# From market failure to missing markets: the change in the notion of equilibrium and welfare economics

Franklin Serrano[1]

Gabriel Aidar

## Abstract

Garegnani (1976) drew attention to the major methodological shift in neoclassical theory from the traditional method of long-period equilibrium to the method of intertemporal equilibrium. Our contribution in this paper consists of showing that this change has had a key influence on neoclassical welfare theory's evolution, specifically on the way externalities are dealt with under the assumption of complete future markets. Such analyses have changed from the original approach in Pigou's *The Economics of Welfare*, focused on what is now known as market failure, to the focus on the notion of missing markets, pioneered by Coase (1960) and Arrow (1969). In this context, we also apply the Sraffian theoretical and methodological critiques to both the older market failure and the newer missing market approaches to neoclassical welfare theory. The results of this paper reinforce Garegnani's (2007) position on the inadequacy of the neoclassical approach to welfare economics in general and of the notion of Pareto-efficiency in particular.

**Keywords: History of Economic Thought; Sraffian; Welfare Economics**

**JEL Classification: B10; B24; D60**

[1]Associate Professor and PhD Candidate at the Universidade Federal do Rio de Janeiro. Email: franklin.serrano@gmail.com

We thank Fabio Petri, Tony Aspromourgos and Lucas Teixeira for comments on an early version of this draft. All errors and shortcomings are our own.

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.

## 1. Introduction

The existence of market failure in Neoclassical economics corresponds to situations in which competitive markets do not produce a Pareto-efficient allocation[1]. In other terms, the first welfare theorems do not hold. Consequently, the competitive market equilibrium is not Pareto-efficient. Market failure is generally associated with the concept of externalities[2]. In their textbook on the economics of the public sector, Stiglitz and Rosengard (2015, chap. 4) present externalities as one of five other sources of market failure. The authors dedicate one chapter to this concept. In Mas-Colell et al. (1995, chap. 11), externalities and public goods are presented as sources of market failure that prevent the Pareto-efficient outcomes of the competitive general equilibrium model. Externalities are then central in neoclassical economics to guide State intervention in market economies.

The concept of externalities is generally understood as external effects that may affect consumers' utility, or firms' production functions. Both textbooks mentioned above provide two kinds of solutions to externalities that can restore Pareto-efficient market equilibrium. One solution is the pigouvian taxes/subsidies. The other solution is propriety rights enforcement, which 'internalize' externalities under the conditions of the Coase Theorem. Stiglitz and Rosengard (2015, chap. 6) call the former "Public Sector Solutions" and the latter "Private Solutions" to externalities.

We argue in this essay that the different solutions indicated to the externalities problem for neoclassical economics were, in fact, sequential instead of parallel solutions. We show how the understanding of this concept changed over time in the historical development of neoclassical theory. From the original concept of external economies, in Book IV of Marshall's *Principle of Economics* and Pigou's *Economics of Welfare*, to the formal presentation of externalities as missing markets in Arrow (1969), we see a shift in the neoclassical understanding of the notion and causes of externalities.

In its initial treatment, externalities are defined as a market failure that prevent the equalization of marginal private net product and marginal social net product[3]. As initially discussed by Pigou (1932) in a marshallian long-period equilibrium framework, the solution for the market failure is the introduction of subsidies or taxes. Unlike this approach, Arrow (1969) puts forth a formal presentation of externality as caused exclusively by missing markets in an intertemporal competitive general equilibrium framework. Thus, the latter development implies market (or private) solutions to externalities as the right incentives through newly created or reformed markets. In this case, the neoclassical answer is 'more markets' instead of 'market correction'.

This change is already identified in the literature (Berta, 2017; Papandreou, 1994). Our contribution is to add what seems to be another relatively little-noticed consequence of the major change in neoclassical economics's concept of equilibrium as initially shown by Garegnani (1976). Neoclassical economics's major change has transformed general equilibrium theory from its long-period version to its new intertemporal form as

---

1 As it is largely known, Pareto-efficiency, in a production economy, is defined as a situation in which any change in the given allocation of goods and factors inputs will cause a decrease in the production of at least one firm and a decrease in the utility of at least one consumer. A formal treatment can be found in chapters 3 and 14 in Petri (2021).

2 This essay deals only with competitive markets. Therefore, for simplicity, we do not deal with the neoclassical discussion of market failure related to non-competitive markets.

3 See chapter IX from Pigou (1932).

developed, for instance, by Debreu (1959)[4]. A critical assumption of this version is complete markets[5], which is used to derive the first theorem of welfare economics. We argue that this new concept of equilibrium is central to understanding the shift in the approach to externalities. Therefore, although both notions of externalities (market failure and missing market) are still presented today, the more formal derivations of externalities in the context of intertemporal general equilibrium is connected to the concept of missing markets, as clearly put forth by Mas-Colell et al. (1995, p. 358).

Once we associate the changing notion of externalities with the emergence of the new notion of intertemporal general equilibrium, we can apply the criticism of neoclassical welfare theory in both the market failure and missing market versions. In the former, the indeterminacy of the long-period equilibrium (Garegnani, 1990) means the theoretical impossibility to determine Pareto-efficiency, and reverse capital deepening and reswitching also undermine the tendency towards full employment. In the latter, the assumption of complete markets (including future markets) is very unrealistic, and so are the conditions necessary for the economy to reach this sequency of equilibria (Petri, 2021, chap. 14)[6]. Our conclusions reinforce Garegnani's (2007) position on the inadequacy of the neoclassical approach to welfare economics in general and of the notion of Pareto-efficiency in particular.

The paper is divided into six sections. After this introduction, a brief description of the change in the notion of equilibrium in neoclassical economics is provided (section 2). We then present the original concept of external economies as found in Marshall's *Principle of Economics*, Pigou's *Economics of Welfare*, and other developments from the 1950's that provided more explicit definitions of externalities as a market failure (section 3). Next, we show the change in the concept of externalities and its connection to the major shift in the neoclassical notion of equilibrium (section 4). In the subsequent section, we discuss the Sraffian criticism of neoclassical welfare analysis based on the concept of externalities in the long-period and intertemporal versions of neoclassical general equilibrium (section 5). Final remarks close the essay (section 6).

## 2. The change in the notion of equilibrium in neoclassical economics

Neoclassical authors such as Wicksell and Marshall have worked with the method of long-period equilibrium positions associated with a uniform rate of profit and constant equilibrium relative prices. These theoretical prices of goods and factors of production explained by the theory were understood as gravitational centers around which the actual prices fluctuate (Garegnani, 1990). According to this tradition, the forces determining the long-period method's theoretical variables are more persistent than the numerous events and accidents that may affect the actual or observed variables. It does not mean that the independent variables that determine the equilibrium (preferences, technology and factor endowments) do not change, but they change more gradually than actual market prices. In this approach, the representation of a uniform rate of profit, around which the actual rates of profit gravitate, is central feature of the assumption of

[4] Garegnani (1976) stresses a second possibility, which is *temporary* equilibrium as originally developed by Hicks (1946).

[5] In case of temporary equilibrium, one has to assume that price expectations are based on perfect foresight (Petri, 2021).

[6] These problems may explain why the market-failure approach to externalities remains in the microeconomic textbooks. See, for instance, Mas-Colell et ali. (1995, chap. 11).

free competition among firms in all sectors. The condition of a uniform rate of profit requires that the composition of the capital endowment is endogenously adjusted while the total amount of capital in real terms is fixed.

In the Intertemporal General Equilibrium (IGE) model, this old tradition of a long-period equilibrium is abandoned in favor of a 'very' short-period analysis (Petri, 2021, chap. 8), in which both the size and composition of the initial capital endowment are taken as given in physical terms. This assumption is not compatible with a uniform rate of profit (Garegnani, 1990). Moreover, instead of an atemporal equilibrium position, there is a sequence of equilibrium positions corresponding to each period. Hence, one of the crucial assumptions in the IGE approach is the completeness of markets, including futures markets. So, instead of having long-period equilibrium prices, we have a path of short-run equilibrium prices, and the economy is supposed to be in its equilibrium position at each moment of time.

Garegnani (1976, 1990) and Petri (1978) argue that the change from the notion of the long-period equilibrium to the IGE is a consequence of the difficulties of measuring the quantity of capital independently of distribution.

After this very brief discussion of the change in the notion of equilibrium in neoclassical economics, we will show, first, the original version of the concept of externalities as developed by Marshall and Pigou. In the sequence, we present how Arrow's (1969) contribution to the notion of externalities as missing markets is a formal consequence of the shift in neoclassical economics towards the IGE approach.

## 3. External economies and market failure

### 3.1. Marshall's approach to external economies

The concept of external economies is put forth in the Book IV of the *Principles of Economics* (Marshall, 1920[2013]). Marshall presents in this volume his supply theory by introducing the determinants of land and labor supply and the determinants of returns of scale in the industries – among which he highlights the division of labor, the use of machinery, the industrial localization, the scale of production and the business management. According to Mongiovi (1996), one of Marshall's main interests in his discussion of the supply is to deal with increasing returns, which he had considered an empirical element of a growing economy.

Marshall (1920[2013]) summarizes the distinction between what he considers internal and external economies:

> We may divide the economies arising from an increase in the scale of production of any kind of goods, into two classes-firstly, those dependent on the general development of the industry; and, secondly, those dependent on the resources of the individual houses of business engaged in it, on their organization and the efficiency of their management. We may call the former external economies, and the latter internal economies. In the present chapter we have been chiefly discussing internal economies; but we now proceed to examine those very important external economies which can often be secured by the concentration of many small businesses of a similar character in particular localities: or, as is commonly said, by the localization of industry (Marshall, 1920[2013], p. 221).

Whereas the internal economies are correlated with labor division and the increase in machinery usage, the external economies have their causes found in the geographical concentration of specialized industries. Consequently, external economies allow for increasing returns for the industry where firms are too small to observe internal returns of scale:

> Again, the economic use of expensive machinery can sometimes be attained in a very high degree in a district in which there is a large aggregate production of the same kind, even though no individual capital employed in the trade be very large. For subsidiary industries devoting themselves each to one small branch of the process of production, and working it for a great many of their neighbours, are able to keep in constant use machinery of the most highly specialized character, and to make it pay its expenses, though its original cost may have been high, and its rate of depreciation very rapid (Marshall, 1920[2013], p. 225)[7].

In addition to the concentration of specialized industries, Marshall mentions throughout his Book IV other potential causes of external economies, such as reductions in transportation costs, improvements in communication, and the publicization of technical knowledge. In this sense, Marshall's view on the potential increasing returns in the industries is compared to Adam Smith's insights on the division of labor and cumulative processes in the accumulation process, as suggested by Vaggi and Groenewegen (2003, p. 233) and by Toner (1999, p. 8).

However, Marshall's analysis is based upon the neoclassical competitive long-period equilibrium. Therefore, decreasing returns, which are needed in order to derive the supply curve, are not compatible with his inquiry on increasing returns. As Sraffa (1925, 1926) showed, the only way to make Marshall's observations in Book IV consistent with a neoclassical partial equilibrium model would be to consider only external economies to the firms but internal economies to the industry. Nonetheless, some of the examples given by Marshall, such as a reduction in transportation costs or the publicization of technical knowledge seem impossible to be limited only to one particular industry (Mongiovi, 1996).

Due to the problems that increasing returns brought to the neoclassical approach, we distinguish the debate that followed Marshall's Book IV in three different ramifications. The first one is derived from the cost controversy of the 1920's (Brondino and Lazzarini, 2017) and resulted in the models of imperfect competition, such as Robinson (1933) and Chamberlin (1933). A second branch, which could also be connected to the cost controversy, is the debate around the 'empty boxes' (Clapham, 1922) and the literature on increasing returns such as Young, Rosenstein-Rodan, Hirschmann, Myrdal and Kaldor (Toner, 1999). Finally, the third segment was pursued by Pigou (1932). Pigou embraces the concept of external economies in the *Economics of Welfare* as central to the analysis of welfare. It is worth saying that although Marshall deals with welfare analysis establishing the concepts of consumer's and producer's surplus (respectively on Chapter VI, Book III, and Chapter IX, Book IV), it is Pigou who proposes the connection between external economies and the welfare analysis. That is why the rest of this section deals with the pigouvian approach to external economies.

[7] It is worth mentioning that Marshall (1920[2013]) discuss mostly cases of increasing returns (either internal or external) for industries. Although decreasing return is not discarded, its causes are limited to managerial complexity of growing firms in Chapter XII.

### 3.2. Applying the external economies concept to the welfare analysis: Pigou's formulation

We limit our analysis in this essay to Pigou's welfare theory as presented in the *Economic of Welfare*. In Part I of Pigou (1932), he connects the measure of welfare to his definition of national dividend in the economy. By national dividend, Pigou understands the total amount (in money value) of goods and services produced each year minus the expenses to keep the stock of capital intact (Pigou, 1932, Part I, Chapter III). Since welfare and the national dividend are related, the maximum national dividend is also the economy's maximum welfare. Additionally, Pigou considers the optimality of the national dividend distribution in Part II of his work. Here, the core idea is the notion of marginal net product. The marginal net product is also measured in money value and corresponds to the marginal increment of some given quantity of a specific resource (Pigou, 1932, Part II, Chapter II). However, there is a difference between the private marginal net product and the social marginal net product. While the former corresponds to a return limited to an economic agent (being a consumer or a firm), the last is understood as:

> (…) the total net product of physical things or objective services due to the marginal increment of resources in any given use or place, no matter to whom any part of this product may accrue (Pigou, 1932, p. 134).

To maximize welfare, Pigou (1932, Part II, Chapt. III) argues that the social marginal net product in all occupations must be the same, because if there were room to increase the social marginal product in one occupation, the transference of resources to this occupation would increase total welfare. Moreover, the author argues that perfect competition can maximize total welfare provided that the private marginal net product equals the social marginal net product (Pigou, 1932, Parti II, Chapt. IV). Although not formally developed, this result is close to the latter notion of the first welfare theorem, which states that competitive markets produce Pareto-efficient allocation.

Nevertheless, as shown in Pigou's (1932) Chapters IX and XI, the private marginal net product may be different from the social marginal net product, preventing perfect competition to maximize social welfare. In explaining the causes of this inequality, Pigou uses the marshallian concept of external economies to argue that external costs or benefits can be generated in the production process of a firm or by providing services that may affect other parties not involved in the transaction. In other words, the provision of a given good or service generates positive (negative) effects that are not compensated by whom is benefited (paid by whom causes the harm).

One famous example of such an external benefit is the lighthouse. The lighthouse is used to describe a situation in which the a ‘well-placed lighthouse’ does not charge for its service of ship's orientation (Pigou, 1932, p. 184). An example of a not compensated external cost is pollution. The pollution generated, for instance, by a firm A which affects the production of a firm B (which is not a producer nor a consumer of the goods produced by A) is an external cost (not charged) that A causes to B. In the case of negative external effects mentioned by him in his example of pollution, taxes that reflect

the external costs can correct the divergence between private and social marginal net product.

Therefore, Pigou reasons that we should have state intervention, mainly through taxes or subsidies, whenever there is a divergence between private return and social outcome. Pigou also includes as a public tool for increasing welfare the public investments on the well-known examples of positive external economies and public goods (later defined by Samuelson (1954))[8] still used today, such as investments in parks, railways, and research and development.

Note that despite the later criticism coming from Coase (1960) as we will see below, Pigou seemed to be skeptical about legal arrangements that could eventually correct the divergence between private and social marginal products by creating markets where there is not. According to him:

> § 13. It is plain that divergences between private and social net product of the kinds we have so far been considering cannot, like divergences due to tenancy laws, be mitigated by a modification of the contractual relation between any two contracting parties, because the divergence arises out of a service or disservice rendered to persons other than the contracting parties. It is, however, possible for the State, if it so chooses, to remove the divergence in any field by "extraordinary encouragements" or "extraordinary restraints" upon investments in that field. The most obvious forms which these encouragements and restraints may assume are, of course, those of bounties and taxes. Broad illustrations of the policy of intervention in both its negative and positive aspects are easily provided (Pigou, 1932, p. 192).

After Pigou (1932), numerous authors have dealt with the concept of externalities[9] in the context of neoclassical theory, exploring the sources of market failure[10]. Those authors have provided more precise and more explicit definitions of externalities. Scitovsky (1954), for instance, proposes the distinction between technological and pecuniary externalities. Whereas the latter is associated with all direct interdependence among producers that change market prices, and thus affect their profits, the former affects either the utility or the production functions and this impact is not reflected in market prices.

Pecuniary external economies' case is exemplified with the problem related to the installation or expansion of new industrials plants. In this case, the industrial firm's profit is a function of its outputs, factors inputs, and other firms' outputs inputs. Scitovsky then argues that an expansion (or installation) of a new industrial plant causes a decrease in its output prices and increases the firm's profitability that consumes its output as a factor input. In turn, these firms can now expand, causing an increase in demand for their inputs. This last effect will then increase the input price (or the output price for the first firm). In the end, this process will generate an increase in social gains. Scitovsky (1954) stresses that markets cannot reach this outcome, for the private return for the first firm, in the beginning, does not compensate for the higher cost of an

---

8 Samuelson's proposition is inspired in the pigouvian idea of divergence between the social return of public goods' consumption and the private return associated with its production.

9 It is worth stressing that Pigou (1932) did not use the word "externality". The word was introduced during the 1950s (Gehrke, 2015).

10 See Papandreou (1994).

expansion in production. Scitovsky (1954) expresses through this concept his strong belief that in a decentralized economy, numerous failures will result from coordination problems in markets. Thus, for him, the solution would necessarily pass by the State coordination, mainly through investments in new industrial sectors[11].

Bator (1958) discarded pecuniary externalities because it is incompatible with neoclassical competitive equilibrium, because any interdependence captured by prices (in output and factors of production) cannot be considered an unpaid benefit. If the implicit productivity increase of a new investment is reflected in a decreasing input price, he argues, competition among profit-maximizing firms will produce an optimal equilibrium. Hence, this author's most important feature in our investigation is his more precise and explicit explanation of the causes of externalities. Moreover, similar to Pigou (1932), he does not consider that enforcing appropriability can translate into a proper solution to market failure. In his own words:

> But I think it more natural and useful to broaden rather than restrict, to let 'externality' denote any situation where some Paretian costs and benefits remain external to decentralized cost revenue calculations in terms of prices. If, however, we do so, then clearly 'nonappropriability' will not do as a complete explanation. Its concern with the inability of decentralized markets to sustain the solution-prices and quantities called for by a price-profit-preference type calculation, as computed by a team of mathematicians working with IBM machines, tends to mask the possibility that such machine-calculated solution q's may well be nonefficient. It explains failure 'by enforcement', but leaves hidden the empirically more important phenomena which cause failure by 'non-existence', 'signal', and 'incentive' (Bator, 1958, p. 362 and 363).

In sum, we saw the pigouvian market failure view on externalities in this section. For these authors, a market failure reflects interactions between economic agents not captured by competitive market prices. Note that according to this view, even if markets were created for these externalities, they would fail to internalize them adequately. This approach to neoclassical welfare excludes the possibility of creating markets as a real possibility to correct externalities. In the next section, we will see how the change in the notion of neoclassical general equilibrium in the 1960s influenced welfare economics.

## 4. Missing markets in the neoclassical intertemporal general equilibrium approach

### 4.1 Coase's critique to Pigou

The main target of Coase's (1960) critique is the *Economics of Welfare* from Pigou. His critique relies on the argument that in the presence of a non-market interdependence between agents, it may be preferable for both agents to bargain a market solution. In this case, any legal arrangement that helps create propriety rights, and allows for a bargain, will provide a better social result than the one created by State intervention through taxes or subsidies.

To defend his argument, Coase (1960) implicitly assumes a partial equilibrium competitive framework, since no wealth effects nor the impacts on other markets are

[11] That is why Scitovsky (1954) had a great influence in the development economics literature that stressed the role of the State coordinating investments (see Toner (1999)).

considered. In his arguments, an example is presented: a cattle-raiser who causes negative (external) effects to his neighbor who grows crops. Coase argues that if the cattle-raiser is liable for the inflicted damage, he will pay the farmer for the generated 'disservice' up to the point that its cost is below its marginal cost on production. Also, the affected farmer will accept payments to the extent that the cost of damage is below the payment (the farmer can also choose not to produce). Therefore, in the optimal position, the additional cost paid for the inflicted damage will be equal to the first firm's marginal product and the marginal cost of damage of the second firm. According to Coase (1960), this situation allows for maximum production.

Coase argues that the imposition of a direct tax/subsidies may provoke unpredictable results caused by price distortions. So these sorts of measures would reduce the efficiency of markets. He proposes another example to justify his ideal of inefficiency: the waste of time of a person waiting in the red line in an empty street. In this case, if the rushed driver could pay other drivers to cross the intersection of the roads, instead of wasting time waiting while there are no other drivers on the other road, everybody would be better off. Another relevant example is his answer to Pigou's use of the example of lighthouses.

Coase (1974) tackles the historical evolution of lighthouses, the famous pigouvian example of externalities. According to the author, the British Lighthouse system's development has shown that private owners could charge for the lighthouse service. Private firms could provide this service, which would be compensated by the payment of light dues by shipowners. The role of the State is then limited to enforcing the propriety rights of the lighthouse. Coase (1974) is, therefore, not just presenting the possibility of private solutions to the lighthouse problem but also trying to justify that the private funding by shipowners of this activity is more efficient than the usage of public resources.

Although Coase (1960) did not build a formal model, he stresses the implicit assumption in the past explanation that there are no transaction costs to establish the legal arrangement necessary for bargaining. Besides, the legal authority must be able to enforce propriety rights, or, in other words, damage must be liable to someone. Finally, it is also supposed that both parties have equal bargaining power in this transaction, meaning that firms must operate under perfect competition. No matter how famous has become Coase's theorem, as we will see, it was not until Arrow's (1969) contribution that this proposition was formalized.

### 4.2 From market failure to missing markets: Arrow's intervention and the shift in the notion of equilibrium

The emergence of the neoclassical IGE approach, as developed by Debreu (1959), provided the necessary formal basis for Coase's idea. In this model, it is assumed that commodities (and markets) are differentiated not just by their physical proprieties but also by their delivery date and location. Markets are then assumed to be complete for different goods, location and time, and prices are determined for each of the distinguished commodities:

> A commodity is characterized by its physical properties, the date at which it will be available, and the location at which it will be available. The price of a

> commodity is the amount which has to be paid now for the (future) availability of one unit of that commodity (Debreu, 1959, p. 28).

This definition of commodities, or markets, as mentioned in section 1.2, is directly connected to the treatment given by the solution to a general equilibrium model with heterogenous capital goods. This assumption is also behind the first welfare theorem, which states that the competitive equilibrium of markets generates optimal welfare outcomes, in other words, Pareto-efficient results. Thus, all competitive equilibria are Pareto-efficient. To obtain this strong result, among other assumptions (such as convexity of preferences and technology sets), the model needs to assume market completeness ('universal price quoting') and perfect competition ('price taking') for all traded goods (Mas-Colell et al., 1995, p. 550)[12].

From this condition of market completeness and its relation to the first welfare theorem, it is straightforward that any external obstacles to market efficiency can be understood as an institutional problem of missing markets, which brings us back to Coase (1960). In this context Arrow (1969) is a pioneer in stating that externalities are nothing but missing markets. Berta (2017) suggests that there would be a lack of rigorous definition of externalities in the pigouvian tradition before Arrow's intervention. Unlike this understanding, we interpret Arrow's intervention as a formal adaption of the concept of externalities to the neoclassical IGE model. In particular, given the mentioned importance of the assumption of complete markets in this framework, it is a logical consequence that the only reason to exist 'external' effects should be associated with a missing market[13]. As we argued in section 1.3, the authors who developed the idea of market failure following Pigou's original idea did not seem to consider the abstract idea of complete markets. Hence, their approach did not lack more rigor, but were rather skeptical of market solutions to the failures they were observing.

Arrow (1969) represents externalities formally as non-independent utility functions in his model. If prices do not mediate these interactions, markets will not be complete because goods (or services) will be exchanged without attributed prices. Consequently, the competitive equilibrium ceases to be considered Pareto-efficient, and the first welfare theorem does not hold. Therefore, a critical assumption behind the first welfare theorem is that the consumer's utility function depends only on her consumption bundle (i.e. an independent utility function) (Petri, 2021, chap. 14).

Since externalities cause the interdependency of the utility functions, Arrow (1969) deals with these externalities by artificially transforming them into commodities, so he internalizes these effects by defining prices for them. In doing so, Arrow restores the complete markets assumption and the first welfare theorem becomes valid again. This solution is also translated into the already mentioned Coase's theorem, provided that the

---

[12] Papandreou (1994) also emphasizes the role of non-convexities causing externalities. In this case, other problems arise, such as imperfect competition. Since we are restricting our analysis to perfect competition, which does not change our central argument in this essay, we do not deal with problems related to non-convexities in general equilibrium models.

[13] Note that one can also find the notion of 'incomplete markets' in neoclassical IGE models. It is related to any incapacity of markets transferring wealth to the future due to the absence of appropriate financial instruments in the presence of uncertainty. We are not dealing with uncertainty in neoclassical general equilibrium models in this essay. For a more detailed discussion, see Petri (2021, chap. 9).

hypothesis of no transaction costs and perfect competition hold (Mas-Colell et al., 1995, p. 357). Therefore, in the intertemporal version, an external effect such as pollution (carbon emissions, for instance), should be dealt with by creating markets that cover all the possible emissions in time, space and 'states of the world'. The 'propriety rights' for emission should be defined in terms of all those categories. For instance, a carbon emission right should be defined as 1 million ton of CO2 to be emitted in 2050, in Rio de Janeiro in a rainy day.

The pollution 'good' damages other firms and/or consumers, who demand compensatation for this right to pollute. It should also include the not-yet-born consumers (since future markets should also be complete) whose preferences affect the equilibrium prices today[14]. Therefore, carbon emitters and other firms and/or consumers affected by carbon emissions would trade these rights attributing present (and future) prices for the right to pollute that would satisfy both sides[15] (under free competition[16]). These would be Pareto-efficient prices, and they define an equilibrium path, i.e., each period (and in each place and state of the world) the economy is in a Pareto-efficient equilibrium. Accordingly, the assumption of market completeness is central to this argument. Besides, the IGE approach provides a theoretical formalization of Coase's original reasoning that market creation would provide better social outcomes compared to State intervention. In our example, creating a market for CO2 emission rights would be more efficient than imposing a pigouvian pollution tax. It is clear then that externalities' descriptions as market failure or as missing markets are not parallel ideas as sometimes presented in textbooks. Instead, both explanations for externalities are sequential and follow the neoclassical theory's shift with the replacement of the long-period notion of equilibrium with the intertemporal equilibrium (and its assumption of complete markets).

Notice that the lighthouse's problem that we saw in Pigou's and Coase's work is understood by Arrow (1969) as a matter of lack of competition preventing an optimal market solution. He points out that the lighthouse may be able to charge for its services, so a market solution is possible. However, the potentially limited number of competitors makes the market for lightning orientation unlikely competitive. In that case, Coase's theorem does not apply, and market creation is a non-efficient solution.

Note also that Arrow himself acknowledges that the assumption of complete markets in an intertemporal model seems implausible:

> Finally, in this review of the elements of competitive equilibrium theory, let me repeat the obvious and well-known fact that in a world where time is relevant, the commodities which enter into the equilibrium system include those with future dates. In fact, the bulk of meaningful future transactions cannot be carried out on any existing present market, so that assumption (M), the universality of markets, is not valid (Arrow, 1969, p. 504).

[14] This idea of not-yet-born consumers impacting prices today in IGE is found in Petri (2021, chap. 8).

[15] It is important to notice that there would be no trade in disequilibrium conditions. The observed prices of carbon emission rights would already be the equilibrium ones.

[16] In this case large multinational companies responsible for carbon emission would equally compete with small local companies or local consumers.

In contrast to this statement, he provides a formal treatment of externalities as missing markets in a neoclassical IGE approach, and this is the same model largely diffused in his advanced microeconomic textbook with Frank Hahn (Arrow and Hahn, 1971, p. 132 to 136).

Another example of such contradiction is the fact that Mas-Colell et al. (1995) present formally externalities only in the context of partial equilibrium analysis. Although they limit their analysis to the (long-period) marshallian world, they consider the missing market approach, in the context of the IGE, as a more logical and formally convenient cause of externalities (Mas-Colell et al., 1995, pp. 358 and 359). One hypothetical answer to this contradiction could be that, as Arrow (1969) himself pointed, the neoclassical IGE model and the assumption of complete markets are too strong to develop the welfare analysis. The limitation to the partial equilibrium case, in which there are no wealth effects, and the supply and demand of other markets are given, would provide a more plausible welfare assessment. However, this hypothesis is confronted by the fact that the same textbook provides a formal presentation of the first welfare theorem in the context of the competitive general equilibrium model, in which the intertemporal framework is a particular version of the main model (Mas-Colell et al., 1995, p. 732). Therefore, the contradiction in this textbook regarding the different approaches to externalities remains.

## 5. Neoclassical welfare economics from a sraffian standpoint

### 5.1 The 'market failure' welfare economics

In section 1.3 of this essay, we saw that pigouvian externalities were caused by the divergence between the private marginal product and the social marginal product due to different types of market failure. This neoclassical formulation, which can still be found in textbooks on the economics of the public sector (Stiglitz and Rosengard, 2015, chap. 4), is based on the traditional long-period general equilibrium. In the absence of externalities, perfect competition produces the equivalence between private and social marginal products, and the economy reaches a Pareto-efficient equilibrium. In the presence of externalities, State intervention, such as taxes and subsidies, can equalize private and social marginal products (under perfect competition) and restore the Pareto-efficient equilibrium.

The various aspects of the sraffian critique of the long-period version of neoclassical general equilibrium theory also apply to the pigouvian welfare economics. A first sraffian critique concerns the supply of capital. Garegnani (1990) shows that in order to determine a uniform rate of profit, the long-period version of the neoclassical theory requires that endowment of capital should be expressed as a single magnitude in real value. However, under heterogenous capital, the relative prices of the different capital goods in the endowment will necessarily vary when the distribution between wages and profits changes. This change in relative prices will inevitably change the real value of the capital endowment measured in any numeraire. Therefore, the actual quantity of capital of the economy will only be determined if the distribution is already known and cannot be used to determine the rate of profits. The main implication of this is that there

isn't and cannot be a proof of the existence of the long-period general equilibrium of the economy. If there is no proof existence of the long-period general equilibrium position, there is neither a proof of the Pareto-efficiency of such position under heterogenous capital. Moreover, this indeterminacy in regard to the quantity of capital also undermines the position of the demand functions of labor and all other factors of production, rendering the determination of their marginal products impossible. Thus, there is also no such a thing as a rigorously defined private marginal product of factors to compare with the social marginal product.

A second sraffian critique concerns the demand side of the factors of production. The critique consists of demonstrating that the choices of technique, even abstracting from the insoluble problems with defining the quantity of capital, may not always be inversely related to the relative price of each factor of production due to reverse capital deepening (in which the intensity of use of a factor decreases when its price falls) and reswitching (when the same technique is actually chosen at very different levels of the rate of profits). The demonstration of the reverse capital deepening and reswitching deprives the theory of a solid basis for postulating well-behaved demand curves for factors of production.

Therefore, both aspects of the sraffian critique imply that there is also no solid general basis for the idea of a tendency to full employment equilibrium. But without this tendency to full employment, as pointed out by Garegnani (2007), the notion of Pareto-efficiency loses any usefulness because, in the context of idle resources, everyone can be better off, for instance, by increasing aggregate effective demand.

### 5.2 The 'missing market' welfare economics

The missing market welfare economics is subject to the general Sraffian critique of the IGE approach[17]. Petri (2017) emphasizes three problems: (i) the impermanence problem ,(ii) the substitutability problem and (iii) the price change problem.

The impermanence problem corresponds to the lack of persistency of the intertemporal equilibrium path determined from the arbitrary initial endowment of heterogenous capital goods. The equilibrium path is not independent of the endogenous changes in the capital endowment that will occur as the relative production of different capital goods varies in the adjustment process. Therefore, the equilibrium positions over time are not a gravitational center to market adjustments, as was the case in the long-period equilibrium. In this case, it does not seem to have any practical relevance to treat this changing equilibrium as a Pareto-efficient benchmark for market outcomes and regulation. Thus, there is no room in this framework for trial-and-error exchanges between the economic agents to produce a Pareto-efficient outcome. Instead, the auctioneer tale (and complete markets) provides equilibrium prices and endowments before transactions occur. From a pragmatic point of view, this framework does not seem to be a useful tool for policy guidance.

[17] Fratini (2019) distinguishes two streams regarding the criticism raised against the IGE. First, the critique of the methodological notion of intertemporal (or temporary) equilibrium itself. The second set of critiques stresses the possibility of reswitching and reverse capital deepening in the intertemporal (or temporary) general equilibrium. Since there is still an ongoing controversy regarding this point (see Garegnani (2012)), we shall not refer to this second strain here.

The second problem mentioned by Petri (2017) is the substitutability problem. The need to specify the capital endowment as a set of specific heterogenous capital goods in order to avoid having to take as given the quantity of capital in terms of its real value requires that the techniques in use in the economy should use very different proportions of each of these capital goods and labor (and other factors of production). This would be necessary to ensure that the demand curve for each of these capital goods would be sufficiently elastic. This is an extremely implausible assumption, as most specific capital goods can only be combined in very rigid ways with labor and other factors of production.

The third problem, as mentioned by Petri (2017), is the price change problem. Unlike the long-period theory, equilibrium relative prices in the IGE approach are not expected to remain constant because capital endowments will necessarily change in the equilibrium path. So, to determine the impact of these changes from the initial period of the analysis, the whole set of prices that will rule in the subsequent period must be known. This leaves the neoclassical intertemporal approach with two alternatives: either to assume given expected prices under perfect foresight (as in temporary general equilibrium) or to assume complete future markets. Both alternatives are very unrealistic. In particular, the idea of complete markets used for neoclassical welfare analysis implies that markets for every period of time and state of the world actually exist. This would also require that all the preferences, technologies and endowments of production factors in the future are already known.

According to Ciccone (1999), the assumption of complete markets also implies that there is an almost infinite list of possible contingent markets, which brings further indeterminacy in this model for market and equilibrium prices – besides the unrealistic assumption that agents will have perfect information about such distinguished and objectively unpredictable markets.

In addition to being unlikely that the economy could tend to this kind of equilibrium path and to the unrealism of the assumption of complete markets, the missing market approach to welfare is based on the assumption of price-taking perfect competition. However, it is very unlikely that such contingent markets could be competitive. Moreover, the idea that agents in the markets created to internalize externalities would behave as price takers, without a good justification in terms of ease of entry and exit or large numbers, makes the proofs that such markets could be efficient be often presented as mere analogies. In our former example of markets for carbon emission rights, it is equivalent to saying that big multinational companies are as price takers as the local consumers affected by carbon emissions in Rio de Janeiro.

## 6. Final remarks

The first contribution of this essay was to show how the change in the notion of equilibrium in neoclassical equilibrium impacted the welfare analysis in this approach. This was done by a non-exhaustive analysis of the evolution of the notion of externalities from marshallian/pigouvian external economies to Arrow's contribution. In this process, the analysis of externalities moved from a 'market failure' basis to a 'missing markets' justification. Moreover, we argued that this change was profoundly influenced by the little-noticed migration from a long-period general equilibrium approach to an intertemporal general equilibrium approach in neoclassic theory.

The second contribution of this essay consisted of showing that the sraffian criticism of both the long-period and intertemporal approaches to neoclassical theory apply fully to these two versions of welfare theory. In particular, the underlying unrealism of the complete markets assumption seems to explain why in fact the welfare analysis as presented, for instance, in Mas-Colell et al. (1995, chap. 11) is developed under the long-period version of the general equilibrium approach. Petri (2021, chap. 14) stresses this ambiguity, noting that neoclassical welfare theorists do not seem to grasp that the method of long-period general equilibrium is incompatible with the modern formulation of the IGE model.

In our view, the issues discussed here are of particular interest for understanding the fate of postwar development economics (as discussed in our introduction to the dissertation) that mainly relied on the pigouvian market failure approach, either through subsidies, taxes, or public investments. In the 1980's, international institutions such as the World Bank and the IMF had a drastic shift in their orientation from market failure to missing markets as the roots of development problems, which was presented as a solid theoretical foundation for neoliberalism. Therefore, the above-mentioned tools to correct market failure that was highly important to economic development in many countries were replaced by propriety rights enforcement and incentives for more efficient markets. Privatization and the focus on creating markets has become since then a persistent reference in the developing world (Serrano, 2014)[18]. Given the failure of such strategies in both economic and social terms, it is high time we critically examine the theoretical foundations of the neoclassical welfare theory.

[18] The extent of this ideological onslaught may be measured by reference to Krueger (1990) critique of market failure based development economics using the very unrigorous concept of 'government failure': '...policies directly controlling private economic activity are likely to be less efficacious in terms of achieving their objectives than policies that provide incentives for individuals to undertake the activities which are deemed desirable. This can often be achieved by finding ways which strengthen the functioning of markets (Krueger, 1990, p. 21)'.

## References


Arrow, K. J. 1969. The Organization of Economic Activity: Issues Pertinent to the Choice of Market Versus Nonmarket Allocation, *Congress of the United States, The Analysis and Evaluation of Public Expenditures: The PPB System*, 47–64

Arrow, K. J. and Hahn, F. H. 1971. *General Competitive Analysis*, North-Holland

Bator, F. M. 1958. The Anatomy of Market Failure, *The Quarterly Journal of Economics*, vol. 72, no. 3, 351–79

Berta, N. 2017. On the definition of externality as a missing market, *The European Journal of the History of Economic Thought*, vol. 24, no. 2, 287–318

Brondino, G. and Lazzarini, A. 2017. Sraffa's 1920S Critique and its Relevance for the Assessment OF Mainstream Microeconomics, *Research in the History of Economic Thought and Methodology*, vol. 35B, 131–51

Chamberlin, E. 1933. *The Theory of Monopolistic Competition*, Cambridge, Harvard University Press

Ciccone, R. 1999. Classical and Neoclassical Short-Run Prices: a Comparative Analysis of Their Intended Empirical Content, pp. 60–81, in Mongiovi, G. and Petri, F. (eds.), *Value, Distribution and Capital: Essays in honour of Pierangelo Garegnani*, London, Routledge

Clapham, J. H. 1922. On Empty Economic Boxes, *The Economic Journal*, vol. 32, 305–14

Coase, R. H. 1960. The Problem of Social Cost, *The Journal of Law and Economics*, vol. 3, no. 1, 1–44

Coase, R. H. 1974. The Lighthouse in Economics, *The Journal of Law and Economics*, vol. 17, no. 2, 357–76

Debreu, G. 1959. *Theory of Value: An Axiomatic Analysis of Economic Equilibrium*, New Haven and London, Yale University Press

Fratini, S. M. 2019. On the Second Stage of the Cambridge Capital Controversy, *Journal of Economic Surveys*, vol. 33, no. 4, 1073–93

Garegnani, P. 1976. On a Change in the Notion of Equilibrium in Recent Work on Value and Distribution, in *Essays in Modern Capital Theory*, Amsterdan, North-Holland

Garegnani, P. 1990. Quantity of capital, pp. 1–78, in Eatwell, J., Milgate, M., and Newman, P. (eds.), *Capital Theory*, London, Palgrave Macmillan UK

Garegnani, P. 2007. Professor Foley and Classical Policy Analysis, *Review of Political Economy*, vol. 19, no. 2, 221–42

Garegnani, P. 2012. On the present state of the capital controversy, *Cambridge Journal of Economics*, vol. 36, no. 6, 1417–32

Gehrke, C. 2015. Formalizing "external economies": Viner, Chipman, and Krugman, *Œconomia. History, Methodology, Philosophy*, nos. 5–3, 331–62

Hicks, J. R. 1946. *Value and Capital: An Inquiry into Some Fundamental Principles of Economic Theory*, Oxford, Oxford University Press

Krueger, A. O. 1990. Government Failures in Development, *Journal of Economic Perspectives*, vol. 4, no. 3, 9–23

Marshall, A. 1920[2013]. *Principles of Economics*, London, Palgrave Macmillan

Mas-Colell, A., Whinston, M. D., and Green, J. R. 1995. *Microeconomic theory*, New York, Oxford University Press

Mongiovi, G. 1996. Sraffa's critique of Marshall: a reassessment, *Cambridge Journal of Economics*, vol. 20, no. 2, 207–24

Papandreou, A. A. 1994. *Externality and Institutions*, Oxford, UK, Clarendon Press

Petri, F. 1978. The Difference Between Long-Period and Short-Period General Equilibrum and The Capital Theory Controversy, *Australian Economic Papers*, vol. 17, 246–60

Petri, F. 2017. The Passage of Time, Capital, and Investment in Traditional and in Recent Neoclassical Value Theory, *Œconomia. History, Methodology, Philosophy*, nos. 7–1, 111–40

Petri, F. 2021. *Microeconomics For The Critical Mind - Value, Distribution and Employment*, Springer Cham

Pigou, A. C. 1932. *The Economics of Welfare*, London, Macmillan and Co.

Robinson, J. 1933. *The Economics of Imperfect Competition*, London, Macmillan

Samuelson, P. A. 1954. The Pure Theory of Public Expenditure, *The Review of Economics and Statistics*, vol. 36, no. 4, 387–89

Scitovsky, T. 1954. Two Concepts of External Economies, *Journal of Political Economy*, vol. 62, no. 2, 143–51

Serrano, F. 2014. El Neoliberalismo Como Regreso de la Economía Vulgar, *Circus Revista Argentina de Economía*, vol. 6

Sraffa, P. 1925. Sulle relazioni fra costo e quantita` prodotta, *Annali Di Economia*, vol. II, no. 1, 277-328. [English translation by J. Eatwell and A. Roncaglia (1998). On the relations between cost and quantity produced. In L. Pasinetti (Ed.), Italian Economic Papers (vol. III, p. 323 363). Oxford: Oxford University Press].

Sraffa, P. 1926. The laws of returns under competitive conditions, *The Economic Journal*, vol. 36, no. 144, 535–50

Stiglitz, J. E. and Rosengard, J. K. 2015. *Economics of the Public Sector: Fourth International Student Edition*, W. W. Norton & Company

Toner, P. 1999. *Main Currents in Cumulative Causation: the Dynamics of Growth and Development*, New York, Macmillan Press

Vaggi, G. and Groenewegen, P. 2003. *A Concise History of Economic Thought: From Mercantilism to Monetarism*, New York, Palgrave Macmillan