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On Taxation Policy in Strategic Bilateral Exchange: A review*

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Abstract

This paper provides a comprehensive review of the literature on tax policy within the framework of strategic market games (SMG). We refer to a simple prototype of SMGs called bilateral oligopoly models. The review reveals that the effects and effectiveness of redistributive tax policies depend on the preferences of individuals who behave strategically in trade. A crucial element of this analysis is the influence of strategic interactions on the price formation mechanism and, therefore, on the optimality of a tax-and-transfer policy to improve allocation efficiency. Then, we connect our findings to broader discussions in the literature, specifically regarding the effects of taxation on general and partial equilibrium (tax incidence: ad valorem versus per unit taxes; optimal taxation and market power; market imperfections, strategic interactions, and taxation). Although the comparison remains conceptually complicated, we show the complementarity of the diverse literature.

Keywords: Imperfect competition, Market power, Strategic market game, Tax policy.

JEL Classification: C72, D43, D51, H22

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1 Introduction

Market power is a key economic issue and is important in public policy design. Market power creates inefficiencies in resource allocation, resulting in a deadweight loss and reduced welfare. Taxation is seen as a potentially effective tool for correcting these inefficiencies.[1] The literature on taxation, following Ramsey (1927), initially focused on the perfectly competitive market (Mirrlees 1971; Atkinson and Stiglitz 1976). For instance, Mirrlees (1971) shows that optimal taxation should focus on income rather than goods taxation, which minimizes economic distortions. Some works have linked Mirrlees' theoretical analysis to the data by studying the effect of tax reforms on equity and efficiency (Piketty 1997; Saez 2001). More recent work has analyzed taxation in a context where market failures (information asymmetries, externalities, imperfect competition) are possible (Lewis and Winkler, 2015; Etro 2018; Kaplow, 2021; Eeckhout et al., 2021; Gürer, 2022). For example, Kaplow (2021) analyzes how significant market power and the presence of rents influence optimal income taxation. He shows that correcting non-proportional margins can improve welfare. Besides, Gürer (2022) looks at the effects of increasing margins on the optimal taxation of profit and income. He shows that increasing taxes on profits to reinforce redistribution while reducing taxation on labor income maximizes total welfare.[2]

In this paper, we review the literature devoted to tax policy in the framework of a bilateral oligopoly. The bilateral oligopoly models were introduced by Gabszewicz and Michel (1997), and further developed by Bloch and Ghosal (1997), Dickson and Hartley (2008), Amir and Bloch (2009) and Busetto et al. (2020). This model describes an exchange economy with two commodities and two types of traders divided into two sectors with a finite number of traders on each side. Each type of trader has *corner endowments* but wants to consume both commodities. Thus, each agent decides the amount of the good s/he owns to put up in exchange for the other commodity. Given a vector of offers, the market aggregates *all bids* via a trading post, then determines the market-clearing price.[3] The bilateral oligopoly model is a simple prototype of a strategic market game. The strategic market games were introduced by Shapley (1976) and Shapley and Shubik (1977) and further developed by Amir et al. (1990) and Sahi and Yao (1989).

[1]Taxation is not only an instrument for the government to collect revenues but also an instrument of fiscal policy to influence the agents' behavior. Taxation policy (i) serves to correct externalities (Pigou, 1920; Sandmo, 1975), (ii) serves to finance public expenditure to redistribute resources (Ramsey, 1927; Mirrlees, 1971), and (iii) reduces distortions in the context of imperfect competition (Guesnerie and Laffont, 1978; Myles, 1989).

[2]Other examples include Coto-Martinez et al. (2007) and Etro (2018), who respectively analyze the effects of capital and labor income taxation, taking into account distortions related to competition and firm entry.

[3]The bilateral oligopoly model can be applied in several economic environments. For example, spatial economics, international trade, digital markets, communication networks, and two-sided markets with differentiated products, such as mobile telephony markets.

The main motivation for studying taxation in a bilateral strategic exchange framework is twofold. First, tax policies play a dual role (resource collection and redistribution), and the effects and effectiveness of these redistributive tax policies depend on the preferences of individuals who behave strategically in trade. Secondly, unlike the literature mentioned above, where strategic interaction is modeled at a sectoral level, in a bilateral oligopoly model, strategic interaction occurs between and within sectors: strategic interaction is intra- and inter-sectoral (see Giraud (2003) and Dickson and Tonin (2021) for a survey). We start our analysis by synthetically presenting the general framework of strategic market games and the bilateral oligopoly models derived from them. We discuss the existence and inefficiency of the Nash equilibrium and present some comparative statics results. Next, we study the public policies proposed in the literature to correct market failures. In particular, we analyze various taxation policies and show they do not always lead to the first-best optimum. Finally, we discuss how our study relates to the literature that deals with the general and partial equilibrium effects of tax policy. Our paper speaks to three strands: (i) a comparison between ad valorem and per unit taxation, (ii) optimal taxation and market power, and (iii) market imperfections, strategic interactions, and taxation.

This paper is organized as follows. In Section 2, we present the general framework on which bilateral oligopoly models are based. We focus on the existence and nonoptimality of a Cournot-Nash equilibrium. Then, we examine the effectiveness of tax policies in Section 3. In Section 4, we discuss how our study relates to the literature that deals with the general and partial equilibrium effects of tax policy. In Section 5, we discuss some possible extensions. In Section 6, we conclude.

2 From strategic market games to bilateral oligopoly

Two main approaches have introduced strategic interactions into the general equilibrium framework *à la Arrow-Debreu*. The first is the model of Gabszewicz and Vial (1972), where they introduced the concept of *Cournot-Walras equilibrium*. In this model, some agents behave strategically *à la Cournot* and a large number of agents behave competitively *à la Walras*.[4] This model is initially based on a Walrasian market price mechanism and aims to study the consequences of market power within interrelated markets. However, two problems emerge from this approach: the problem of profit maximization and the problem of price normalization. Profit maximization may not be seen as a rational decision criterion for agents able to manipulate prices, as it would lead to neglecting alternative strategies that would achieve higher levels of utility for

[4]See also Roberts and Sonnenschein (1977), Roberts (1980), Dierker and Grodal (1999) and Mas-Colell (1982) for a model of an exchange economy with production and Codognato and Gabszewicz (1991), d'Aspremont et al. (1997) and Julien and Tricou (2005) for a pure exchange economy.

shareholders.[5] Some models have been developed in the vein of this approach, but for a pure exchange economy due to two related challenges mentioned above (see Codognato and Gabszewicz (1991) for the seminal paper). More specifically, Codognato and Gabszewicz (1991) show that the Cournot-Walras equilibrium converges by replication towards the Walrasian equilibrium. Besides, Julien and Tricou (2005) extend the asymmetric Cournot-Walras equilibrium à la *Codognato–Gabszewicz* to the case of symmetric behavior. This approach is important for three reasons for these authors: a. it respects the symmetry between agents and markets; b. it leads to differentiated behavior for each trader; c. it considers that each set of traders has a unique good, which echoes the idea of specialization.

The second approach to introduce strategic interactions in general equilibrium is the *strategic market game* originally introduced by Shapley (1976) and Shapley and Shubik (1977) and further developed by Amir et al. (1990) and Sahi and Yao (1989). This approach models the decentralization of exchanges in the sense that there is no auctioneer. This model describes a symmetric oligopoly since *all* traders are strategic. The theory of strategic market games (SMG) examines the interaction between individuals in an economy and the impact of their behavior on fundamental macro-variables such as prices, income distribution, volume of trade, and velocity of money (Giraud, 2003).

We present in the following section a synthetic overview of the three main classes of strategic market game models, namely Shapley and Shubik's (1997) model, the Amir et al. (1990) model, and the Sahi and Yao (1989) model.

2.1 Three main classes of strategic market game

We now present the three main kinds of strategic market games (Shapley and Shubik, 1977; Amir et al., 1990 and Sahi and Yao, 1989).

2.1.1 Shapley and Shubik (1977) model

In a series of articles published in the 1970s, Shapley and Shubik (1977) unveiled a new concept of games: strategic market games. This new concept promotes a decentralization of exchanges in which prices adjust according to traders' actions. In this model, the economy includes n agents and L goods, with L being the commodity money. Agents' preferences are represented by an increasing, continuous, and concave utility function $u^i = u^i(x_1^i, \ldots, x_{L-1}^i, x_L^i)$. For each good $k = 1, \ldots, L-1$, there is a trading post. The good L representing the commodity money is considered as the currency. q_k^i and b_k^i represent, respectively, the quantities of good k that the trader is willing to give for sale and the quantity of money that he would be willing to pay for the purchase of good k. We denote by w_k^i the initial endowments of individuals,

[5] See Bonanno (1990) for a discussion and Mas-Colell (1981) and Neary (2003) for an alternative approach.

with $w^i_k = (w^i_1, w^i_2, \ldots, w^i_L)$. The price of the good k is given by:

$$p_k = \frac{B_k}{Q_k}. \tag{1}$$

where $B_k = \sum_i b^i_k$ represents the supply of money "placed" on the post of exchange k and $Q_k = \sum_i q^i_k$ the sum of the offers of the good k. The player's final allocation is given by:

$$x^i_k = w^i_k - q^i_k + \frac{b^i_k}{p_k}. \tag{2}$$

The corresponding allocation is given by:

$$x^i_L = w^i_k - \sum_{k=1}^{L-1} (q^i_k - q^i_k p_k). \tag{3}$$

Prices are determined by supply and demand on all markets, with the good L as an intermediary in trade. Nevertheless, the model introduced by Shapley and Shubik (1977) can lead to a bank failure insofar as the economy does not have enough currency.[6]

2.1.2 Amir et al. (1990) model

In the model of Shapley and Shubik (1977), the commodity money is used as an intermediate in trade. So, only commodity money may be used to buy other commodities. In the Amir et al. (1990) model, any commodity can be used to buy other commodities. In this model, we consider an exchange economy with at least two goods, two traders, and one trading post for each pair of goods. Assume two goods k and l; the relative price of good k to good l is denoted by p_{kl}. So, unlike Shapley and Shubik (1977), to determine the relative price p_{kl}, we are only interested in what happens on the exchange post (k, l) or on the market of goods k and l. We will obtain the following relation:

$$p_{kj} p_{lk} \neq p_{lk}. \tag{4}$$

The idea of such a mechanism is that if a third good is introduced into the economy, the relative price between two goods at one trading post can be affected if transiting through two other trading posts. With the introduction of a third good, the transitivity of exchange prices on each of the two posts between this last good and the first two goods leads to inconsistency. To overcome the price inconsistency problem identified by Amir et al. (1990), a pricing mechanism should be introduced, the basic idea of which is to ensure that the determination of each relative price depends on all transactions between the different commodity pairs.

[6]The introduction of money in the model allows both the reduction of transaction costs and the informational asymmetry in trade. Indeed, introducing money into the model leads to a limitation in the number of transactions.

2.1.3 Sahi and Yao (1989) model

Consider an exchange economy with at least two goods and two traders. The model of Sahi and Yao (1989) is based on a bid price rule. In this model, trade is centralized by a "clearing house," which determines prices via trading posts using the following equations:

$$\sum_{k=1}^{L}\left(\sum_{i=1}^{N}\alpha_{kl}^{i}p_k\right) = p_l\sum_{k=1}^{L}\left(\sum_{i=1}^{N}\alpha_{lk}^{i}\right), \quad l = 1, \ldots, L \tag{5}$$

where α_{lk}^{i} represents the supply or amount of commodity l that agent i offers on the market in exchange for commodity k. The universe of each trader type i is an $L \times L$ matrix. Assume two goods k and l; the relative price of good k to good l is denoted by p_{kl}. The relative price p_{kl} and all relative prices of all other goods are modified when the quantity of good k offered by an agent to acquire good l is changed. The final allocation can be described as follows:

$$x_l^i = w_l^i + \frac{1}{p_l}\sum_{k=1}^{L}p_k\alpha_{kl}^{i} - \sum_{k=1}^{L}\alpha_{lk}^{i}. \tag{6}$$

Then the agent's allocation l will be equal to the sum of its initial endowment and its net demand for good l; otherwise, allocation is equal to the difference between the quantity of good l obtained by disposing of all other goods and the quantity of good l offered to acquire the other goods. The value of the supply must be equal to everything offered in the market.

The impact of strategic behavior on price formation is a key issue, and strategic market games (SMG) provide a sophisticated framework that effectively captures both aspects. In the next section, we introduce a simple prototype of strategic market games called *bilateral oligopoly models.*

2.2 Bilateral oligopoly models

The bilateral oligopoly model is a simple prototype of strategic market games. However, when the economy includes two goods and two types of agents who have corner endowments, all three main classes of strategic market games (Shapley and Shubik, 1977; Amir et al., 1990 and Sahi and Yao, 1989) are equivalent. The bilateral oligopoly model was introduced by Gabszewicz and Michel (1997) and further developed by Bloch and Ghosal (1997), Dickson and Hartley (2008), Amir and Bloch (2009) and Busetto et al. (2020).

The bilateral oligopoly model describes an exchange economy with two goods and two types of agents divided into two market sides. In this exchange economy, each type of agent is endowed with one good but wants to consume both goods. In this model, all agents behave strategically.[7] A non-cooperative game in which simultaneous decisions are associated with this exchange economy. The players are the traders, the strategies are the quantities offered, and

[7] A trader from one class can manipulate the whole price vector via their supply.

the payments are the utility levels achieved after the exchange. Thus, each agent decides how much of a good, or what fraction of its endowment, to trade on the market to acquire the other good, to maximize its utility. There is a trading post that aggregates all the agents' offers and allocates the amounts exchanged to each agent in proportion to its offer. The resulting equilibrium is a non-cooperative equilibrium, i.e., a Cournot-Nash equilibrium (CNE thereafter).

2.2.1 Cournot Nash Equilibrium: definition and example

Consider an exchange economy, $\mathcal{E}$, with two commodities X and Y, and including *2n* agents, falling into two sectors, with $n \geq 2$ on each side, where $4 \leq n < \infty$. Let p_X(resp p_Y) be the unit price of commodity X (resp. Y), with $p_Y = 1$. Traders type 1 are indexed by $i \in \mathcal{I}_1$, and traders type 2 by $i \in \mathcal{I}_2$. Let $\mathcal{I}_1$ and $\mathcal{I}_2$ be the set of agents type 1 and 2 respectively, with $\mathcal{I}_1 = \{1, \ldots, n\}$ and $\mathcal{I}_2 = \{n+1, \ldots, 2n\}$, where $\mathcal{I}_1 \cap \mathcal{I}_2 = \emptyset$. We denote by $u_i(x_i, y_i) : \mathbb{R}^2_+ \to \mathbb{R}$ the utility function of each type of agent, which represents their preference relation among the commodity bundles. The endowments are given by:

$$w_i = \begin{cases} (\alpha_i, 0), & i \in \mathcal{I}_1; \\ (0, \alpha_i), & i \in \mathcal{I}_2, \end{cases} \tag{7}$$

where $\alpha_i > 0$. To this exchange economy, we associate a bilateral oligopoly game Γ. Then, in the game Γ, a player's strategy consists of an offer of only a fraction of the commodity they initially hold. Each type of agent decides the amount of the commodity it wants to offer in exchange for acquiring the other good. Each trader type 1 (resp. 2) decides on the amount q_i (resp. b_i) of the commodity X (resp. Y) s/he wants to offer in exchange for the commodity Y (resp. X). The strategies of each type of trader are given by:

$$\mathcal{Q}_i = \{q_i \in \mathbb{R}_+ : 0 \leq q_i \leq \alpha_i\}, \quad i \in \mathcal{I}_1; \tag{8}$$

$$\mathcal{B}_i = \{b_i \in \mathbb{R}_+ : 0 \leq b_i \leq \alpha_i\}, \quad i \in \mathcal{I}_2. \tag{9}$$

Let $\mathbf{q} = (q_1, \ldots, q_i, \ldots q_n)$ and $\mathbf{b} = (b_{n+1}, \ldots, b_i, \ldots, b_{2n})$. Given a 2n-tuple of strategies $(\mathbf{q},\mathbf{b}) \in \mathcal{Q} \times \mathcal{B}$ with $\mathcal{Q} = \prod_{i=1}^{n} \mathcal{Q}_i$ and $\mathcal{B} = \prod_{i=n+1}^{2n} \mathcal{B}_i$, the market aggregates the offers of *all* agents and determines the relative price. The relative price of the commodity is defined as the ratio of the total bids $B = \sum_{k \in \mathcal{I}_2} b_k$ over total offers $Q = \sum_{k \in \mathcal{I}_1} q_k$,

$$p_X(\mathbf{q},\mathbf{b}) = \begin{cases} \frac{\sum_{k \in \mathcal{I}_2} b_k}{\sum_{k \in \mathcal{I}_1} q_k}, & \text{if } \; B > 0 \; \text{ and } \; Q > 0; \\ 0, \; \text{ if } \; B = 0 \; \text{ and } \; Q = 0 \end{cases} \tag{10}$$

When trade takes place, each type of agent receives a proportional share of the total amount offered on the market. Taking into account the relative price given by (10), the allocation of each type of trader is given by: $(x_i, y_i) =$

$(\alpha_i - q_i, p_X q_i)$, for trader type 1 and by $(x_i, y_i) = (\frac{1}{p_X} b_i, \alpha_i - b_i)$, for trader type 2, which can be rewritten as follows:

$$(x_i, y_i) = \left(\alpha_i - q_i, \frac{\sum_{k\in\mathcal{I}_2} b_k}{\sum_{k\in\mathcal{I}_1} q_k} q_i\right), i \in \mathcal{I}_1; \tag{11}$$

$$(x_i, y_i) = \left(\frac{\sum_{k\in\mathcal{I}_1} q_k}{\sum_{k\in\mathcal{I}_2} b_k} b_i, \alpha_i - b_i\right), i \in \mathcal{I}_2. \tag{12}$$

The payoffs defined by $\pi_i(q_i, q_{-i}; b) = u_i(\alpha_i - q_i, p_X q_i)$, for trader $i \in \mathcal{I}_1$ and by $\pi_i(b_i, b_{-i}; q) = u_i(\frac{1}{p_X} b_i, \alpha_i - b_i)$, for trader $i \in \mathcal{I}_2$, can be rewritten as follows:

$$\pi_i(q_i, q_{-i}, b) = u_i\left(\alpha_i - q_i, \frac{\sum_{k\in\mathcal{I}_2} b_k}{\sum_{k\in\mathcal{I}_1} q_k} q_i\right), i \in \mathcal{I}_1; \tag{13}$$

$$\pi_i(q, b_i, b_{-i}) = u_i\left(\frac{\sum_{k\in\mathcal{I}_1} q_k}{\sum_{k\in\mathcal{I}_2} b_k} b_i, \alpha_i - b_i\right), i \in \mathcal{I}_2. \tag{14}$$

Definition. The strategy profile $(\tilde{\mathbf{q}}, \tilde{\mathbf{b}}) \in \prod_{i=1}^{n} \mathcal{Q}_i \times \prod_{i=n+1}^{2n} \mathcal{B}_i$, is a Cournot-Nash equilibrium of the game Γ, if for each trader $i \in \mathcal{I}_1$, $\pi_i(\tilde{q}_i, \tilde{\mathbf{q}}_{-i}, \tilde{\mathbf{b}}) \geq \pi_i(q_i, \tilde{\mathbf{q}}_{-i}, \tilde{\mathbf{b}})$, $\forall q_i \in \mathcal{Q}_i$, and for each trader $i \in \mathcal{I}_2$, $\pi_i(\tilde{\mathbf{q}}, \tilde{b_i}, \tilde{\mathbf{b}}_{-i}) \geq \pi_i(\tilde{\mathbf{q}}, b_i, \tilde{\mathbf{b}}_{-i})$, $\forall b_i \in \mathcal{B}_i$.

We now introduce two examples to illustrate the concept of CNE in the bilateral oligopoly model.

Example 1 (Gabszewicz and Grazzini, 2001). We consider an exchange economy in which all agents have the same Cobb-Douglas utility function given by $u_i(x_i, y_i) = x_i y_i$, $i \in \mathcal{I}_1 \cup \mathcal{I}_2$. The endowments are given by (7), with $\alpha_i = 1$ (this assumption is standard in the finite bilateral oligopoly game: each type of trader has a corner endowment). This exchange economy has a unique competitive equilibrium (CE thereafter) given by the price vector $p^* = (1, 1)$, and the allocation $(x^*, y^*) = (\frac{1}{2}, \frac{1}{2})$, for trader $i \in \mathcal{I}_1$, and by $(x^*, y^*) = (\frac{1}{2}, \frac{1}{2})$, for trader $i \in \mathcal{I}_2$. The CE is Pareto-optimal as $MRS_i(x_i, y_i) = 1$ at $(x^*, y^*) = (\frac{1}{2}, \frac{1}{2})$, for trader $i \in \mathcal{I}_1$ and $MRS_i(x_i, y_i) = 1$ at $(x^*, y^*) = (\frac{1}{2}, \frac{1}{2})$, for trader $i \in \mathcal{I}_2$, where $MRS_i(x_i, y_i)$ is the marginal rate of substitution of the trader.

The relative price and payoffs are given respectively by (10) and (13)-(14). The oligopoly equilibrium is the simultaneous solution to the *2n* problems given as follows:

$$\begin{cases} \max_{q_i} \pi_i(q_i, q_{-i}, b_i) = (1 - q_i)\left(\frac{\sum_{k\in\mathcal{I}_2} b_k}{\sum_{k\in\mathcal{I}_1} q_k} q_i\right), \ i \in \mathcal{I}_1; \\ \\ \max_{b_i} \pi_i(q_i, b_i, b_{-i}) = \left(\frac{\sum_{k\in\mathcal{I}_1} q_k}{\sum_{k\in\mathcal{I}_2} b_k} b_i\right)(1 - b_i), \ i \in \mathcal{I}_2. \end{cases} \tag{15}$$

The CNE satisfies the $2n$ first-order sufficient conditions given by $\frac{\partial \pi_i(q_i, q_{-i}, b_i)}{\partial q_i} = 0$, for $i \in \mathcal{I}_1$ and by $\frac{\partial \pi_i(q_i, b_i, b_{-i})}{\partial b_i} = 0$, for $i \in \mathcal{I}_2$, which can be rewritten as follows:

$$\begin{cases} -\frac{\tilde{q}_i}{\sum_{k\in\mathcal{I}_1} q_k} + (1-\tilde{q}_i)\frac{\sum_{k\in\mathcal{I}_1} q_k - \tilde{q}_i}{\left(\sum_{k\in\mathcal{I}_1} q_k\right)^2} = 0,\ i\in\mathcal{I}_1; \\ \\ -\frac{\tilde{b}_i}{\sum_{k\in\mathcal{I}_2} b_k} + \left(1-\tilde{b}_i\right)\frac{\sum_{k\in\mathcal{I}_2} b_k - \tilde{b}_i}{\left(\sum_{k\in\mathcal{I}_2} b_k\right)^2} = 0,\ i\in\mathcal{I}_2. \end{cases} \tag{16}$$

Since the market is symmetric, we have $\tilde{q}_i = \tilde{q}$ for each trader $i \in \mathcal{I}_1$ and $\tilde{b}_i = \tilde{b}$ for each trader $i \in \mathcal{I}_2$. Indeed, we consider the symmetric Cournot equilibrium where $\tilde{q} = \tilde{b}$ in which:

$$\left(\tilde{q}, \tilde{b}\right) = \left(\frac{n-1}{2n-1}, \frac{n-1}{2n-1}\right). \tag{17}$$

Example 1 states that strategic offers increase with the number of agents. In addition, from (17) we have $lim_{n\to\infty}(\tilde{q}, \tilde{b}) = lim_{n\to\infty}\left(\frac{n-1}{2n-1}; \frac{n-1}{2n-1}\right) = \left(\frac{1}{2}, \frac{1}{2}\right)$, which corresponds to the competitive equilibrium supply when there is free entry. On a symmetric market, traders of the two types make identical offers, and the *relative price* is equal to 1 at equilibrium. However, due to market power *all*, traders' offers are less than those of the competitive equilibrium. In example 1, we have presented an exchange economy in which the Cournot-Nash equilibrium is non-trivial. However, there are exchange economies where the Cournot-Nash equilibrium is *trivial* (autarkic equilibrium). The next example (example 2) supports this viewpoint since a linear bilateral oligopoly model shows that the trivial equilibrium is a Nash equilibrium of the game.[8]

Example 2 (Cordella and Gabszewicz, 1998) . Consider an exchange economy in which the preferences of traders are represented by the linear utility function defined as follows:

$$u_i(x_i, y_i) = \begin{cases} \beta x_i + y_i, & i \in \mathcal{I}_1; \\ x_i + \beta y_i, & i \in \mathcal{I}_2. \end{cases} \tag{18}$$

The endowments are given by (7), with $\alpha_i = 1$. For trader type 1 we have, $w_i = (1, 0)$ and for trader type 2, $w_i = (0, 1)$. This exchange economy has a unique CE given by the price vector $p^* = (1, 1)$, and the allocation $(x^*, y^*) = (0, 1)$, for trader $i \in \mathcal{I}_1$, and $(x^*, y^*) = (1, 0)$, for trader $i \in \mathcal{I}_2$.

The relative price and payoffs are defined respectively by (10) and (13)-(14). The oligopoly equilibrium is the simultaneous solution given by:

$$\begin{cases} \max_{q_i} \pi_i(q_i, q_{-i}, b_i) = \beta\,(1-q_i) + q_i\frac{\sum_{k\in\mathcal{I}_2} b_k}{\sum_{k\in\mathcal{I}_1} q_k}, & i\in\mathcal{I}_1; \\ \\ \max_{b_i} \pi_i(q_i, b_i, b_{-i}) = b_i\frac{\sum_{k\in\mathcal{I}_1} q_k}{\sum_{k\in\mathcal{I}_2} b_k} + \beta\,(1-q_i)\,, & i\in\mathcal{I}_2. \end{cases} \tag{19}$$

[8] Cordella and Gabszewicz (1998) present a linear utility bilateral oligopoly. They study under which condition a non-trivial Nash equilibrium exists, i.e., an equilibrium with trade. A conclusion emerges from this analysis: autarkic equilibrium is always a Nash equilibrium of the game.

Since the preferences are symmetric and the first-order necessary and sufficient conditions, we can show that the only equilibrium candidate is given by the following equation:

$$\frac{\left(\sum_{k\in\mathcal{I}_2} b_k\right)\left[\sum_{k\in\mathcal{I}_1} q_k - q_i\right]}{\left(\sum_{k\in\mathcal{I}_1} q_k\right)^2} - \beta \geq 0. \tag{20}$$

We obtain the following relation:

$$\beta \leq \frac{n-1}{n}.\ ^{9} \tag{21}$$

From Cordella and Gabszewicz (1998) and Busetto and Codognato (2006), we know that the autarkic equilibrium is always a Nash equilibrium of the game. The autarkic equilibrium supplies are given by $(\tilde{q}, \tilde{b}) = (0, \dots, 0; 0, \dots, 0)$. An "autarkic equilibrium" refers to an equilibrium where agents have no incentive to engage in the market actively and can remain inactive without competitive pressure.

In the next section, we study the comparative static properties in a bilateral oligopoly.

2.2.2 Comparative statics

Some studies explore comparative static properties in bilateral oligopoly models. For instance, Bloch and Ferrer (2001) analyze the Nash equilibrium when the degree of substitution between the two goods depends on the constant elasticity of substitution, where the same CES (Constant Elasticity Substitution) utility function represents agents' preferences. They show that the Nash equilibrium is an interior equilibrium that converges towards the competitive equilibrium when the elasticity of substitution between the goods tends to zero. Moreover, the equilibrium offers vary with the degree of substitution of the two goods. Thus, the equilibrium offers decrease when the degree of substitution between the two goods increases. Besides, Bloch and Ghosal (1997) show that, with identical traders on each market side, when we increase the number of traders on one side of the market, the payoff of traders on the opposite side of the market rises.

Amir and Bloch (2009) study the effects of entry in bilateral oligopoly models where buyers and sellers act strategically. They show that the normality of both goods is required for equilibrium bids and sellers' equilibrium utilities to increase with the number of buyers. Moreover, when the economy is replicated, the normality of both goods and gross substitutes guarantees that the equilibrium of the strategic market game converges monotonically to the competitive equilibrium. In this vein, Dickson and Hartley (2008) analyze the effect of additional entry into the bilateral oligopoly and examines whether bilateral

[9] If $\beta \leq \frac{n-1}{n}$, the economy has a trivial equilibrium when the values of n are small and a n-upset of competitive allocations that is the unique equilibrium point of the economy for large values of n. However, if $\beta > \frac{n-1}{n}$, the economy has a unique trivial equilibrium.

oligopoly and Cournot competition are equivalent when there are many buyers (see also Dickson, 2013). A so-called experimental result was found by Duffy et al. (2011), who explored whether competitive outcomes arise in an experimental implementation of a strategic market game (see also Barreda-Tarrazona et al., 2018).

Within a bilateral oligopoly model, Julien and Tricou (2009) show that the Cournotian behavior is neither effective when the number of suppliers of the considered good is large, nor effective when the preferences are strongly unbalanced. These results suggest that the strategic behavior may not hold when market power is equally distributed in economies with a finite number of traders. In this vein, Julien (2015) explores the effectiveness of market power and provides some measures of relative market power. He shows that it depends on the relative size of the market and the ratio of price elasticities of supply. However, when there is free entry, it does not always lead to the competitive equilibrium market outcome.

Other studies have extended strategic market games to a sequential context to define Stackelberg equilibria (Groh, 1997; Julien and Tricou, 2010, 2012; and Julien, 2024, Kabré, 2023a,b, among others). For instance, Groh (1997) and Julien (2024) have studied the existence of a sequential Stackelberg-type Nash equilibrium.

In the next section, we examine the efficiency of the strategic equilibrium.

2.2.3 Efficiency

To show that the CNE is not Pareto-optimal, consider trader i's marginal rate of substitution at the interior CNE. From (16), we can show that:

$$\begin{cases} p_X = \frac{n}{n-1}\ MRS_i(x_i, y_i),\ i \in \mathcal{I}_1; \\ \\ \frac{1}{p_X} = \frac{n}{n-1}\ MRS_i(x_i, y_i),\ i \in \mathcal{I}_2, \end{cases} \tag{22}$$

where, $MRS_i(x_i, y_i) = \left(\frac{\partial u_i/\partial x_i}{\partial u_i/\partial y_i}\right)_{|(x_i,y_i)}$, is the marginal rate of substitution of agent i at (x_i, y_i). In addition, as the interior CNE is symmetric, i.e., $\tilde{q} = \tilde{b}$, so $p_X = 1$. Then, we have: $MRS_i(x_i, y_i) = \frac{n-1}{n}$, for trader $i \in \mathcal{I}_1$ and $MRS_i(x_i, y_i) = \frac{n}{n-1}$, for trader $i \in \mathcal{I}_2$. The non-equality of the MRS stipulates that the strategic equilibrium does not lead to a Pareto optimal allocation. The mark-up or market power to manipulate prices is given by $\frac{\partial p}{\partial q_i} q_i = \frac{\partial p}{\partial b_i} b_i = \frac{1}{n}$. Thus, when the number of agents is large enough, each trader loses his power to manipulate price:

$$\lim_{n\to\infty} \frac{\partial p}{\partial q_i} q_i = \lim_{n\to\infty} \frac{\partial p}{\partial b_i} b_i = \lim_{n\to\infty} \frac{1}{n} = 0. \tag{23}$$

This proposition reflects the fact that the strategic power of agents tends to become insignificant for sufficiently large values of n. This result is in the Cournotian spirit: when the number of agents is large enough, i.e., sufficiently large, each trader loses his power to manipulate quantities and, therefore, the price, and the equilibrium price will be reached in a certain case. The equilibrium obtained by Cournot is not socially efficient, nor is it efficient from the agent's viewpoint alone, in the sense that each could individually obtain more gains if some agreed to reduce their supply level jointly. A question arises. Does some public policy exist that can restore Pareto optimality or reduce market distortions caused by strategic behavior?

In the following section, we study fiscal policies in bilateral oligopoly models in which the Cournot-Nash equilibrium is interior. The purpose is to highlight the main properties and conclusions that emerge from this literature.

3 Fiscal policies in bilateral oligopoly

Taxation policies have been introduced into the bilateral oligopoly model by Gabszewicz and Grazzini (1999, 2001). Specifically, Gabszewicz and Grazzini (1999) shows that endowment taxation with transfers in linear, Cobb-Douglas, and CES bilateral oligopoly models can implement a Pareto optimal allocation. This mechanism consists of levying a uniform tax on endowments before trade and then redistributing the income from taxation among agents after trade.

Besides, Gabszewicz and Grazzini (2001) studied three taxation policies in a bilateral oligopoly model where traders hold all goods and where an agent without an endowment is subsidized. Agents' preferences are represented by identical Cobb-Douglas utility functions. They show that taxing endowments by subsidizing all agents implements a first-best optimum. Elegbede et al. (2022) extend and generalize the contribution of Gabszewicz and Grazzini (2001) by considering a bilateral oligopoly model in which agents' preferences are represented by CES utility functions with non-unitary shares on consumption. They show that the two tax policies with transfers (ad valorem taxation and endowment taxation) implement a Pareto-optimal allocation when goods are perfect complements or perfect substitutes. A possible extension would be generalizing the preceding results in a more general framework (Julien and Yebarth, 2024). More recently, Yebarth (2025) shows that the ad valorem taxation welfare dominates per unit taxation in a bilateral oligopoly model where the same Cobb-Douglas utility function represents agents' preferences. Moreover, ad valorem and per-unit taxes have qualitatively different effects on strategic equilibrium offers.

Other studies have analyzed the effect of taxes in bilateral oligopoly models with an exchange economy with production (Julien et al., 2023; Kabré, 2023b; Grazzini, 2006). For instance, Grazzini (2006) compares the per unit and the ad valorem taxes in an economy with production where the behavior of traders is asymmetric, as *few* traders have market power while a *large* number of traders are price takers. Grazzini (2006) shows that per-unit tax welfare dominates ad valorem tax when the number of competitive agents is sufficiently high compared to the number of strategic agents. More recently, Julien et al. (2023) introduced polluting emissions in a sequential bilateral oligopoly model. They show that when strategies are substitutes (resp. complements), the leader pollutes more (resp. less) than the follower. However, (a) leader (resp. follower) emissions fall with a per-unit tax on strategies, and those when leader and follower strategies were substitutes, (b) agents' emissions can decrease or increase with the price of the permit, and those as a function of a threshold value. Besides, Kabré (2023b) analyzes the emission levels of firms competing *à la Stackelberg* when producing the manufactured good that generates environmental externalities.[10]

We now consider an example to illustrate fiscal policies in a bilateral oligopoly. The following example uses the linear preferences analyzed in example 2 to study a tax and transfer policy's effectiveness in an exchange economy where a finite number of traders initially hold both goods.

Example 3 (Gabszewicz and Grazzini, 1999). Consider the exchange economy analyzed in Example 2, where a linear utility function represents the preferences of the traders. Consider that a tax $\tau \in (0,1)$ is levied on endowments before the exchange takes place in this economy. After the trade, a share of the product of the tax in commodity X (resp. Y) is transferred to all agents and is equal to $\frac{\tau}{1-\tau}q_i$ (resp.$\frac{\tau}{1-\tau}b_i$). The set of strategies is now given by: $\mathcal{Q}_i = \{q_i \in \mathbb{R}_+ : 0 \leq q_i \leq 1-\tau\}$, for trader $i \in \mathcal{I}_1$ and by $\mathcal{B}_i = \{b_i \in \mathbb{R}_+ : 0 \leq b_i \leq 1-\tau\}$, for trader $i \in \mathcal{I}_2$. Given a vector of strategies $(\mathbf{q},\mathbf{b}) \in \prod_{i=1}^{n} \mathcal{Q}_i \times \prod_{i=n+1}^{2n} \mathcal{B}_i$, a new market price p_X is determined, and the resulting post-tax allocation is given by: $(x_i, y_i) = \left(1-\tau-q_i, \frac{\sum_{k\in\mathcal{I}_2} b_k}{\sum_{k\in\mathcal{I}_1} q_k}q_i + \frac{\tau}{1-\tau}q_i\right)$, for trader $i \in \mathcal{I}_1$ and by $(x_i, y_i) = \left(\frac{\sum_{k\in\mathcal{I}_1} q_k}{\sum_{k\in\mathcal{I}_2} b_k}b_i + \frac{\tau}{1-\tau}b_i, 1-\tau-b_i\right)$, for trader $i \in \mathcal{I}_2$. Therefore, we can define the new payoffs, which may be written as:

$$\pi_i(q_i, q_{-i}, b_i, \tau) = \beta\,(1-\tau-q_i) + \frac{\sum_{k\in\mathcal{I}_2} b_k}{\sum_{k\in\mathcal{I}_1} q_k}q_i + \frac{\tau}{1-\tau}q_i, \quad i \in \mathcal{I}_1; \tag{24}$$

$$\pi_i(q_i, b_i, b_{-i}, \tau) = \frac{\sum_{k\in\mathcal{I}_1} q_k}{\sum_{k\in\mathcal{I}_2} b_k}b_i + \frac{\tau}{1-\tau}b_i + \beta\,(1-\tau-b_i), \quad i \in \mathcal{I}_2. \tag{25}$$

The CNE satisfies the $2n$ first-order sufficient conditions given by $\frac{\partial \pi_i}{\partial q_i} = 0$, for

[10] Koutsougeras and Ziros (2015) study the decentralization of a Pareto-optimal allocation when markets are non-Walrasian. The aim is to develop a game that implements Pareto-optimal allocations as the Nash equilibrium of market strategic exchange. They use a strategic market game with fiat money, first introduced by Postlewaite and Schmeidler (1978) and further analyzed by Peck et al. (1992). Crettez et al. (2021) analyze a two-sector oligopoly model with pollution permits in which some traders behave strategically *à la* Cournot, and a representative consumer is considered a price-taker. They study under what conditions a supply subsidy given to the oligopolists that is financed by a tax on the competitive agent is Pareto-improving.

trader $i \in \mathcal{I}_1$ and $\frac{\partial \pi_i}{\partial b_i} = 0$, for trader $i \in \mathcal{I}_2$, which can be rewritten as follows:

$$\begin{cases} -\beta + \sum_{k\in\mathcal{I}_2} b_k \frac{\sum_{k=1}^{1} q_k - \tilde{q}_i}{\left(\sum_{k\in\mathcal{I}_1} q_k\right)^2} + \frac{\tau}{1-\tau} = 0, \quad i \in \mathcal{I}_1; \\ \sum_{k\in\mathcal{I}_1} q_k \frac{\sum_{k\in\mathcal{I}_2} b_k - \tilde{b}_i}{\left(\sum_{k\in\mathcal{I}_2} b_k\right)^2} + \frac{\tau}{1-\tau} - \beta = 0, \quad i \in \mathcal{I}_2. \end{cases} \tag{26}$$

Since the market is symmetric we have $\tilde{q}_i = \tilde{q}$ for each trader $i \in \mathcal{I}_1$ and $\tilde{b}_i = \tilde{b}$ for each trader $i \in \mathcal{I}_2$. Indeed, we consider the symmetric Cournot equilibrium where $\tilde{q}(\tau) = \tilde{b}(\tau)$ in which:

$$\left(\tilde{q}(\tau), \tilde{b}(\tau)\right) = (1 - \bar{\tau}, 1 - \bar{\tau}) \tag{27}$$

Example 3 shows that an endowment tax with transfer among agents can implement a first-best allocation. In our example, a linear utility function represents agents' preferences. Gabszewicz and Grazzini (1999) show that when agents' preferences are represented by a Cobb-Douglas and CES utility function, such a taxation mechanism (taxing agents' endowments before trade and then proportionally redistributing the income from the tax among the agents) leads to a first-best allocation.

In this paper, we explore a model in which tax policies play a dual role: collecting resources and redistributing them. The main motivation is to study, in a simple framework, to what extent the effects and effectiveness of redistributive tax policies depend on the preferences of individuals who behave strategically in trade.

In the following section, we compare the results emerging from the literature devoted to tax policy in the framework of strategic market games and the literature that deals with the general and partial equilibrium effects of taxation policy.

Authors	**Aim of this paper**	**Taxation policies**	**Main Findings**
Gabszewicz and Grazzini (1999)	Investigate the effectiveness of endowment taxation with incentive transfers in the linear, Cobb-Douglas, and CES bilateral oligopoly models.	A uniform tax is levied on endowments before exchange takes place. After trade has occurred, the product of the tax is redistributed to all agents.	Endowment taxation with transfer can lead to a Pareto-optimal allocation.
Gabszewicz and Grazzini (2001)	Investigate the effectiveness of endowment taxation with transfers in the Cobb-Douglas bilateral oligopoly in which two commodities are initially held by a finite number of inside agents, the traders, while one agent, the outside agent, owns nothing.	Three kinds of tax policy: taxing trade and endowments by subsidizing an outside agent who is deprived of any commodity; and taxing endowments and subsidizing both the outside agent and the traders.	The first two kinds of lump-sum taxes with transfers can only reach a second-best optimum, whilst the third one leads to a first-best optimum.
Elegbede et al. (2022)	Investigate the effectiveness and the welfare implications of various fiscal policies in strategic bilateral trade.	Extend Gabszewicz and Grazzini's contributions by considering two kinds of lump-sum tax and transfer mechanisms (ad valorem and endowment taxes).	Both fiscal policies with transfers implement a first-best allocation only when commodities are perfect complements or perfect substitutes.
Grazzini (2006)	Compares ad valorem and specific taxes in an economy with production.	Ad valorem and Per unit taxes.	Per unit taxation welfare dominates ad valorem taxation when the number of competitive traders is sufficiently high compared to the number of strategic traders.
Julien and Yebarth (2024)	Explores the possibility that a taxation mechanism always implements a Pareto-optimal allocation in strategic bilateral exchange.	Endowment taxation	There exists an interior CNE with taxation such that the taxation mechanism always implements a Pareto optimal allocation.

Table 1: Main studies on taxation policies in bilateral oligopoly models.

Authors	Aim of paper	Taxation policies	Main Findings
Julien et al. (2023)	Study polluting emissions in a sequential noncooperative oligopoly model of bilateral exchange.	Two kinds of regulation are considered to limit the emissions: two taxation mechanisms (ad valorem taxation on emissions and per unit taxation on the relative price) and one permit market.	When strategies are substitutes (resp. complements), the leader pollutes more (resp. less) than the follower. However, (a) leader (resp. follower) emissions fall with a per-unit tax on strategies, and those when leader and follower strategies were substitutes, (b) agents' emissions can decrease or increase with the price of the permit.
Yebarth (2025)	Compares ad valorem and per unit taxes in a strategic bilateral exchange.	Ad valorem and Per unit taxes.	Ad valorem taxation welfare dominates per unit taxation. While ad valorem taxation does not impact strategic offers, the per-unit taxation reduces strategic offers at equilibrium.
Kabré (2023b)	Investigate and compare the consequences of three out-of-contract civil liability mechanisms in terms of incentives to reduce pollution, when firms generate indivisible harms.	Three Liability Sharing Rules: first, the market share rule; the second liability rule, called the uniform or per capita rule, and the third rule combines the previous two in that part of the harm is equally divided, while the other part depends on the market shares.	Environmental harm is lowest with the market share rule, followed by the combination of both rules, and by the uniform rule. However, except for the mixed apportionment mechanism, the variation in the sum of utilities of productive firms is higher without a leader than in the presence of a leader.

Table 1 (continued)

4 Discussion

There is a growing body of literature that deals with the general and partial equilibrium effects of taxation policy. In this section, we discuss how our study relates to the literature. We address three aspects of the literature: (i) a comparison between ad valorem and per unit taxation, (ii) optimal taxation and market power, and (iii) market imperfections, strategic interactions, and taxation. Although the comparison remains conceptually complicated, we show the complementarity of the diverse literature.

4.1 Tax incidence: ad valorem versus per unit taxation

Taxation in an oligopoly model has generally been analyzed within a partial equilibrium framework. Several studies, including Seade (1985), Katz and Rosen (1985), Stern (1987), Dierickx et al. (1988), and Besley (1989), have shown that consumption taxes can have different effects in an oligopolistic market. It has been found that in such markets when the prices are increased, these taxes can lead to overshifting. This result has been confirmed by a few empirical studies such as Besley and Rosen (1999) and Carbonnier (2007). The outcome is robust and valid across a wide range of models of imperfect competition. Formal analyses of tax incidence have tended to focus on two types of taxation mechanisms: the per-unit and the ad valorem taxes.

In a perfectly competitive market, the two kinds of tax are equivalent (Suits and Musgrave, 1953, Bishop, 1968). However, in an imperfectly competitive market, this equivalence breaks down. Suits and Musgrave (1953) have shown that for any given tax revenue, an ad valorem tax is superior in welfare terms to a specific tax in a monopolistic market. Suits and Musgrave's contributions have been extended across different market structures including oligopoly competition (Delipalla and Keen, 1992; Skeath and Trandel, 1994; Denicolò and Matteuzzi, 2000; Anderson et al., 2001; Wang and Zhao, 2009 and Wang et al., 2018), monopolistic competition (Schröder, 2004; Dröge and Schröder, 2009 and Aiura and Ogawa, 2019), and monopoly competition (Blackorby and Murty, 2007, 2013). Other contributions have extended the analysis by comparing these two taxes under uncertainty (Goerke, 2011; Kotsogiannis and Serfes, 2014) and general equilibrium settings (Grazzini, 2006; Collie, 2019 and Chu and Wu, 2023).

For instance, Delipalla and Keen (1992) show that an ad valorem tax welfare dominates per-unit tax in a symmetric oligopoly. This result was also obtained in an asymmetric oligopoly by Denicolò and Matteuzzi (2000). Indeed, they show a superiority of the ad valorem tax for both symmetric and asymmetric Cournot competition when the goods are homogeneous. However, Delipalla and Keen (1992) show a conflict of interest between the competitive and strategic sides of the economy. Keen (1998) comes to the same conclusion as Delipalla and Keen (1992) when we are in a Cournot competition with homogeneous goods. Under uncertainty about firms' cost structures, Kotsogiannis and Serfes (2014) show that ad valorem tax revenues may not dominate specific revenues.

Wang et al. (2018) show in an oligopolistic setting, assuming fixed total output, that a per-unit tax can be superior to an ad valorem tax if the quality difference is greater than the marginal cost difference.

Other examples include Grazzini (2006), Chu and Wu (2023), and Yebarth (2025), who compare these two taxes under a general equilibrium setting. For instance, using the exchange economy with production, including two goods and two types of traders: some agents who behave *strategically* and large agents who behave *competitively*, Grazzini (2006) shows that specific taxation welfare dominates ad valorem taxation when the number of competitive agents is sufficiently high compared to the number of strategic agents. In a dynamic stochastic general equilibrium (DSGE) framework with nominal price rigidity and monopolistic competition, Chu and Wu (2023) show that the welfare dominance between an ad valorem tax and a unit tax depends on their relative marginal costs.

The comparison between ad valorem and per unit taxes is generally based on three broad families of assumptions. The first is the *neutral-revenue* hypothesis, which implies that revenues from ad valorem taxation and specific taxation are equal (Suits and Musgrave, 1953; Grazzini, 2006). The second is based on the assumption of *identical industrial output*, which assumes that average industrial output (total output) under both tax regimes is identical (Denicolò and Matteuzzi, 2000; Anderson et al., 2001). The third assumes that revenues from specific and ad valorem taxes result in the *same price* (Collie, 2019).

The results show that, depending on the models' specifications, the ad valorem tax can dominate the specific tax and *vice-versa*. However, in the "real world", the choice between these two types of tax depends on the objective of the public authorities and the type of market.

4.2 Optimal taxation and market power

Theoretical studies on market power have significant empirical resonance. Recent literature has highlighted links between major economic trends, such as falling labor incomes, rising profit margins, market concentration, and economic performance (Syverson, 2019). Although concentration is often used to measure market power, research mainly focuses on firms' margins, calculated as the ratio between price and marginal cost, to assess this power.[11] De Loecker and Eeckhout (2018); Hall (2018) and De Loecker et al. (2020) show that profit margins are increasing in many countries, including the USA, where they increased from 21% to 61% between 1980 and 2016 (De Loecker et al., 2020).[12] De Loecker et al. (2020) also highlights an increase in the average profit rate

[11] Two of the most commonly used methods measuring market power are the so-called "demand" approach, and direct measures of concentration, such as the Herfindahl-Hirschman Index (HHI). When all consumers perceive products as identical, the HHI remains an appropriate and direct indicator for measuring market power. However, when products are differentiated, there is no longer any relationship between concentration and market power (Bresnahan, 1989).

[12] De Loecker et al. (2020) show that this is accompanied by a reallocation of market shares, with high-margin companies gaining in importance at the expense of low-margin ones.

from 1% to 8%, with macroeconomic implications for the share of labor and capital, as well as the dynamism of the labor market. Likewise, Barkai (2020) shows that the profit share in the US economy has increased at the expense of the labor share since the 1980s.[13]

Some literature has also explored redistributive taxation in the presence of market power (Boar and Midrigan, 2019; Kaplow, 2021 and Eeckhout et al., 2021). For instance, Eeckhout et al. (2021) show that increasing market power increases income inequality and harms economic efficiency. These authors recommend reducing taxes on workers while increasing those on entrepreneurs but insist on eliminating market power via antitrust policies as the optimal solution. Besides, Kaplow (2021) analyzes how significant market power and the presence of rents influence optimal income taxation. He shows that correcting non-proportional margins can improve welfare. Gürer (2022) investigates the effects of increasing margins on the optimal taxation of profit and income. He shows that increasing taxes on profits to reinforce redistribution, while reducing taxation on labor income, maximizes overall welfare. In another approach, Dworczak et al. (2021) explore the design of optimal fiscal mechanisms when buyers and sellers have private information in their valuations of the good. They show that optimal redistribution through markets can be achieved by a simple combination of lump-sum transfers and rationing.[14]

4.3 Market imperfections, strategic interactions and taxation

A growing body of literature deals with optimal taxation in interrelated markets with strategic interactions (Aumann and Kurz, 1977; Guesnerie and Laffont, 1978; Myles, 1989; Coto-Martinez et al., 2007; Lewis and Winkler, 2015; Etro, 2018). For instance, Guesnerie and Laffont (1978) studied optimal taxation in a general equilibrium model with a monopolist when the government's objective is to restore the first-best optimum. They study the problem of designing fiscal instruments to compensate for the distortions resulting from imperfect competition. These authors show that a linear taxation regime for the monopolist allows the first-best optimum to be reached. Besides, by addressing the Ramsey problem of setting commodity tax rates to maximize welfare under a revenue constraint, Myles (1989) develops a general equilibrium framework with imperfect competition, analyzing how taxation affects equilibrium prices and profits, and extending standard tax rules to non-competitive market structures. Collie (2019) analyzes the effects of taxation under general equilibrium settings. They show that a lump-sum tax (resp. profits tax) on a monopoly or a Cournot oligopoly will result in an increase in the price and a decrease in

[13] See also Aghion et al. (2023), which examine how the concentration of market power affects economic growth in the long term.

[14] In this model, when inequalities between buyers and sellers are large, a price differential is imposed to redistribute the surplus to the poorer side of the market. Optimal rationing varies: on the sellers' side, a single price can target less-favored sellers, while on the buyers' side, offering several prices better identifies better-off buyers. Other studies, such as that by Boar and Midrigan (2019), investigate optimal policies in product markets where firms are concentrated and margins increase with firms' market shares.

welfare (resp. no effect on the price or welfare) with homothetic preferences, but no effect on price or welfare (resp. but will decrease the price and increase welfare) with quasi-linear preferences.

Other studies have examined different forms of taxation with market imperfections and strategic interactions that allow endogenous firm entry and markups. For instance, considering a general equilibrium model with endogenous firm entry, Lewis and Winkler (2015) show that optimal taxes on labor and entry vary with demand structure and goods substitutability. Likewise, Bilbiie et al. (2019) focused on demand-side complementarities, contrasting CES (Constant Elasticity of Substitution) demand with translog preferences, while Colciago (2016) examined supply-side complementarities. Other examples include Coto-Martinez et al. (2007) and Etro (2018), which respectively analyze the effects of capital and labor income taxation, considering distortions linked to competition and firm entry.

4.4 The comparison with the bilateral oligopoly framework

Studying taxation policies in a context of strategic interaction is fundamental to understanding how agents adjust their behavior by anticipating the impact of their decisions on others and the market as a whole. In this framework, taxation policies directly influence agents' incentives to trade or to adjust the quantities of goods traded. These taxes modify relative prices, thus affecting exchange strategies and market equilibrium. Understanding these strategic interactions makes it possible to assess in greater detail the effects of taxes on collective and individual welfare, and to design tax policies that minimize the distortions caused by the exercise of market power or maximize the gains that agents can obtain from trade.

In a globalized economy, an approach that takes account of strategic interactions is needed to adapt public policy to current economic realities. It is no longer enough to analyze the impact of a tax on an agent in isolated cases; it is crucial to understand how these decisions influence the determination of market quantities. What's more, these decisions are taken in a context where market quantities are determined in oligopolistic markets (with or without product differentiation). So, for example, in the presence of strategic market interactions, the effectiveness of tax policy may be challenged. This problem of tax policy efficiency becomes particularly important when tax policies have a dual role, that of collecting resources and using these resources for redistribution purposes.

In contrast to the above-mentioned literature, in which studies model strategic interactions within a given sector, the bilateral oligopoly model allows us to model two-sector economies with specialization in endowments, in which agents engage in strategic competition from a dual viewpoint: within a given sector and between sectors. The effects of a tax policy therefore, depend on strategic interactions within and between sectors.

The following table summarizes, for each type of literature and taxation, the impact in terms of equilibrium and efficiency.

Literature	Taxation policy	Effects / Efficiency	Structure	Main aspects
Bilateral oligopoly models (Theoretical analysis and experiments)	- Endowment taxation - Ad vaolrem taxation - Per unit taxation - Permit market	- Redistributive tax policies do not always lead to a first-choice allocation - Taxation policies and permit markets can implement a Pareto-improving allocation	Oligopoly markets (General equilibrium framework)	- Strategic interaction occurs between and within sectors (intra- and inter-sectoral) - Provide a unified framework to compare different kinds of oligopoly: symmetric, asymmetric, simultaneous, and sequential
Tax incidence literature (Empirical and theoretical analysis)	- Ad valorem taxation - Per unit taxation	Depending on the models' specifications and assumptions, the ad valorem tax can dominate the per unit tax and vice versa	Oligopoly, monopoly, and monopolistically competitive markets (partial and general equilibrium framework)	- The impact of a tax is determined by supply and demand in the market for the taxed good
Literature on optimal taxation and market power (Empirical and theoretical analysis)	- Income taxation - Labor taxation - Capital taxation	- Increasing market power increases income inequality - Market power and the presence of rents influence optimal income taxation - Increasing taxes on profits to reinforce redistribution, while reducing taxation on labor income, maximizes welfare	Oligopoly and monopoly market (general equilibrium framework)	- Strategic competition takes place within a given sector (sector level) - Complexity of the trade-off between desired redistribution and the economic distortions caused by high tax rates
Literature on market imperfections, strategic interactions, and taxation (Empirical and theoretical analysis)	- Income taxation - Labor taxation - Capital taxation	- Lump-sum tax, profit tax and income tax have different effects on the price and welfare of agents - Optimal taxes on labor and entry vary with demand structure and goods substitutability	Oligopoly and monopoly market (general oligopoly framework)	- Strategic competition takes place within a given sector (sector level) - Fiscal policy instruments' impacts depend on their interaction with other policy measures

Table 2: Comparative results on the effect of a taxation policy.

5 Some possible extensions

A possible extension would be to open the way to studying a taxation mechanism in the context of mixed exchange economies, i.e., markets in which the large traders, the atoms, compete with the small traders, the parts without atoms. The mixed exchange economies describe a model where large traders are represented as atoms and small traders are represented by an atomless part. The key distinction lies in the relative size of their initial endowments: atoms hold a significant share of the total resources, whereas agents in the continuum have an infinitesimal impact individually. This approach was first introduced in cooperative game theory by Gabszewicz and Mertens (1971) and Shitovitz (1973). The mixed exchange economy model was extended to noncooperative game theory by Okuno et al. (1980) and further generalized by Busetto et al. (2011) and Busetto et al. (2018).

Within these models, we aim to consider changes in the size and number of traders by introducing heterogeneity in the weights of large traders. Then, we could study competition policy recommendations to address the issue of market efficiency and social welfare. The idea is also to propose new criteria for judging the oligopolistic behavior of large traders, which do not always lead to distortions in resource allocation (with appropriate numbers, sizes, and weights, oligopolistic behavior can also maintain market efficiency). Then, our study can be based on models for which the existence of Cournot-Nash strategic equilibria has been proven (Codognato and Julien, 2013; Busetto et al., 2018).

The second direction concerns models in which strategic interactions are sequential (Stackelberg-Nash equilibria). The novelty will lie in introducing a sequence of strategic decisions to analyze the effectiveness of a taxation policy. The aim will be to determine the extent to which sequential strategic decisions affect the effects of taxation policy. We will use the literature devoted to Stackelberg equilibria in strategic market games (Groh, 1997; Julien and Tricou, 2012; Julien, 2013, 2024; Kabré, 2023a,b). This will enable us to compare the effectiveness of public policies in the two models. Then, we will examine the effect of taxation and the welfare implications in the context of a non-cooperative sequential equilibrium concept, namely the Stackelberg-Nash equilibrium, in a game where heterogeneous atomic traders interact in interrelated markets.

A possible extension is to investigate whether the results from the bilateral oligopoly model with a finite number of agents hold for another kind of strategic market game, namely that with fiat money first introduced by Postlewaite and Schmeidler (1978) and further analyzed by Peck et al. (1992) and Koutsougeras and Ziros (2015). Another possible extension and comparison would be to discuss/establish, and consider the case of price (Bertrand) competition between the oligopolists. How would the results fare in the case of Cournot competition? In this paper, the analysis considers an exchange economy with endowment-levied taxation. A discussion of an equivalent analysis in the framework of a monetary economy with income, e.g., labor and taxation, would be in order.

6 Conclusion

Market power is an important issue in economics. In our global markets, most of which have an oligopolistic structure, firms have market power. Market power creates inefficiencies in resource allocation. This paper reviews the literature devoted to taxation policies in bilateral oligopolies. In this model, tax policies play a dual role: they mitigate the distortions in resource allocation caused by imperfect competitive behavior, and they also play a redistributive role. We show that they do not always lead to a first-best allocation. This taxation mechanism involves levying a uniform tax on the endowments of traders (endowment taxation) or transactions (ad valorem taxation). In both cases, the product of the tax is transferred to the agent. Gabszewicz and Grazzini (1999, 2001) shows that endowment taxation with transfers for the linear, Cobb–Douglas, and CES utility functions can implement the first-best allocation. Elegbede et al. (2022) extends and generalizes the model of Gabszewicz and Grazzini (2001) by analyzing the effect of taxation on the strategic behavior of agents when their individual decisions depend on both the degree of substitution between goods and the share of consumption of these goods in their utility. A possible extension would be generalizing the preceding results in a more general framework (Julien and Yebarth, 2024).

In this bilateral oligopoly model, the effects and effectiveness of redistributive tax policies depend on the preferences of agents who behave strategically in trade. Besides, bilateral oligopoly can be used to provide a strategic foundation for asymmetric oligopoly models that impose price-taking assumptions on some agents, but this requires a particular timing structure in that those agents that are assumed to be price takers, and are replicated, must move last, and can also be used to provide a strategic foundation for models that assume price taking for all agents, where in contrast timing does not matter (Dickson and Tonin, 2021).

Finally, we discuss how our study relates to the literature devoted to the general and partial equilibrium effects of taxation policy. Although comparing our analysis with the literature dealing with efficiency and the fiscal impact of a tax policy remains conceptually complicated, we show the complementarity between the various approaches.

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