



# On the takeover mechanism in market socialism

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## Abstract

In the three decades since the collapse of the Soviet Union, the notion of socialism has been swept into almost total disrepute. The more recent economic literature, however, has shown a resurgence of interest in the concept of socialism, albeit on very different theoretical grounds than in the past. This article investigates the reasons for the socialist movement’s historical distrust of the development of “well-defined” economic projects. This attitude seems to have disappeared in contemporary “socialist projects”. The article also discusses the Shareholder Socialism proposal developed by economist Corneo (*Is capitalism obsolete? A journey through alternative economic systems*. Harvard University Press, Cambridge, 2017, *Ann Public Coop Econ* 89(1):11–24, 2018, *Rev Soc Econ* 77(1):35–55, 2019) and proposes a different mathematical formulation of the mechanism through which the takeover of private industries by the public sector should be conducted.

**Keywords** Market socialism · Nationalization · Economic systems

**JEL Codes:** H1 · B14 · B24

## 1 Introduction

In recent years, several economists have put forwards models for socialist economies (see Carnevali and Pedersen Ystehede (2023) for a comprehensive survey on the subject).

The originality of this strand of contemporary economics literature does not only lie in the subject matter, although the renewed interest in the concept of socialism is undoubtedly a novelty after years of comparative economics studies focused almost

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exclusively on the analysis of varieties of capitalism, or on the problems of economies in transition from socialism to capitalism. What is also original is the approach with which these contemporary economists have sought to elaborate precise economic-institutional models for a contemporary project of socialism.

In the past, economists with socialist ideas have devoted their attention to elaborating models to explain the functioning, the dynamics - and of course the flaws - of the capitalist economy. Much more rarely they have tried to elaborate models of how a socialist economy should exactly work.

In Sect. 2 of this article we will reconstruct the historical and philosophical reasons for socialists' traditional distrust of models. Section 3 will focus on the contemporary revival of a very old idea in the history of the socialist movement: market socialism.

The second part of the paper contains a practical example of the application of this method starting from one of the most authoritative contemporary proposals of market socialism: the one elaborated by Giacomo Corneo (2017, 2018, 2019) on the basis of earlier works by John Roemer (1992, 1994) and Leland Stauber (1987).

Section 4 briefly describes the mechanism that in Corneo's model should govern the process of nationalisation of private companies. Section 5 proposes an alternative model to represent the behaviour of private agents within market socialism. We believe that our approach can help to derive in a clearer and more direct way an effective rule for the process of gradual takeover of private firms by the public sector in market socialism. Section 6 includes a series of tests to assess the dependence, or otherwise, of Corneo's mathematical model on specific families of probability distributions in studying the behaviour of private sector agents in market socialism. Section 7 concludes.

## 2 Why socialists did not like models

Historically, socialists never showed great interest in detailed programmes of how a socialist economy should look like. By the time of the Second International (1889), Marxism was already the hegemonic philosophical framework of the movement. And from a Marxist perspective, the exercise of trying to devise precisely the institutional arrangements of the "new world" was basically pointless. That was a typical approach taken by utopian thinkers, that is to say socialists who put forward their ideas before the advent of "scientific socialism".

Historical materialism was supposed to be the methodology through which socialism could reach its intellectual maturity. The claim was that when society is analysed under the lens of historical materialism, its general laws of motion become apparent.

The transition from a social-economic system to another is the result of contradictions that cannot find a solution within the old institutions anymore. It is not the result of a well-defined plan implemented by people of goodwill (or of bad will; even the distinction is quite pointless when the main distinction becomes the one between "progress" and "backwardness"). Likewise, the advent of socialism will

never follow from a “good plan”: it will be the natural product of the specific contradictions of the capitalist society, of the

“conflict existing between the social forces of production and the relations of production” (Marx 1959, p. 12).

Famously, Marx preferred to confine himself to “the mere critical analysis of actual facts, instead of writing receipts [...] for the cook-shops of the future” (Marx 1932, p. 21). His rare references to the characteristics of a socialist society are very vague:

“united cooperative societies are to regulate national production upon a plan, thus taking it under their own control, and putting an end to the constant anarchy and periodical convulsion which are the fatality of capitalist production” (Marx 1975, p. 335).

One could even define some of these references, paradoxically, quite utopian:

“in communist society [...] it is possible for me to do one thing today and another tomorrow, to hunt in the morning, fish in the afternoon, rear cattle in the evening, criticise after dinner, just as I have a mind, without ever becoming hunter, fisherman, herdsman or critic” (Marx and Engels 1932, p. 53).

With the October Revolution (1917), socialism became a reality and revolutionaries had to devise a socialist model under the most difficult circumstances. It took place in a country—the Czarist empire—that was well behind the frontier of economic and social development of the time. It was a revolution “against Karl Marx’s Capital”. Antonio Gramsci commented:

“The Bolsheviks repudiate Karl Marx, they affirm with the testimony of action performed, of achievements realised, that the canons of historical materialism are not as rigid as one might think and as one has thought”<sup>1</sup> (Gramsci 1917).

Still, this did not mean a renewed interest in “models” in the international socialist movement. On the one hand, the legacy of the Hegelian-Marxist prejudice against abstract and anti-historical theorisations was still strong in the cultural elite of the movement, especially in continental Europe; on the other hand, many socialists thought they had finally found their model: the Soviet Union was to become the “living showcase” of the Socialist society, the exemplar for revolutionaries worldwide to follow. When other revolutions triumphed, such as in Cina (1949) or in Cuba (1959), socialism was built on imitation of the Soviet political and economic model.

It is true that in the Soviet Union an intense debate briefly took place between 1924 and 1928 on what exactly a socialist economy should consist of. More precisely, two major issues were discussed:

- (a) the strategy of economic development: here the contraposition was between the left-wing of the Bolshevik Party (Yevgeni Preobrazhensky and Leon Trotsky),

<sup>1</sup> Our translation from Italian.

- that pushed for a rapid industrialisation of the country (prioritising the heavy industry) and the right-wing (Lev Shanin and Nikolai Bukharin), which favoured a more balanced growth of industry and agriculture (Shanin's position could be even described as an "agriculture-first policy" (Gregory and Stuart 1990, p. 89));
- (b) the model of planning: here the contraposition was between the approach advocated by the so-called "geneticists" (Nikolai Kondratiev, Vladimir Bazarovand, Vladimir Groman) and an alternative program that has been defined as the "teleological" approach to planning (Stanislav Strumilin, Georgy Pyatakov, Valerian Kuibyshev, Grigory Feldman). In this case, the discussion was focused "on the issue of whether planning was to be directed (and limited) by market forces or molded by the will of planners, unconstrained by market forces and limited only by the physical constraints of the economy" (Gregory and Stuart 1990, p. 103).

However, after Stalin's consolidation of power, a specific strategy was chosen and the debate was closed forever (many of the participants of that debate were physically eliminated). And despite the defeat of the left-wing opposition in the Party in 1927-1928, the rapid industrialisation option and the teleological approach to planning would become the two major characteristics of the Stalinist model.

Even in the reformist wing of the movement, many have showed a similar skepticism towards models, probably because the lessons of history were pointing towards the close correlation between dogmatism and authoritarianism. To come out with a fully-fledged plan for a future society could somehow be considered a distraction from the more concrete battles on the improvement of the living condition of the working class. This is the approach that resonates in Eduard Bernstein's famous dictum:

"The final goal of socialism is nothing to me, the movement is everything"  
(Bernstein 1993, p.190).

The crisis of "real socialism" became apparent well before the collapse of the Berlin Wall and the demise of the Soviet Union. However, once again, the major attempts to reform "real socialism" societies did not try to elaborate detailed economic road maps or programmes based on defined models. We refer to "major" attempts here, because in this context we want to focus on the main centres of the socialist world: the Soviet Union and the Popular Republic of China. Experiments that have involved more "peripheral" countries (e.g. Yugoslavia, Hungary) will be briefly addressed to in Sect. 3.

When Mikhail Sergeevich Gorbachev became General Secretary of the Communist Party of the Soviet Union, in 1985, he did not have a clear economic plan to inspire his reform process. With respect to the economic system *strictu sensu*, it has been noted that several planks of Gorbachev's *Perestroika* (or restructuring) were in fact "recycled from the 1960s" (Gregory and Stuart 1990, p.152), mainly from the (limited) debate that developed in the last years of Khrushchev's era and from the Kosygin Reform (1965) that was, for the most part, reversed during the 1970s. His "radical reform" (*radikal'naia reforma*) was *radical* more for his efforts to implement a "controlled" liberalisation and democratisation of the

political, social and cultural life of the Soviet Union rather than for the proposed changes in its economic institutions. Between 1986 and 1987, important legislation was passed on enterprise management, private activities, cooperatives for the production of consumer good and services, joint ventures with foreign firms. These were major innovations, but not a complete “shake up” of the Soviet economic structure along a predefined scheme. In his excellent biography of Gorbachev, William Taubman observed that:

“Gorbachev disdained detailed plans or blueprints because he associated them with the iron schema the Bolsheviks had forced on the Russian people. [...] A sworn opponent of Bolshevik-style social engineering, he tried to engineer his own anti-Bolshevik revolution by peaceful, evolutionary means. He trusted the people to embrace self-governance, and their elected representatives to shape democratic institutions—until it turned out that they didn’t know how and no longer trusted him” (Taubman 2018, p. 690-691).

China’s “reform and opening up” (*Gǎigé kāifàng*) followed a completely different path: the Communist Party retained full control of the state and the political process, whereas the economy was gradually liberalised and the institutions of Soviet-style central planning dismantled. Yet the man that pushed through this process—Deng Xiaoping—had something, very important, in common with Gorbachev: a disdain for predetermined patterns. Again, it can be useful to resort to an analysis of the personality of the man, his background, and his mentality, to fully capture this aspect. The personality of leaders does matter in history. Even more so, in authoritarian regimes. In his article “Deng Xiaoping: The Economist”, Barry Naughton tried to outline “ways in which Deng contributed personally in the evolution of economic policy in China” (p. 510). Here are his conclusions:

“In a broader sense, one might ask whether China’s economic reform reflects any of the personal characteristics of Deng’s approach to economic issues. Here the answer must be yes. Paradoxically, the most important characteristic is simply the lack of an overarching vision of the reform process or its goal. China’s reform has proceeded gradually and experimentally, and without a clear sense of ultimate objective” (Naughton 1993, p.510).

### 3 The revival of market socialism

As we said in Sect. 2, the crisis of “real socialism” became apparent well before the events in Eastern Europe at the end of the 1980s. Enrico Berlinguer, the leader of the Italian Communist Party and one of the most authoritative personalities behind the “Eurocommunism” movement, expressed a sense of disillusion even within the ranks of the “faithful” when he declared that the October Revolution had “exhausted its propulsive force” (1981). Indeed, the Italian Communist Party—which has been by far the biggest Communist Party among Western Countries—changed its name into the “Democratic Party of the Left” in 1989.

However, it was with the collapse of the Soviet Union (1991) that the notion of socialism has been swept into almost total disrepute.

Only very recently a kind of reconsideration of the “socialist project” made its reappearance in the public sphere of Western societies, in particular in the English-speaking world. The popularity of self-declared “democratic socialist” politicians—such as Bernie Sanders, Alexandra Ocasio-Cortez and Jeremy Corbyn—among the younger generation is something that could not be expected only a few years ago.

Traces of a similar “comeback” can be found in academic literature. Carnevali and Pedersen Ystehede (2023) present a survey of contemporary economic projects that can generally be described as “socialist”.

What almost all of them have in common is that they do not share the traditional reluctance of the socialist movement to put forward well-defined socialist blueprints. This could be a consequence of the harsh lessons of history: there is widespread acknowledgement, nowadays, that credible plans are needed before the word “socialism” can have a real chance to regain appeal and inspire viable political programmes. History is not “naturally” moving toward a “socialist paradise” anymore: men and women with good ideas should step in.

The interest in plans does not mean that contemporary socialism shares with traditional/Marxist socialism its “messianic core”. Carnevali and Pedersen Ystehede (2023) point out that

“most contemporary socialist projects champion a reformist approach that starts from the existing capitalist economy and promotes the introduction of more and more elements of socialism in it” (Carnevali and Pedersen Ystehede 2023, p. 23).

Its attitude towards economic institutions is flexible and pragmatic:

“Private ownership needs to be abolished only when—and insofar as—different institutions can better serve intrinsic values such as democratic participation, equality and the freedom of pursuing a meaningful life” (Carnevali and Pedersen Ystehede 2023, p. 23).

Even the market has been widely “rehabilitated” by contemporary socialist theorists as an effective means for the allocation of resources. Indeed, some of those that we regard as among the most interesting proposals in this field consist of the rediscovery and renewal of a rather old idea in the socialist movement: market socialism.

According to Alberto Chilosì (1992), it is possible to distinguish two theoretical approaches to the market socialist idea: the *Manchesterian* and the *Non-Manchesterian* one. The first line of thought features a strong belief in the market as a device to reach some sort of socially-optimal result. Competition is of foremost importance in this framework and therefore freedom of access to different markets/industries should be protected and promoted. Examples of this tradition can be found in the works of Dühring (1873); Hertzka (1891); Oppenheimer (1922). By contrast, for the *Non-Manchesterian* strand, the market

“does not have any *a priori* optimality propriety, but is only a convenient coordinating device, deprived of the potentially tyrannical tendencies of a centralised administration of the economy” (Chilosi 1992, p. 174).

Therefore, the emphasis should be put on the virtues of big industries, rather than on the virtues of competition. This is an attitude “typical of the German Social Democratic cultural tradition” (Chilosi 1992, p. 174). Examples of this kind of approach can be found in the works of Moellendorf and Wissel (1919); Bauer (1921); Heimann (1922).

From a historical perspective, the two major experiences of market socialism have been developed in Yugoslavia since the early 1950s, after the break between Tito and Stalin, and in Hungary since the introduction of the “new economic mechanism” (1968) (for a detailed contemporary study of experiments in market socialism in Eastern European Country see Boer (2023)).

The two systems had different characteristics. The Yugoslavian model was based on the idea of self-management of firms that acted as independent agents. In that framework, the functions of the national plan were “in principle only indicative, confined basically to provide information and framework for (voluntary) coordination” (Brus 1990, p. 16). In Hungary the market relations were expanded beyond the traditional sphere of consumption goods into the sphere of capital goods. Prices were partially liberalised to clear the markets. However, the plan devised by central authorities retained a crucial role in “the allocation of the main bulk of investment funds among sectors, areas and large individual projects” (Brus 1990, p. 173). Despite the gradual rise of a small private and cooperative sector, firms were for the vast majority state-owned and no principle of self-management was introduced.

From the beginning of the 1980s, significant market reforms were introduced in China too (see Sect. 2). In the beginning, the main area of experimentation was agriculture. The successes in this field prompted the leadership of the Communist Party to gradually extend market relationships in all the other sectors of the economy. In 1992 the Chinese Communist Party endorsed the goal of a “socialist market economy” in its 14<sup>th</sup> Congress. The following year, Article 15 of the Constitution of the People’s Republic of China was emended to replace the reference to the “supplementary role” of the market in coordinating economic activities, with a more explicit declaration that “the state practises the socialist market economy” (Constitution of the People 1982). Today, it is not easy to understand to “what extent is it reasonable to think of China as a form of socialism” (Naughton 2017, p. 4) given the socio-economic characteristics of that model and the significant size of the private sector in the Chinese economy.

Anyway, contemporary theoretical projects for “market socialism” do not look at China as an exemplar to follow, as they tend to emphasise the close relationship between a stronger redistribution of income, wealth and power that should be implemented in the economic sphere and further democratisation of social and political institutions (Carnevali and Pedersen Ystehede 2023).

In our opinion, one of the most interesting and complete proposals of “market socialism” in contemporary economic literature has been devised by Giacomo Corneo (2017, 2018, 2019).

Corneo's blueprint addresses a wide range of topics, not exclusively related to the economic system (see, for instance, his discussion of the advantages of "participatory democracy" in Corneo (2019)). However, in the following section of this paper we will focus on a specific economic issue of his work, namely the mechanism that should regulate a peaceful and consensual transition from a capitalist to a socialist economy.

#### 4 A "maximin" takeover mechanism

Corneo's blueprint is based on a two-sector economy where big and mainly state-owned corporations coexist with smaller private-owned enterprises. The first sector would allow a fairly equal distribution of income and wealth, as most of the profits made by these corporations would be "revenues" for the government and therefore would accrue to the citizens through the public budget. The second sector (the private sector) would allow innovation and dynamism.

Indeed, the lack of incentives to innovate can explain the very poor performance in terms of productivity growth and technological progress that characterised Soviet-type economies (with some exceptions, such as military procurements and space research). In these economies, the formation of small and medium-sized firms was strongly discouraged by the legal system or explicitly banned. With no private firms or potential startups in a position to profit from the introduction of new processes or new products, there was little space for new ideas to rise and spread. The problem with devising a two-sector economy with a public and a private sector whose boundary is based on the size of the firms is threefold:

- (a) where exactly to set the threshold and on the basis of which parameters (revenues, profits, number of employees, etc);
- (b) how to avoid the rules that are set are circumvented (for instance, by splitting a firm in two);
- (c) how to keep the incentive for smaller firms to grow, given the fact that they would know that crossing the line means being nationalised.

Corneo's takeover mechanism aims to solve all three problems by tackling specifically point c). There is no specific threshold, although credit-rationed young firms could initially be exempted by taking part in the mechanism. The nationalisation of a private firm is "always possible, independently of its size, but its owner chooses the minimum level of compensation that she will receive if the firm is nationalized" (Corneo 2019, p.43). The institutional arrangement is explained with the help of a formal mathematical model. The main characteristics of the model will be briefly presented here (for a more detailed description of the model see (Corneo 2019, section 4)).

The annual profit of a private firm (which we shall call "Company A") is equal to  $Y$ . Given the interest rate  $r$ , the "theoretical" present value of Company A is  $\frac{Y}{r}$ . At the end of each year, the owner of Company A does not formally pay any tax



on profit. She makes a voluntary contribution to the government and she decides the amount of the contribution,  $B$ . However, her Company will be put for sale in a mandatory second-price sealed-bid auction and the floor price will be  $mB$ , where  $m$  is a multiplier decided by the government (e.g.  $m = 80$ ). Larger, profit-maximising state-owned corporations can take part in the auction, and of course they will submit an offer only insofar as they consider the floor price convenient. We call  $P$  the sale price and  $q$  the probability of the sale to be carried out (there must be offers above the floor price for the transaction to take place). Using these variables, at the beginning of each period the expected value  $\Pi$  of Company A for its owner satisfies the relation:

$$\Pi = \frac{Y - B + qP + (1 - q)\Pi}{1 + r}. \tag{1a}$$

If we solve for  $\Pi$ ,

$$\Pi = \frac{Y - B + qP}{r + q}, \tag{1b}$$

we get that the expected value of Company A depends on some variables that the owner cannot set arbitrarily ( $Y$  and  $r$ ), a variable whose value is directly decided by the owner ( $B$ ), and two variables that in turn depend on  $B$  ( $P$  and  $q$ ). The higher  $B$ , the higher the floor price, the higher the sale price  $P$ , and the lower the probability  $q$  that offers beyond the floor price are submitted.

For the owner of Company A the challenge is now to find a value for  $B$  that maximises  $\Pi$ . She does not know the exact function that links  $q$  and  $B$ , and she does not know what will be the price of the winning bid in the auction, in case there are offers beyond the floor price. Her value maximisation strategy will have to follow simple rules of thumb.

Corneo employs a maximin approach initially developed by Gilboa and Schmeidler (1989) to address the Ellsberg’s paradox (Ellsberg 1961), that is to say to offer a formal solution to an expected utility maximisation problem in case of a very limited knowledge of the priors on which a traditional utility maximisation should be conducted.

Corneo’s approach is summarised in the following proposition (Corneo 2019, p.45):

**Proposition:**

- (i) By choosing to pay a contribution  $\hat{B} = \frac{Y}{1+rm}$ , the agent can always secure an expected value of the firm equal to

$$\hat{\Pi} = (1 - \tau) \frac{Y}{r},$$

where  $\tau = \frac{1}{1+rm}$

$$(ii) \quad \hat{B} = \arg \max_B \min_{P,q} \Pi,$$

where  $\Pi$  is minimised with respect to  $P$  and  $q$ , and  $\arg \max$  indicates the maximiser with respect to  $B$ .

It is worth observing here that the optimal contribution ensuring the maximisation of the minimum of  $\Pi$  depends explicitly on how the probability  $q$  is related to  $B$  and the other parameters featured by the model (in particular, the profit  $Y$ ). This optimal contribution—that requires the owner of Company A to possess well-defined priors about the strategic setting she faces in the auction—may or may not coincide with the strategic contribution  $\hat{B}$  proposed by Corneo, which is devised as a worst-case scenario in the absence of information about  $P$  and  $q$ . For the proof of Proposition (i) we refer the reader to Corneo (2019). Proposition (i) is very “convenient” because it allows the system to reproduce the same outcome one would have if the firm’s profit was taxed at a rate  $\tau$  in a standard capitalist economy. In this way, similar incentives to invest as in capitalism are thus preserved and the incentive intensity can be modulated by the government through choice of  $m$ .

Now, the point is: how do we know that the owner of Company A should choose  $B = \hat{B}$ ? Why is this a sensible rule of thumb that we can expect her to adopt?

A rational approach, in this case, would be to envisage a “conservative” estimate of what the owner can get if there is a successful bid in the auction for her firm. The minimum price  $\tilde{P}$  satisfies  $\tilde{P} = mB$ . Let  $\tilde{q}$  be the value of  $q$  that minimises  $\Pi$ . Then, the most conservative estimate of the expected value of the firm would be

$$\tilde{\Pi} = \frac{Y - B(1 - \tilde{q}m)}{r + \tilde{q}}. \tag{2}$$

As the company’s owner does not know the form of the dependence of  $q$  on  $B$  and the other parameters, then, in the spirit of the maximin approach,  $q$  is allowed to vary for a fixed  $B$ . Thus, to ensure the minimisation of  $\tilde{\Pi}$  with respect to  $\tilde{q}$  for all values of  $B$ , we search for a critical point, first by differentiating  $\tilde{\Pi}$ ,

$$\frac{\partial \tilde{\Pi}}{\partial \tilde{q}} = \frac{B(1 + rm) - Y}{(r + \tilde{q})^2}, \tag{3}$$

and then setting  $\frac{\partial \tilde{\Pi}}{\partial \tilde{q}} = 0$  at  $B = \hat{B}$ .

This entails:

$$\hat{B}(1 + rm) - Y = 0, \quad \text{that is} \quad \hat{B} = \frac{Y}{1 + rm}, \tag{4}$$

so that we have:

$$\text{if } B = \hat{B}, \quad \text{then } \tilde{\Pi} = \hat{\Pi} = \frac{mY}{1 + mr} \quad \text{for all } \tilde{q}. \tag{5a}$$

If the owner of the Company A chooses to pay  $B > \hat{B}$ , then  $\frac{\partial \tilde{\Pi}}{\partial \tilde{q}} > 0$ . The lower  $\tilde{q}$  is, the lower the expected value  $\Pi$  is. Its minimum value will be attained when  $\tilde{q} = 0$ . If

she pays a lot to secure a high floor price for the auction, then the lower the probability of a sale is, the more likely the scenario in which her high payment goes “wasted” is. Plugging  $\tilde{q} = 0$  in (2), we set:

$$\text{if } B > \hat{B}, \quad \text{then } \tilde{\Pi} = \frac{Y - B}{r}. \tag{5b}$$

Conversely, if she chooses to pay  $B < \hat{B}$ , then  $\frac{\partial \tilde{\Pi}}{\partial \tilde{q}} < 0$ . The higher  $\tilde{q}$  is, the lower the expected value  $\Pi$  is. Its minimum value will be when  $\tilde{q} = 1$ . If she pays a very low tax that implies a very low floor price, then the higher the probability of a sale is, the more likely the scenario in which she sells the firm for a price below its value is. Plugging  $\tilde{q} = 1$  in (2), we set:

$$\text{if } B < \hat{B}, \quad \text{then } \tilde{\Pi} = \frac{Y + (m - 1)B}{1 + r}. \tag{5c}$$

Putting together Eq. (5), we obtain  $\tilde{\Pi}$  as a piece-wise function of  $B$ :

$$\tilde{\Pi} = \begin{cases} \frac{Y+(m-1)B}{1+r} & \text{if } B < \hat{B} \\ \frac{mY}{1+mr} & \text{if } B = \hat{B} \\ \frac{Y-B}{r} & \text{if } B > \hat{B} \end{cases}. \tag{6}$$

Consequently, the minimum  $\tilde{\Pi}$  is monotonically increasing for  $B < \hat{B}$ , monotonically decreasing for  $B > \hat{B}$  and has a maximum in  $\hat{B}$ . That is why choosing  $B = \hat{B}$  is the most rational choice for the owner of Company A. Corneo explains the strengths of this elegant approach to derive  $\hat{B}$  as follows:

“to compute it, no expectations about the bidder’s behaviour (functions  $q$  and  $P$ ) must be formulated. The government in a market socialist economy could easily inform the owners of private firms about this possibility they have” (Corneo 2019, 46).

### 5 An alternative derivation of the voluntary contribution

The conclusion presented in Sect. 4 faces three different challenges:

- (a) to minimise the value of  $\Pi$  without knowing the function  $q = f(B)$  we assume that  $\tilde{q} = 1$  as soon as  $B$  is marginally smaller than  $\hat{B}$ , and we assume that  $\tilde{q} = 0$  as soon as  $B$  is marginally higher than  $\hat{B}$ . A rational agent could struggle to build her strategy for the choice of  $B$  on such extreme, binary assumptions;
- (b) the calculation of  $\hat{B}$  is made with no expectations of the function  $q = f(B)$ . Therefore, the resulting optimal voluntary contribution may differ from the strategic contribution  $\hat{B}$  suggested by Corneo’s maximin approach. Still, the value of  $\hat{B}$

- should be compatible with a robust range of reasonable (monotonically decreasing) functions that link the probability of a sale to the level of the voluntary contribution;
- (c) it would be easy for the government to “inform the owners of private firms about” the value of  $\hat{B}$ , but much less easy to communicate the reasoning behind, to show why  $\hat{B}$  maximises the expected value of the firm through the derivation of equation (6).

In this section we will deal with point (a) and (c) by presenting an alternative derivation of the strategic voluntary contribution  $\hat{B}$ .

In the next section we will focus on the compatibility of the result reached in Sect. 4 with a reasonable family of (monotonically decreasing) functions relating the probability of a company to be sold on auction  $q$  to the voluntary contribution  $B$  (point b)).

We would like our alternative solution to satisfy the following characteristics:

- (1) it provides a reasonable strategy for the company’s owner to set the voluntary contribution, in the absence of any knowledge about the functional dependence of  $q$  on  $B$ ;
- (2) it is not based on complex maximin procedure, and therefore it is very easy to communicate and explain;
- (3) it comes to the same conclusion reached in Corneo (2019), so that it keeps one of the main strengths of that mechanism:  $\hat{B}$  reproduces the same outcome one would have if the firm’s profit was taxed at a rate  $\tau = \frac{1}{mr+1}$  in a standard capitalist economy.

We assume that once the owner of Company A chooses a value of the voluntary contribution  $B$ , she will stick to this decision in the subsequent periods if the conditions of her choice are not changed. We can distinguish two different scenarios:

Scenario (1) If there are no successful bids in the auction, she will keep her firm. The present value of the firm in this case is:

$$\Pi = \frac{Y - B}{r}, \quad (7)$$

where  $Y - B$  is the net profits (gross profits minus the voluntary contribution) of the firm in each period; the lower the value of  $B$ , the higher is the net profit and therefore the present value of the firm.

Scenario (2) If there is a successful bid in the auction, the owner of company A gets at least  $mB$ ; the higher the value of  $B$ , the higher is the compensation she will get for the nationalization of her firm.

It is clear that in Scenario 1 the owner of Company A benefits from a low value of  $B$ , whereas in Scenario 2 she benefits from a high value of  $B$ . She does not know which scenario is more likely. The most sensible choice is to set a value of  $B$  so

that she will be equally satisfied in both scenarios. She will be equally satisfied if the present value of the firm is equal to the compensation for the nationalisation:

$$\frac{Y - B}{r} = mB. \tag{8}$$

If we solve Eq. 8 for  $B$  we get:

$$B = \frac{Y}{1 + rm} \tag{9}$$

which is the same value as  $\hat{B}$  derived in Corneo (2019). We think the procedure described in Eqs. 8 and 9 presents the characteristics described in points (1), (2), (3) above. In the next section, we will refer to this “strategic” contribution as  $\hat{B}$  to emphasise that it aligns with the value obtained through Corneo’s maximin approach.

### 6 Embedding a probability function into the takeover mechanism

Given a specific functional dependence of the probability of being sold at an auction ( $q$ ) on the voluntary contribution ( $B$ ), an optimal voluntary contribution (calculated as below) may differ from the strategic contribution  $\hat{B}$ .

Still, the value of  $\hat{B}$  should be compatible with a robust range of reasonable (monotonically decreasing) functions.

Observe that, for the sake of our analysis, we are focussing here only on the dependence of the probability on the voluntary contribution, neglecting the potential dependence on other relevant factors, such as the company value.

The simplest way to model  $q \equiv q(B)$  is to assume that  $q$  is 1 if the owner of Company A sets the contribution  $B$  to zero, and decreases monotonically, reaching the asymptotic value  $q = 0$  when the contribution is theoretically infinite, so that  $q$  is never exactly zero for any level of contribution, but becomes negligible for large contributions. The simplest of these families assumes a hyperbolic dependence of  $q$  on  $B$ , in the form

$$q \equiv q(B) = \frac{1}{1 + K \left( \frac{B}{Y} \right)}, \tag{10}$$

where  $K$  is a positive, real parameter, potentially depending on the annual profit  $Y$ , the interest rate  $r$ , and the multiplier  $m$ . We have highlighted the dependence of  $q$  on  $B$  via the dependence on the voluntary taxation rate  $\frac{B}{Y}$ .

We start by plugging (10) into (2), maintaining the most conservative estimate of the expected value by setting the lowest selling price  $\hat{P} = mB$  in the same spirit of the maximin approach, as we look for a maximiser of the minimum expected value  $\hat{\Pi}$  with respect to  $B$ . We first compute

$$\frac{d\tilde{\Pi}}{dB} = \frac{[(m - 1)(r + 1) + K]Y^2 - 2BK(r + 1)Y - rB^2K^2}{[Y(r + 1) + rBK]^2}, \tag{11a}$$

for which the condition of maximisation,  $\frac{d^2\tilde{\Pi}}{dB^2} < 0$ , is automatically satisfied for all  $B > 0$  (as it can be easily verified after a tedious computation). Finally, we solve  $\frac{d\tilde{\Pi}}{dB} = 0$  with respect to  $B$ , obtaining

$$\left. \frac{d\tilde{\Pi}}{dB} \right|_{B=\hat{B}_{op}} = 0 \text{ for } \hat{B}_{op} = \frac{[-(r + 1) + \sqrt{1 + r(mr + r + K + 1)}]Y}{Kr}, \tag{11b}$$

where the subscript ‘‘op’’ indicates the optimal character of the contribution, and where we have considered the only root of the second-degree equation resulting from setting the first derivative to zero returning positive values. In particular, we have  $\hat{B}_{op} \geq 0$  either for all  $K > 0$  when  $m > \frac{1}{r}$ , or for  $K \geq 1 - mr$  when  $0 < m < \frac{1}{r}$ ; this latter choice is usually outside the range of values of interest for the multiplier  $m$ , but can be relevant when the interest rate  $r$  is particularly small. Substituting (11b) into (10), we have that the probability of nationalisation if paying the optimal voluntary contribution  $\hat{B}_{op}$  is:

$$q_{op} = \frac{1 + \sqrt{1 + r(mr + r + K + 1)}}{mr + r + K + 1}, \tag{12}$$

whereas the minimum expected value  $\tilde{\Pi}$  is

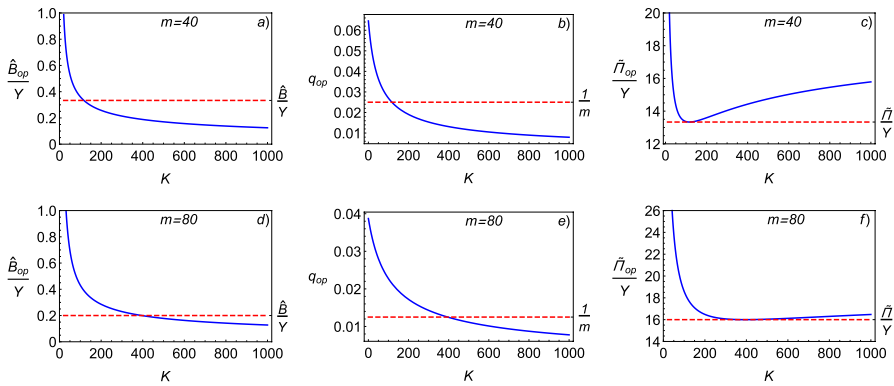
$$\tilde{\Pi}_{op} = \frac{[2 + (K + m + 1)r - 2\sqrt{1 + r(mr + r + K + 1)}]Y}{Kr^2}. \tag{13a}$$

This quantity is positive for all choices of  $m, r > 0$  if  $K > 1$ ; whereas, for  $0 < K \leq 1$ , this quantity is positive either for  $0 < m < m_*$  and  $0 < r < r_*$ , or for  $m > m_*$  and  $r > 0$ , with

$$m_* = 1 - K + 2\sqrt{1 - K}, \quad r_* = \frac{4m}{(3 - m)(1 + m) - 2K(1 + m) - K^2}. \tag{13b}$$

As  $K$  approaches infinity, the minimum expected value  $\tilde{\Pi}_{op}$  asymptotically approaches  $\frac{1}{r}$ : in other words, for large  $K$ , the minimum expected value  $\tilde{\Pi}_{op}$  tends to show less and less dependence on  $m$  and  $K$ .

Both functions,  $q_{op}$  and  $\tilde{\Pi}_{op}$ , are shown in Fig. 1, along with  $\frac{\hat{B}_{op}}{Y}$ , for typical values of  $m$  and  $r$  as suggested in (Corneo 2019, p. 47), the second function in the form of the ratio  $\frac{\tilde{\Pi}_{op}}{Y}$ . As expected, the qualitative behaviour does not change as one varies the parameter  $m$ , whereas the most macroscopic effect of changing the parameter  $r$  is only that of affecting the horizontal asymptote attained by the ratio between the minimum expected value  $\tilde{\Pi}_{op}$  and the profit  $Y$  as  $K$  increases.



**Fig. 1** Plot of  $\frac{\hat{B}_{op}}{Y}$  (left),  $q_{op}$  (centre) and  $\frac{\hat{\pi}_{op}}{Y}$  (right) as functions of  $K$ , for typical values of  $m$  ( $m = 40$  in Fig. 1a, b, and c; and  $m = 80$  in Fig. 1d, e, and f) and  $r = 0.05$ . The red dashed lines represent the value  $\hat{B} = \frac{1}{1+r}$  (left),  $q = \frac{1}{m}$  (centre) and  $\frac{\hat{\pi}}{Y} = \frac{m}{m+r+1}$  (right), which are attained for  $K = \bar{K}$ , see (14)

By comparing (11b) with (4), we see that the optimal contribution  $\hat{B}_{op}$  does differ from the strategic contribution  $\hat{B}$  (as derived from the maximin approach or the rule of thumb), and features an explicit dependence on the probability function via the dependence on the external parameter  $K$ . In general, if a hyperbolic model is assumed to be valid, the value of  $K$  can be estimated using linear regression on data collected from past rounds of auctions, observing the frequency of nationalisation for companies with a comparable ratio between voluntary contribution and value. Moreover, it is possible to imagine that changes in  $m$  and  $r$  may affect the probability too: in a hyperbolic model, this effect can be introduced by adding an explicit dependence of  $K$  on  $r$  and  $m$ , which—in a real world scenario—can be again reconstructed by observing several rounds of auctions over a long period.

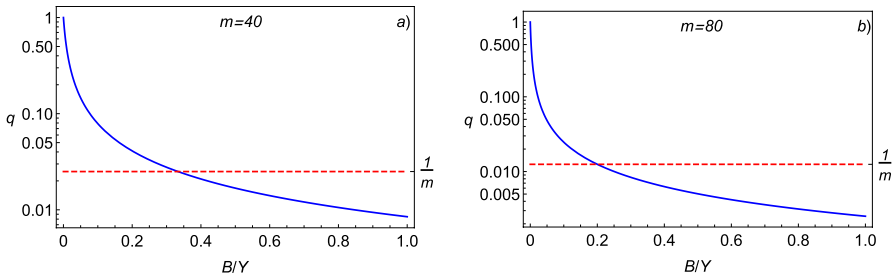
The optimal contribution  $\hat{B}_{op}$  matches the strategic contribution  $\hat{B}$  only for a special choice of the parameter  $K$ , namely for  $K = \bar{K}$ , with

$$\bar{K} = (m - 1)(m r + 1). \tag{14}$$

Substituting this latter value of  $K$  into the original model (10) for the probability  $q$ , we have the neat expression:

$$\bar{q} \equiv \bar{q}(B) = \frac{1}{1 + (m - 1)(m r + 1) \left(\frac{B}{Y}\right)}. \tag{15}$$

When  $B = \hat{B}$ , formula (15) gives  $q = \frac{1}{m}$ , namely the probability of sale is equal to the inverse of the multiplier, which is externally set by the state, irrespective of the annual profit  $Y$ .



**Fig. 2** Semi-log plot of  $q$  as a function of  $\frac{B}{Y}$  (continuous line in blue), for typical values of  $m$  ( $m = 40$  in Fig. 2a; and  $m = 80$  in Fig. 2b) and  $r = 0.05$  and  $K = \bar{K}$  ( $\bar{K} = 117$  in Fig. 2.a;  $\bar{K} = 395$  in Fig. 2b). The red dashed line represents the value of  $q = \frac{1}{m}$  ( $\frac{1}{m} = \frac{1}{40} = 2.5\%$  in Fig. 2a;  $\frac{1}{m} = \frac{1}{80} = 1.25\%$  in Fig. 2b) when  $B = \hat{B}$

For all  $K \neq \bar{K}$ , then the minimum expected value  $\tilde{\Pi}_{op}$  for the company A achieved if the owner pays the optimal voluntary contribution  $\hat{B}_{op}$  is greater than the minimum expected value  $\tilde{\Pi}$  achieved if the owner pays the strategic voluntary contribution  $\hat{B}$ . For  $m > 1$  and  $K > \bar{K}$ , the optimal voluntary contribution  $\hat{B}_{op}$  is less than the strategic voluntary contribution  $\hat{B}$ , and the probability of takeover  $q_{op}$  becomes less than  $\frac{1}{m}$ . On the contrary, for  $m > 1$  and  $0 < K < \bar{K}$ , the optimal voluntary contribution  $\hat{B}_{op}$  is greater than Corneo’s strategic voluntary contribution  $\hat{B}$ , and the probability of takeover  $q$  is greater than  $\frac{1}{m}$ .

Two further, interesting conclusions can be drawn from the economic interpretation of these results:

- (1) The parameter  $K$  can be interpreted as a characterisation of the behavior of the participants in the private firm auctions. Indeed, the higher  $K$ , the faster  $q$  decreases as the voluntary contribution increases. For very high values of  $K$ , even small voluntary contributions are sufficient to secure Company A from being sold at the auction; on the contrary, for low values of  $K$ , substantial voluntary contributions are necessary to decrease the probability of being sold at the auction. In the context of a highly consolidated public sector, comprised of a small number of large corporations with substantial spending capacity, we can expect a lower  $K$ , which results in a slower decay of the  $q$  function. When  $K < \bar{K}$ , as we have previously discussed, a private company owner following the rule of thumb suggested by the strategic contribution  $\hat{B}$  is underpaying. They miss out on the opportunity to be nationalised and receive a sale payment that is a multiple of the voluntary contribution. In other words, as  $K$  decreases, the probability of nationalisation for relatively low voluntary contributions increases: the disparity between what an owner receives in the event of nationalisation following the payment of  $\hat{B}$  and what they could have received by choosing  $\hat{B}_{op}$  weights more on the calculation of the expected values of the firm. This is why the payoff differentials become larger when  $K$  becomes very small (as shown on



the right side of Fig. 1). Said that, however, these differentials are overall small, as they amount to a few percentage points of  $\frac{\bar{\Pi}}{Y}$  for a broad range of values of  $K$ .

(2) In Fig. 2 we have illustrated the behaviour of  $q$  as a function of  $B$ , for  $K = \bar{K}$  and for typical values of  $m$  and  $r$  as suggested in (Corneo 2019, p. 47). The probability  $q$  does not change significantly for  $\frac{B}{Y}$  in a neighborhood of  $\frac{\hat{B}}{Y}$ , remaining in the order of magnitude of  $10^{-2}$  around the value  $\frac{1}{m}$ . The political consequence of this is that the strategy played by the owner of the  $m$  Company A has potentially little effect on the speed of the nationalisation process, which is mostly regulated—rather than by the private agents—by the state policymakers who control the parameter  $m$ . For values of  $m$  in the range considered by Corneo (approximately,  $40 \leq m \leq 80$ ), the probability  $q = \frac{1}{m}$  can be small, but never negligible, and in the long run multiple nationalisations can take place (as the expected value of nationalised companies grows as  $\frac{N}{m}$  per annum, where  $N$  is the number of active companies in the year in the country).

Another simple and natural choice for the dependence of the probability for the Company A to be sold at an auction,  $q$ , on the voluntary contribution,  $B$ , would be that given by assuming a logistic function, for instance in the form

$$q \equiv q(B) = \frac{K_1 + 1}{K_1 + e^{K_2 \left(\frac{B}{Y}\right)}}, \tag{16}$$

where  $K_1 \geq 0$  and  $K_2 > 0$  are two real parameters, so that  $q$  is 1 for  $B = 0$  and tends to 0 as  $B$  approaches infinity, being convex for  $0 < K_1 \leq 1$ , or featuring an inflection point at  $\frac{B}{Y} = \frac{\ln(K_1)}{K_2}$  when  $K_1 > 1$ . However, in this case, the condition for the maximisation of the minimum expected value  $\bar{\Pi}$  of Company A with respect to  $B$  would return a polynomial-exponential transcendental equation in the variable  $B$  that, for generic (and economically relevant) choices of  $K_1$  and  $K_2$  cannot be written explicitly in closed form in terms of elementary functions and of the Lambert function. For all relevant choices of  $K_1 \geq 0$  and  $K_2 > 0$ , the values of  $B$  at which the maximum of the minimum is attained can be computed numerically. Such analytical and numerical study would exceed the aims and scopes of the present work and is left to future investigation.

Different other models for the probability  $q$  are possible. For instance, one could imagine that the probability depends linearly on  $B$ , interpolating between 1 when  $\frac{B}{Y} = 0$ , and the value  $0 \leq \alpha < 1$  when  $\frac{B}{Y} = 1$ , in the form

$$q \equiv q(B) = 1 - (1 - \alpha) \frac{B}{Y}. \tag{17}$$

Applying the same method illustrated above for the hyperbolic dependence of  $q$  on  $B$ , one can determine the optimal value of voluntary contribution corresponding to the maximisation with respect to  $B$  of the minimum of the expected value  $\Pi$ . This turns out to be properly defined for all values of  $\alpha$  in the interval  $[0, 1)$  if and only if  $m > 1$  (which is a reasonable condition from an economics point of view). However,

it is quite immediate to verify that a value of  $\alpha$  for which the optimal contribution matches the strategic contribution  $\hat{B}$  exists if and only if  $m > 1$  and  $0 < r < \frac{1}{m(m-1)}$ , namely only for exceedingly small values of the interest rate. In other words, if the probability depends linearly on the voluntary contribution, in a normal scenario with a realistic value of the interest rate, the optimal and the strategic approach are unrec- oncilable: in practical terms, a company's owner (unaware of how the voluntary contribution affects the probability) paying the strategic contribution will incur in a probability of being nationalised that is even four times the probability of being nationalised had she paid the optimal contribution (which requires knowledge of how the contribution affects the probability).

Although the linear probability model has mainly an academic interest, it serves as a further example to illustrate how the strategic contribution may differ from the optimal contribution ensuing from the knowledge of how the probability depends on the contribution  $B$ .

The analysis conducted in this section can be summarised as follows:

- (i) The strategic contribution  $B = \hat{B}$  appears to be compatible with reasonable functions that link  $q$  to  $B$ . When the probability depends hyperbolically on the contribution (10),  $B = \hat{B}$  coincides with the optimal contribution  $\hat{B}_{\text{op}}$  only for a specific value of the parameter  $K = \bar{K}$ , see (14). For other values of  $K$ , the differences in the payoff between the strategic and the optimal behavior are limited (within a wide range of values for  $K$ ). The strategic contribution appears to be a quite effective rule of thumb, both when the institutional mechanism for the nationalisation of private firms is introduced (and the function  $q(B)$  is still unknown), and when it is fully operational.
- (ii) When the parameter of Eq. (10) is such that the payoff differential between the strategic and optimal contributions is more significant, we can expect the agents to initially adopt the strategic contribution and then switch to the optimal contribution once they start to learn the actual probability function and can carry out proper expected value maximisation calculations. However, the study we have conducted through Eq. (16) shows that it is not always possible to obtain optimal contribution values explicitly in closed form in terms of elementary functions. The procedure of the maximisation of the minimum of the expected value can be extremely complex, and the exact probability function can be difficult to discover. The latter could also evolve as the structures of the public and private sectors are affected by the nationalisation process. For all these reasons, it seems that relying on a preliminary rule of thumb is justified.
- (iii) Not all reasonable functions for the probability  $q$  are compatible with the strategic contribution (e.g. the linear function (17)), meaning that there might be a range of values for the parameters  $m$  and  $r$  such that the strategic contribution  $\hat{B}$  never coincides with the optimal contribution. In such cases, we would expect the transition of the agents from the strategic contribution to the optimal contribution to be faster, conditional on the stability of the probability function (as discussed in point ii) above).

## 7 Conclusions and outlooks

In this paper, we have surveyed the historical reasons of distrust towards “models” by socialist thinkers and analysed the characteristics of the renewed interest in market socialism as a contemporary project for a post capitalist economy. We have focused on Giacomo Corneo’s idea of “Shareholder Socialism” as one of the most complete and promising proposals in this field.

In Corneo’s two-sector economy model, enterprises can be nationalised in annual rounds of mandatory second-price seal-bid auctions in which large state-owned corporations can participate. Private firms pay a yearly voluntary contribution in the absence of taxes on profits; such voluntary contribution is used to set the floor price of the auction.

Corneo employs a game-theory-inspired maximin principle to determine a strategic level of contribution  $\hat{B}$  that the company’s owner would pay to maximise the company’s expected value, given the annual profit, the current interest rate and the multiplier by which the contribution is scaled. In this work, we suggest an alternative, simpler derivation of  $\hat{B}$  in the absence of knowledge of how the probability of takeover depends on a company’s voluntary contribution. Our approach is based only on cost-benefit balancing, and hence the justification of the strategic contribution is more amenable of being proficiently communicated to the agents by the public authority.

It is worth observing that the mechanism envisaged by Corneo and further developed in this paper can have multiple applications apart from the “transition to socialism” that represents the background of our works. In general, it provides an elegant solution to the problem of extracting correct information from economic agents by the public authority. This is a problem affecting socialist and capitalist economies alike, as brilliantly summarised by Alberto Chilosì as follows:

“In socialism, the producers tried to hide their real productive capacities from the planner, in order not to be given too unreasonable production objectives and to be able to receive their bonuses. In capitalism, the producers try to hide their real ability to earn from the public authority, in order to pay less taxes.” (Carnevali and Pedersen Ystehede 2022, p.13).

As already noted by Chilosì (see (Carnevali and Pedersen Ystehede 2022, p.13), such communication in economic systems can be treated as a game theory model with asymmetrical distribution of information among the relevant agents. In view of future studies, it might be interesting to extend Corneo’s idea to other areas of interaction between the private sector and the public authority (from environment protection regulation to tax collection and public finance).

Rather than on the transition from a capitalist to a socialist economy, a different direction of research could focus on the dynamics of the mechanism once that market socialism has been established. In that case, it could be possible to loosen the assumption that the agent does not have any knowledge about the functional dependence of  $q$  on  $B$  (and we could also hypothesise the probability of takeover to depend on the profits). Within this framework, the problem is open to be investigated through a series of numerical simulations, with the agents gradually adjusting

their behaviour while they reconstruct the probability function (via statistical fitting of models to auction data).

A further direction of investigation would be to extend Corneo's model to depend on time by allowing the annual profit  $Y$  to vary on a yearly basis, either in a deterministic manner (e.g., assuming a constant, positive growth rate, or assuming monotonic convergence to an asymptotic value) or via a stochastic process (e.g., as an Ornstein-Uhlenbeck process, or more in general as a process displaying mean-reversion).

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## Declarations

**Conflict of interest statement** The authors report there are no competing interests to declare.

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