right]. \quad (\text{B.25})$$

There are two possible cases.

*Case 1:*

If  $\theta^l \leq \frac{a^l}{a^l + a^h}$ , then  $\frac{\partial P_\alpha}{\partial N} \leq 0$  for all  $N \geq 2$ .

*Case 2:*

If  $\frac{a^l}{a^l + a^h} < \theta^l < \frac{1}{2}$ , then  $\exists A \subset \mathbb{N}$  s.t.  $A = \{a : a \geq [\tilde{N}] + 1\}$ , for which  $\frac{\partial P_\alpha}{\partial N} \geq 0$ , where  $\tilde{N}$  is a positive number such that  $\left[ \left( a^l + \frac{\beta_1(a^l + a^h)\theta^l}{\tilde{N} - \beta_1} \right) \cdot \left( \frac{1}{\tilde{N}(\tilde{N} - 1)} \right) - \frac{(a^l + a^h)\theta^l}{(\tilde{N} - \beta_1)^2} \right] = 0$ .

In both cases, with  $0 < a^l < a^h$ ,  $0 \leq \theta^l < \frac{1}{2}$ ,  $\alpha > 0$ ,  $N \geq 2$ ,  $0 < \gamma, \beta_1 < 1$ ,  $L > 0$ ,  $z_E \geq 0$ ,  $R > 0$ . (See box B.1 for the proof.)

The intuition is as follows. In case 1, as the productivity gap between highly skilled and less highly skilled workers converges toward zero (that is,  $a^l \rightarrow a^h$ ), which is similar to the case if the level of productivity is homogeneous, or the share of the oligopolistic profits of a low-productivity worker approaches zero, the result established in proposition B.1 holds (that is, the negative price effect dominates the positive profit effect of firm ownership), and greater market concentration therefore increases the poverty gap, poverty severity, and other poverty indicators with substantial sensitivity to people in the bottom of the distribution. The effects on the poverty headcount ratio depend on the density distribution just above of the poverty rate and the variation in market power in the relative incomes of these households.

In case 2, because the share of the oligopolistic profits of low-income consumers is sufficiently large (close to half) and because there is a significant productivity gap between less and more highly skilled workers such that the labor income of the low-income consumer is small with respect to the firm ownership income, a drop in the number of firms that compete in the market for a homogeneous good may reduce poverty indicators in which the  $\alpha$  parameter is greater than zero (the poverty gap, poverty severity, and so on). Whether there is any reduction in the poverty headcount depends on the effects, at the margin, of greater market concentration with respect to the households only slightly under the poverty line.

### Box B.1 Proof of Proposition B.1

The proof of case 2 (that is,  $a^l / (a^l + a^h) < \theta^l < 1/2$ ) in proposition B.1 follows directly from the proof of proposition A.1 in annex A.

From expression (B.24), we want to show that, if  $\frac{a^l}{a^l + a^h} < \theta^l < \frac{1}{2}$ , there exists a set of positive integers

$$A = \text{INT} \{N \geq 2\}, \quad (\text{BB.1.1})$$

for which  $\frac{\partial P_\alpha}{\partial N} > 0$ , that is,

$$\left[ \left( a^l + \frac{\beta_1(a^l + a^h)\theta^l}{N - \beta_1} \right) \cdot \left( \frac{1}{N(N-1)} \right) - \frac{(a^l + a^h)\theta^l}{(N - \beta_1)^2} \right] < 0. \quad (\text{BB.1.2})$$

This expression can be reduced to

$$h(N) = N^2(a^l - (a^l + a^h)\theta^l) + N(\beta_1(a^l + a^h)\theta^l + (a^l + a^h)\theta^l - 2\beta_1 a^l) + \beta_1^2(a^l - (a^l + a^h)\theta^l) \quad (\text{BB.1.3})$$

where  $(a^l - (a^l + a^h)\theta^l) < 0$  and  $(\beta_1(a^l + a^h)\theta^l + (a^l + a^h)\theta^l - 2\beta_1 a^l) > 0$  because  $0 < \beta_1 < 1$

and  $\frac{a^l}{a^l + a^h} < \theta^l < \frac{1}{2}$ ; so,  $h(N)$  is an inverted parabola.

Differentiating (BB.1.3) with respect to  $N$  and equalizing it to zero, we may obtain the global maximum of the inverted parabola, as follows:

$$\begin{aligned} \frac{\partial h(N)}{N} &= 2N(a^l - (a^l + a^h)\theta^l) + (\beta_1(a^l + a^h)\theta^l + (a^l + a^h)\theta^l - 2\beta_1 a^l) = 0 \\ \Rightarrow N^* &= \frac{-(\beta_1(a^l + a^h)\theta^l + (a^l + a^h)\theta^l - 2\beta_1 a^l)}{2(a^l - (a^l + a^h)\theta^l)} > 0 \text{ since } \frac{a^l}{a^l + a^h} < \theta^l < \frac{1}{2}. \end{aligned} \quad (\text{BB.1.4})$$

Hence, the maximum of  $h(N)$  is always characterized by a positive value of  $N^*$ .

Next, we need to show that the roots of  $h(N)$  are real, which implies that there exists at least a positive value  $\tilde{N}$  s.t.  $h(\tilde{N})=0$ . So, by the quadratic formula, the roots of  $h(N)$  can be characterized as follows:

$$\begin{aligned} N &= \frac{[\beta_1(a^l + a^h)\theta^l + (a^l + a^h)\theta^l - 2\beta_1 a^l]}{2[(a^l + a^h)\theta^l - a^l]} \pm \\ &\quad \frac{\sqrt{[\beta_1(a^l + a^h)\theta^l + (a^l + a^h)\theta^l - 2\beta_1 a^l]^2 - 4\beta_1^2 [a^l - (a^l + a^h)\theta^l]^2}}{2[a^l - (a^l + a^h)\theta^l]}. \end{aligned} \quad (\text{BB.1.5})$$

It is true that

$$\frac{[\beta_1(a^l + a^h)\theta^l + (a^l + a^h)\theta^l - 2\beta_1 a^l]}{2[(a^l + a^h)\theta^l - a^l]} > 0. \quad (\text{BB.1.6})$$

So, if the determinant of  $h(N)$  is positive, then at least one of the roots of  $h(N)$  must be positive.

This determinant can be transformed to the function

$$f(\beta_1) = \frac{4a^l}{(a^l + a^h)\theta^l} \cdot \beta_1 \cdot (\beta_1 - 1) + 2\beta_1 \left(1 - \frac{3}{2}\beta_1\right) + 1, \quad (\text{BB.1.7})$$

which is strictly positive because  $0 < \frac{4a^l}{(a^l + a^h)\theta^l} < 4$  and  $0 < \beta_1 < 1$ . Hence, there exists a positive

value  $\tilde{N}$  s.t.  $h(\tilde{N}) = 0$ .

Then, because the maximum of  $h(N)$  is always defined by a positive value of  $N$  and the coefficients that characterize  $h(N) = 0$  are real numbers, this guarantees the existence of  $A \subset \mathbb{N}$  s.t.

$A = \{a : a \geq [\tilde{N}] + 1\}$  for which  $h(N)$  becomes negative, and, so,  $\frac{\partial P_\alpha}{\partial N} > 0$  for  $\alpha > 0$ .

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