THE VISIBLE HAND

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1. INTRODUCTION

The main motivation of this work is the Keynesian notion that employment results from supply and demand interaction. The core of the paper is given by one special statement by Keynes: "I regard the price level as a whole as being determined in precisely the same way as individual prices; that is to say, under the influence of supply and demand" (KAHN, 1984, page 59). The counter-point is the fact that, in accordance with KING (1994), post Keynesians lost the interest on the aggregate supply and demand analysis because it has been given a strong neo-classical flavor. This paper argues that, looking from today, it is possible that what could be wrong is the method followed by Keynes in his search for the supply and demand model. In this case, instead of abandoning the theory itself one could perhaps think of looking for a method suited for demonstrating that there is an aggregate supply curve, that it is positively sloped and that, definitively, it is not vertical. Considering, additionally, that demand would hardly play alone, an aggregate supply curve that slopes upwards is a necessary condition for implementing a Keynesian demand-oriented economic policy.

The article has thus two major broad objectives: one, to give some support to the argument that probably supply-and-demand was actually the theory Keynes intended to use and, two, that this theory is not a neo-classical residue in Keynes' work because supply-and-demand is not a neo-classical concern. In methodological terms, the Keynesian statement above may be seen as indicating that, instead of deducing an aggregate supply curve directly from macroeconomic principles and assumptions, one may derive it on the basis of a supply curve at the microeconomic level. Accordingly, the specific objective here is to develop a dynamic supply-and-demand microeconomic model that matches main Keynes' statements like structural unemployment and the leading influence of a demand-oriented economic policy. A strong proposition forwarded is that the notion of supply behavior and supply curve developed here is the one Keynes searched for on the work of Marshall.

Marshall's theory stressed here stems from his analysis of classical notions prevailing at his own time. This theoretical approach, to which economic literature has deserved relatively little attention, is concentrated on the description of price formation in the very short run, or daily market period, when real transactions take place and real prices are observed, but there is no clearing: production never matches consumption, what means that in the daily market there is no equilibrium. This is the same as saying that in the short run there is no supply curve. It is demonstrated that Marshall's supply approach may be complemented by developing the daily market principles into a producers' decision-

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making process which in turn may define a dynamic market model for price and production setting. This model may bring about a long run theoretical status in which the notion of supply curve emerges, providing thus a general model for supply and demand analysis. This could incidentally be the formal modeling Marshall was searching for.

Essentially, the supply-and-demand theory states that, when in a hypothetical equilibrium situation, price and production are the outcome of the interaction of producers and consumers. This theoretical approach may be represented by a model that outlines the interplay of the respective supply and demand curves. Furthermore, while the slopes stem from the behavior of economic agents, the positions of the supply and demand curves depend upon the level given to the exogenous variables, amongst these the economic policy variables. The process of interaction is insufficient to make the system be self-righting because the positions of supply and demand are determined from outside the model. This means that, as Keynes stated, if just let to themselves producers will find an equilibrium situation which is not full employment. Moreover, in a dynamic perspective the model is such that production and price are pushed by demand performance. As a consequence, given exogenous restrictions, economic demand-oriented policy may induce investment in the real sector and, consequently, increase employment.

This paper is organized as follows: section **2** presents a short run dynamic analytical model which leads to the long run theoretical supply curve, and section **3** contains an empirical example of how the model works. Section **4** develops the theoretical principles and assumptions of the model, stressing Marshall's statements on the daily market period. In turn, discussing the relevance of supply curve in modern times, section **5** briefly reviews the state-of-the-art on the matter, both at micro and macroeconomic levels, and outlines how an aggregate supply curve may be obtained from its microeconomic counterpart. Finally, section **6** summarizes the article and suggests some conclusions.

2. A MICROECONOMIC MODEL WITH SOME MARSHALLIAN FEATURES

2.1. THE ANALYTICAL MODEL

The model proposed and developed here refers to the "daily market period", based upon the idea that it is in the daily market that actual trading takes place, including the purchase of those production factors which will be used in the next period. It is during the daily market that decisions made on price and production are transformed into real transactions: observable values, those collected for statistical purposes, are those realized in this period. The dynamics of the short run analytical decision-making model detailed ahead is as follows: variations in the exogenous variables on the consumers' side, such as their income, lead to shifts of the demand curve, then to variations in price and consumption and, thereof, in inventories. A different price means a different profit and, as a consequence, producers are induced to modify their production levels. On the other hand, variations in inventories induce producers to change price and production, each one searching for the best profit allowed for him by the intensity of rivalry and the degree of co-operation between them. Both price and production are thus connected to inventories, and much research work has been conducted on one or other relation: price *vs* inventories, or production *vs* inventories.

In the literature of economics there is little analysis of the simultaneous relations of inventories with price and production. However, this is not a new strand; theoretical contributions are presented in DUMÉNIL & LEVY (1987), KIRMAN & SOBEL (1974),

and in HAY (1970). Additionally, econometric works have been developed by MILLS (1962) and by his critics STEUER & BUDD (1968). Particularly interesting are the empirical findings of KAWASAKI, McMILLAN & ZIMMERMANN (1982), as their work is based upon a statistical method which is similar to a reduced model, but is independent of any particular structural market model. Their conclusion is that firms do react to any shift in the level of inventories, setting new price and production levels, in such a way that convergence to a new equilibrium situation is assured.

The model contains five relations, three equations and two definitions, to solve for five endogenous variables: quantity demanded **D**, market price **P**, amount produced **Q**, profit margin **M**, and inventory level **E**. The exogenous variables are the income-related **F** and the cost-related **W**, acting as shift-parameters. The main feature of the model is the supply behavior, whose decision-making process has been divided in two components: the supply price and the production decision. The supply price equation is such that price depends on stocks and, consequently, on consumers' side behavior: this means that producers **propose** (and do not impose) a price to consumers. The price level proposed - and the mark up rate - will thus vary as a function of the demand strength. Complementing, the production decision is sensitive to inventories, typically a short run concern, but it also responds to profit margin **M** variations, introducing thus a long run perspective.

DYNAMIC ANALYTICAL MARKET MODEL

$$\text{demand: } D_t = a_0 - a_1 P_t + a_2 F_t$$

$$\text{supply price: } P_t = b_0 + b_1 W_t - b_2 E_{t-\varphi}$$

$$\text{production decision: } Q_t = h_0 + h_1 M_{t-\omega} - h_2 E_{t-\theta}$$

where $M_t = P_t - W_t$ is the profit margin; and

$E_t = E_{t-1} + Q_t - D_t$ is the inventory.

When making short run decisions on price proposals and production setting in the daily market, producers take into account a series of the past values of the endogenous variables profit margin and inventories, represented by the lag structure given by φ, ω and θ. This representation stems from the assumption that current values are consequences not only of the last decision, but from a set of previous decisions, following a lag structure that is a priori unknown, but that may be determined ex post by econometrics of the model. Among others, the econometric treatment of the model may use the indirect least squares method (ILS) or the two stages least squares (2SLS), both requiring a reduced model which may state any and all endogenous variables as functions of the complete set of lagged exogenous variables[2]. The model could, alternatively, have introduced the profit margin and the inventory by their expected values. However, given that expected values might be based on the set of lagged exogenous variables, final results in both cases would be the same because they share the same reduced model.

This is not a disequilibrium schedule, it is a dynamic model. Given, hypothetically, a particular equilibrium situation, after an once-for-all external shock in time **t** the model

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[2] This is the same as saying that the causal variable exerts a distributed lag effect on the dependent variable.

would bring about the values of all endogenous variables in time **t+1, t+2, t+3,** and so on. For external shocks given only once, successive adjustments made by producers would make endogenous variables follow a damped oscillatory trajectory in the direction of a new equilibrium situation. However, if different external shocks are successively given, then this trajectory will continuously be modified. In fact, solving the system first for the inventory, one will eventually arrive at a complex difference equation of a certain order given by a combination of the lag operators φ, ω and θ. Substituting then the solution for inventory successively in the price equation and, passing through the profit margin definition, in the production equation, the conclusion will be that any and all endogenous variables are quite complex difference equations of order given by φ, ω and θ.

Notwithstanding, no matter complex these equations may be, their general solution is always twofold. One, the particular solution, may be associated with a long run equilibrium status whose level depends on the exogenous variables set value. This can be seen as the "intrinsically economic" content of an endogenous variable. Two, the trend solution shows, for single exogenous shocks, the trajectory of the endogenous variables towards their equilibrium values. This solution may be associated with the short run, with the deviations of actual data in relation to the equilibrium status. Moreover, exogenous shocks may be supposed not to be single but many and randomly distributed and, consequently, the trajectory towards equilibrium will always be disturbed: "... economic life is continually lurching from one out-of-equilibrium position to another" (ROBINSON, 1960).

Equilibrium is a hypothetical situation where the amount produced would be equal to the amount consumed, and this would only be observed if and when all exogenous variables have stopped varying. Considering that neither the model nor the analyst can exert any kind of influence over the exogenous variables, the best one can do is to **suppose** hypothetically that they are constants[3]. Then, after some time has elapsed, the dynamic effects of external shocks over all endogenous variables would have vanished. The structural market model would thus be in a motionless position: "motionless" is a necessary and sufficient condition for equilibrium. The model is not self-righting towards any kind of "socially just solution"; the model may work out a theoretical equilibrium status at any level of price and production because given the model's coefficients this level no longer depends on the model itself but on the values assumed by the exogenous variables. In other words, special equilibrium values for endogenous variables are neither expected nor assumed ad hoc. For example, inventory, and general idleness, are in no circumstances presumed to be nulls or constants: the intensity of factor's utilization and the employment level will always be consequences of the (unpredictable) values assumed by and given to the exogenous variables set.

The model has thus one theoretical equilibrium position in time **t** which is associated with the values of the exogenous variables in time **t**. Long run equilibrium values are abstractions from reality, a theoretical construction which must necessarily be based on those daily market values. Long run equilibrium values are neither decided nor

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[3] For this to be done it is insufficient to write on a sheet of paper a formal ad hoc assumption simply stating - in no matter how rigorous form - that a certain exogenous variable is supposed to be constant. One should introduce all relevant exogenous variables in the model and admit that they are continuously varying. After empirical estimation one could introduce the hypothesis of constancy, possibly giving the exogenous variable a particular value. In social science practical experiments, and respective data, are generally out of control. The econometric method associated with the *ceteris paribus* clause which has been adopted here overcomes this difficulty because it makes feasible a laboratorial experience with uncontrolled real data.

imposed by producers: they must be theoretically deduced from daily observed values. Once again, this matches a statement by Joan Robinson: "The short period is here and now, with concrete stocks of means of production in existence. Incompatibilities in the situation (...) will determine what happens next. Long-period equilibrium is not at some date in the future; it is an imaginary state of affairs in which there are no incompatibilities in the existing situation, here and now" (ROBINSON, 1965, page 101). One of the most important feature of this approach is that in the daily market amount supplied (produced) is different from amount demanded (consumed) and, consequently, supply price - that price producers intend to charge - will also be a disequilibrium price. This means that actual data - the series of values actually observed and collected for analytical purposes - are assumed to be disequilibrium data which are not directly explainable by any economic theory. Economic theory can and must explain the particular solution, or the "intrinsically economic content", or the long run equilibrium component of the actual value of an endogenous variable. Economic theory cannot explain the short run trend component because this trend is essentially random.

The process through which actual values of economic variables are kept away from their equilibrium status is the gravitation phenomenon, which depends on how fast producers can and want to adjust production to consumption. Measured by the spread between actual and long run equilibrium values, gravitation makes the connection between short run and long run. Gravitation is the link between reality and economic theory[4]. This process of adjustment of production is required as a consequence of exogenous shocks given to the system, from both demand and cost sides. Considering that these shocks are random, gravitation is also random and must have zero mean; it is a disturbance term. This also means that gravitation adds to the behavior of an economic endogenous variable a trend component which must be isolated and controlled because it is just a noise without economic meaning. Gravitation may be seen as an error component of economic variables, and consequently parameters obtained by direct econometric estimation using series of actual data will probably be biased. Alternatively, gravitation may be seen as an omitted variable, implying that there will probably be autocorrelation of the residuals. Therefore, the econometric method should control or eliminate the gravitational component of endogenous variables.
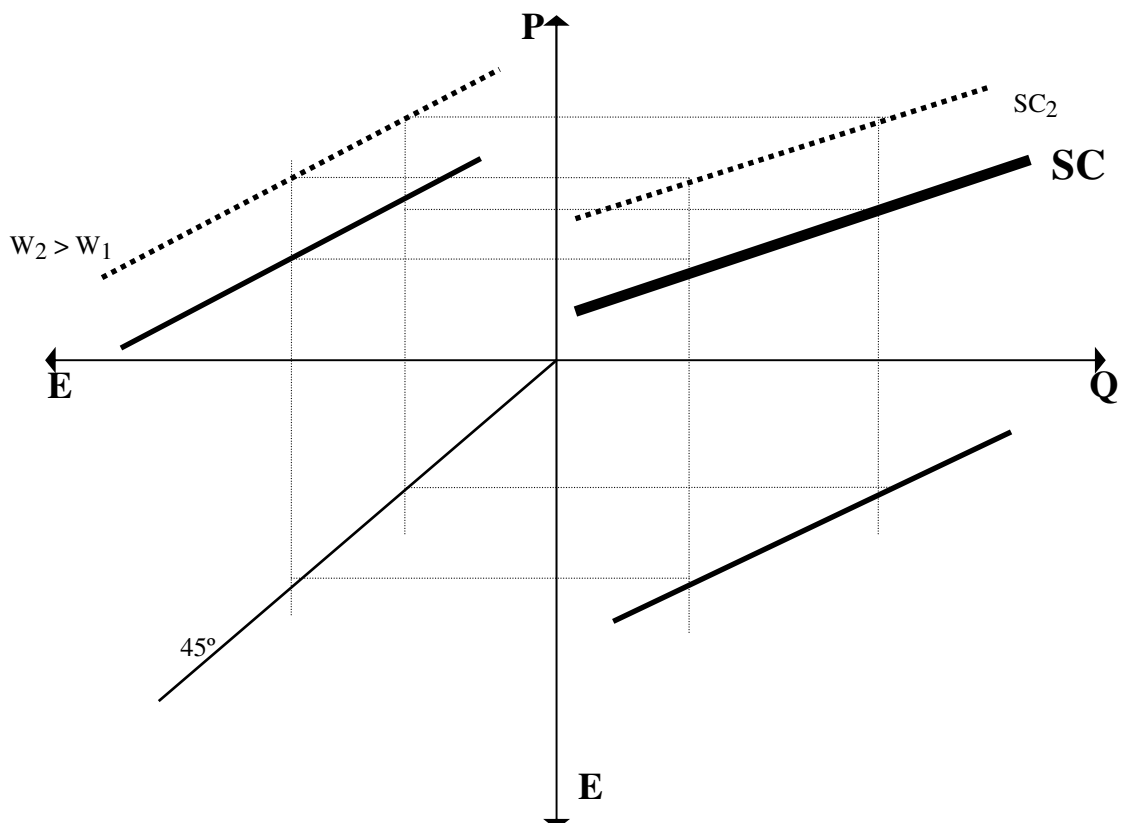
2.2. THE SUPPLY CURVE

The main feature of the dynamic analytical market model above is the supply behavior which has been divided into two separate equations associated with the short run: the supply price and the production decision. However, price and production are mutually dependent, via inventories and, **when in the theoretical situation of equilibrium**, one is connected with the other by a special theoretical relation. The short run supply behavior is such that changes in the level of inventories induce changes in both price and production, and in the same direction, because coefficients have the same negative sign in the supply price equation and in the production decision equation. Therefore, when theoretically in equilibrium these two equations may be combined: first the stock **E** is replaced in the production decision by its expression taken from the supply price equation. The inventory

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[4] LIMA (1992) presents a comprehensive discussion on the econometrics of gravitation. What matters in this paper is the strategic role played by gravitation in the definition of equilibrium and in the distinction between actual short run positions and theoretical long run positions. One should remind, however, that equilibrium here has been associated to a non-anticipated restless position and not to a full employment level as is commonly admitted in the ergodic neo-classical world.

will thus be eliminated in the production decision equation, which will become a function of **M**, **P** and **W**. After that, the profit margin **M** is replaced by its definition, which states that it is the difference between **P** and **W**. These substitutions lead eventually to one expression where **Q** is a function of **P** and **W**, such as for example (asterisks indicate theoretical equilibrium values):

$$\textbf{SUPPLY CURVE:} \quad \textbf{Q*}_t = \textbf{B}_0 + \textbf{B}_1\,\textbf{P*}_t - \textbf{B}_2\,\textbf{W}_t$$

In the diagram below the supply curve **SC** appears in the first quadrant as a graphical composition, through the 45° mirror line in the third quadrant, of two relations: 1) the negative relation between price and inventories in the second quadrant and 2) the negative relation connecting production and inventory in the fourth quadrant. The **SC** line stems from a certain cost level, say **W₁**. If production cost takes the level **W₂** larger than **W₁** then the supply curve will be shifted to the level **SC₂**, but the slope **B₁** remains unchanged.

The supply curve is the line of simultaneous theoretical equilibrium of price and production levels which result from the behavior of producers when deciding on price and production. This means that the supply curve contains only and all simultaneous long run price and production levels which producers consider interesting for them; moreover, these are the reasons why it is a supply curve. Differently from what neo-classical theory states, the supply curve so obtained is not a relation of causality; this would happen only if firms were allowed to decide production based upon a given price level, or vice versa. Instead, firms here have some discretionary power over market prices and can modify them and vary production. In any case, the final theoretical equilibrium levels of price and production depend also upon consumers, via their demand curve.

The supply curve is a theoretical construction connecting imaginary equilibrium levels of price and production; it cannot actually be observed because actual available values are only those computed from the daily market when data are in disequilibrium and there is no supply curve. Given that the supply curve is derived from its two components, the supply price and the production equation, its slope depends upon the propensity to invest and on the simultaneous reactions of all firms in relation to individual inventories shifts. Formally:

$$(dQ/dP) = [(\delta Q/\delta M) \times (\delta M/\delta P)] + [(\delta Q/\delta E) \times (\delta E/\delta P)]$$

where (dQ/dP) is the long run supply slope. The position (height) of the supply curve depends on the technology of production and on input prices, represented synthetically by **W** in the model. On the other hand, the slope of the supply curve is subject to some features such as perishability, technology of production and distribution, management, financial strength, short run cash availability, knowledge of the market and so on. Ultimately, the slope stems from psychological businessmen's characteristics, such as proficiency, reactions to expectations formation, selling eagerness, and rivalry. Competition is in turn conditioned by considerations such as the availability of funds, the notion that it makes no sense for an individual producer to carry stocks if he or she can sell first, and that if the market may grow then one must invest in advance. In this environment, individual profit depends upon one's ability to extract money from customers, upon consumer's resistance to this extraction and, ultimately, upon what competitors are doing, the latter certainly being more important than the former ones. With the exception of the direct effect of profit on production, represented by the first square brackets in the expression above, and the given physical restrictions, MARSHALL (1890) condensed all those behavioral features which influence the supply slope into the single notion of "not spoiling the market".

One important characteristic of those features is that they are non-separable ex post; it is unfeasible to identify empirically the effect of any one of them, thus isolating it from the others, because one cannot have unambiguous statistical information on any of them. This fact emerges from the work by BLINDER (1990), who observed that almost every neo-classical pricing model is based on non-measurable factors. Incidentally, neo-classical theory adds to that list of behavioral features one more hypothesis: that the objective of profit maximization can be described by differential calculus. Following this approach, modern neo-classical analysis such as that developed in BRESNAHAN (1989) applies differential calculus for maximization simultaneously condensing those behavioral features into interesting and powerful synthesising notions such as "index of competitiveness" or "conjectural variation". SCHMALENSEE (1988), more specifically, states that besides maximization the supply slope "emerges from what may be a complex pattern of behavior" (page 650).

However, the fact that the individual effect of each of those features on the supply slope cannot be identified remains untouched if one multiplies or not the composed effect by an additional hypothesis - the profit maximization - about the behavior of producers. Ironically, this means that the critics of the neo-classical theory may reduce its effort in developing economic theory to a simple change in names, replacing "not spoiling" by "complex pattern" without really adding new information on supply behavior. Except if game theory can find a miraculous device such that each firm can measure objectively how

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competitors react, and not simply state the game as a hypothesis unsuited for an empirical test, neo-classical theorists risk being unable to elaborate a general theory of supply behavior.

To sum up, the supply curve is an useful synthetic tool, describing a set of possible equilibrium points of the economy; a situation to which the economy would tend to run, if exogenous variables have stopped varying. The equilibrium levels of price and production depend upon the values assumed by the exogenous variables set, which are of course neither anticipated nor determined by the model itself. The slope is the core of the supply curve and arises mainly from the psychological behavior of producers, which is constrained by some permanent and temporary conditions imposed by institutions of real life. No special value, ad hoc defined, is expected; the slope is a composition of parameters of the structural model and, like them, it cannot be determined ex ante. The slope of the supply curve is a resultant of "a complex pattern of behavior"; instead of theoretically anticipated, it must and can be estimated by econometrics.

3. AN EMPIRICAL APPLICATION

In order to give empirical support to the analytical approach proposed here, this section presents briefly the results obtained in a study on the Brazilian cement industry reported in LIMA (1992). The structure of the market model is that presented in the previous section, and the exogenous variables are: **F**, the national Gross Fixed Capital Formation, and **W**, the estimated direct standard cost of production. The econometric method adopted was either the indirect least squares or the two stages least squares, both leading to a reduced model where each endogenous variable is a function of the exogenous variables set. Due to the distributed lag effect, this set is lagged, with lags being picked up in accordance with econometric performance of each equation. The reduced model is presented below, where **D1** refers to a dummy variable associated with the fact that during the first half of the period of analysis production was constrained by available industrial capacity (**"t"** statistics are in brackets):

ESTIMATED REDUCED MODEL

CONSUMPTION:

$D_t = 9.950 - 0.3159\ W_t + 30.2681\ F_{t-1} - 2.9786\ D1$

$\quad$ (5.27) $\quad$ (-3.00) $\qquad$ (13.27) $\qquad$ (-3.73)

$R2 = 0.97 \qquad DW = 1.90 \qquad F(3,12) = 166.9$

PRICE:

$P_t = 16.782 + 1.0980\ W_{t-2} + 12.0505\ F_{t-1}$

$\quad$ (6.39) $\quad$ (6.12) $\qquad$ (2.37)

$R2 = 0.85 \qquad DW = 2.23 \qquad F(2,12) = 41.6$

PRODUCTION:

$Q_t = 9.419 - 0.3078\ W_t + 31.0835\ F_{t-1} - 2.9818\ D1$

$\quad$ (4.78) $\quad$ (-2.80) $\qquad$ (13.05) $\qquad$ (-3.68)

$R2 = 0.97 \qquad DW = 1.94 \qquad F(3,12) = 162.1$

INVENTORY:

$E_t = 0.308 + 0.0753\ W_{t-1} - 1.6096\ F_t + 1.3774\ F_{t-1} - 0.4019\ D1$

$\quad$ (0.87) $\quad$ (4.55) $\qquad$ (-2.26) $\qquad$ (1.94) $\qquad$ (-2.79)

$R2 = 0.90 \qquad DW = 2.10 \qquad F(4,11) = 36.5$

In the next step the reduced equilibrium model was calculated by supposing theoretically that all exogenous variables were fixed at their levels in time **t** and that the dummy value is zero. This procedure gives noise-free equations and series to be used in the second stage of the econometric work. Formally:

REDUCED EQUILIBRIUM MODEL

consumption: $D^*_t =$ 9.950 - 0.316 W_t + 30.268 F_t

price: $P^*_t = 16.782 + 1.098 W_t + 12.050 F_t$

production: $Q^*_t =$ 9.419 - 0.308 W_t + 31.083 F_t

inventory: $E^*_t =$ 0.075 W_t - 0.232 F_t

where asterisks indicate theoretical equilibrium levels. Considering that the demand equation and the supply price equation are just-identified, their parameters can be computed directly from the coefficients of the reduced equilibrium model following an indirect least squares procedure. However, the production decision requires one to follow the two stages least squares method, thus using the equilibrium series in the second stage of the econometric work to estimate the structural relation between the endogenous variables production, profit margin and inventory. Results obtained are:

DEMAND CURVE (ILS): $D^*_t = 14.780 - 0.288 P^*_t + 33.736 F_t$

SUPPLY PRICE (ILS): $P^*_t = 16.782 + 4.994 W_t - 51.940 E^*_t$

PRODUCTION DECISION (2SLS)[5]: $Q^*_t = -29.284 + 2.440 M^*_t - 7.259 E^*_t$

where   **$M^*_t = (P^*_t - W_t)$**

Finally, the long run equilibrium supply curve may be obtained following three different ways. First, one may derive it as theoretically described, that is, as a combination of the supply price and the production decision equations. Secondly, the supply curve may also be seen as an outcome of an ILS procedure directly from the reduced model and, finally, one may estimate the supply curve in a two stages least squares method. All results are statistically identical. For example, parameters in the expression below was obtained by computation from the pair of equations that describe the short run supply behavior.

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[5] Given that all endogenous variables series are computed from the equilibrium reduced model, structural relations here become in fact linear combinations with correlation coefficient equal to one: residuals are negligible in relation to the level of the dependent variable. However, no matter how small the residual can be, it will display the same time-pattern of the explained variable, what means that the Durbin-Watson test may not allow for the rejection of autocorrelation. In order to test the performance of the structural relation, for instance the production decision, one must replace the equilibrium values of at least one endogenous variable in the equation by its actual value and its gravitational component computed as the percentage difference between the actual and the theoretical equilibrium values. In this case the estimated relation was:

$$Q^*_t = -33.71 + 2.438 M^*_t - 4.317 E_t + 0.04 GDE100_t$$
$$(24.0)\quad (49.9)\qquad (21.1)\quad (15.8)$$

where GDE100 is the inventory gravitation rate. R2 is 0.96, F-statistic is 117.3 and Durbin-Watson statistic is 1.85. This procedure indicates that there is no reason to reject the production decision equation, but this last equation distorts the coefficients of the explanatory variables because gravitation is not statistically independent of the level of the endogenous variable which it is associated with.

SUPPLY CURVE:

$$Q^*_t = -31.63 + 2.580 \, P^*_t - 3.138 \, W_t$$

This was the relation searched for in that study of the Brazilian cement industry. It is a supply curve theoretically constructed ex post from the short run behavior of producers, which is described by two simultaneous equations with non-contemporaneous effect over price and production. This supply curve is therefore a theoretical abstraction: producers' decisions are not guided by it. Despite being itself not a behavioral function, the supply curve is an useful analytical tool: it allows for a theoretical and powerful abstract economic analysis which can show how the two major economic endogenous variables, price and production, are simultaneously determined. This determination is made by the interaction of supply and demand, but the positions of the respective curves are not chosen by producers or consumers; they are consequences of the values assumed by or given to the exogenous variables - economic policy variables among them. The supply-and-demand model brings about a condensed view of the effect of the economic policy on price and production and, thereof, on the economy as a whole.

4. THEORETICAL FOUNDATIONS

The model presented here is based on the oldest principle in economics, condensed by Marshall in a simple proposition: "the general theory of the equilibrium of demand and supply is a Fundamental Idea" (MARSHALL, 1890, Preface to the first edition). This model has therefore two groups of agents, consumers and producers, who interact with each other in such a way that, theoretically, a level of price will be expected to allow the consumption amount to match the production amount. The final objective is a market model, based upon the relation between supply and demand, able to explain how the levels of those endogenous variables - price, consumption and production - are determined.

In its most condensed form the supply-and-demand model is composed of three simultaneous equations, because the endogenous variables are at least three: consumption, price, and production. Accordingly, one must be "sure that he has enough, and only enough, premises for his conclusions (i. e. that his equations are neither more nor less in number than his unknowns)" (MARSHALL, 1890). One of the equations is the demand curve, which provides a relation between price and consumption. The second relation could be the identity between the amount demanded and the amount produced. However, considering that equilibrium may be unfeasible in the real world, it is proposed here that the market clears only in a special circumstance. This circumstance is defined as "theoretical" on the grounds that it is dissociated from actual data collected for empirical work.

It is usual to break analysis into two categories: the short and the long run, but more than this there is also the "very short run", or the "daily market" period. The assumption made is that in the daily market period production only ever matches consumption incidentally: market does not necessarily clear in actual day-to-day transactions. Production is given and hence "Market values are governed by the relation of demand to stocks actually in the market" (MARSHALL, 1890, page 309), with less influence from cost. Accordingly, there is no supply curve in the daily market. It is in the daily market that actual trading takes place, including the purchase of those production factors which will be used in the next period. It is during the daily market that decisions made on price and

production are transformed into real transactions: observable values, those collected for statistical purposes, are those realized in this period.

Considering that in the daily market period price may be adapted to existing conditions, but production cannot because it always takes time, each of these variables - supply price and production - may follow different decision patterns. Supply price and production are therefore non-contemporaneous in relation to their respective formation, but of course they must be mutually consistent on the long run and exhibit a definite pattern ex post. Accordingly, this paper proposes a model of daily market supply behavior in which producers follow a decision-making process divided into two parts, the supply price and the production decision: "Production and marketing are parts of the single process of adjustment of supply to demand" (MARSHALL, 1919, page 181).

In a few words, the proposition is that the supply price is actually observed only in the daily market, and that it is a function of the cost of production and the stock then available; at the beginning of each daily market period the stock is given, and if cost were not considered then the price would be determined exclusively by demand. Theoretically, neither the cost nor the demand which is embodied in the inventory are alone sufficient to explain the price: they are both necessary. The supply price **P** may thus be expressed as a function of the cost **W** and the inventory **E** which comes from the previous period:

$$\textbf{supply price: } \mathbf{P_t = f\,(W_t\,,\,E_{t\text{-}1})}$$

where the derivative in relation to costs (dP/dW) is positive and (dP/dE) is negative. Alternatively, this equation could be seen as a species of variable mark up pricing policy, perhaps identical to some particular model in the post-Keynesian tradition. In this case the mark up would be sensitive to demand pressure, here measured by the inventory level. DOWNWARD (1995) develops an extensive discussion on this matter and presents an empirical support to the thesis that in the post-Keynesian perspective price is sensitive to demand.

On the production side, the theoretical approach here developed it is supposed that industrial production is naturally complex and takes time; nonetheless, any decision on production is transformed into reality in the daily market, through the purchasing and hiring of factors, which are the only events observed for statistical purposes. Production decision is primarily based upon the expected profit margin, defined as the surplus over direct costs; it is the return on the total capital, and depends also on the turnover of floating capital. It is possible that in some daily market period the supply price could be such that the margin would be "insufficient" but, in a long run average, the profit margin must be considered at least as "acceptable"; otherwise the production would gradually fall off. The idea is that the higher the profit margin in a branch, the higher the total capital allocated to this branch, increasing production in the short run, and capacity in the long run. This means that financial capital moves from branch to branch, always searching for the better return. In theoretical terms it may be expected that factor mobility, especially financial capital mobility, will prevent sector production constraints: given a reserve fund, if capital is free to move, then all productive sectors have the financial capital they consider appropriate for the running level of production, obtaining thus an unconstrained, non-uniform, profit margin.

Additionally, production also depends upon inventories: a rise in stock is perceived as a fall in demand, and thus each company, acting alone or in accordance with its competitors, diminishes production in order to avoid excessively rising stock and further pressure of stock on price. On the contrary, if stocks fall producers understand that demand has been shifted upwards and then each company plans to invest and increase production, trying to acquire for itself the largest possible share of the new demand. Therefore, the production decision component of supply behavior may be stated by a equation where production **Q** is a function of the expected profit margin **M** and the stock **E** then available:

$$\text{production decision: } Q_t = h\,(M_t, E_{t-1})$$

where the derivative in relation to profits (dQ/dM) is positive and (dQ/dE) is negative. The complete daily market model has thus as many equations as endogenous variables: producers set price through the supply price equation which states that price is a function of the exogenous variable cost and of the inventory, which has a natural accounting equation associated with it; consumers decide on the amount demanded through the equation of the total demand; and finally producers decide the amount to produce through the equation of the production decision, which is based on the profit margin defined, for instance by the difference between price and cost, and on inventory. In this theoretical approach to the behavior of producers in the daily market there is no supply curve because it would be a redundant equation.

The necessary and sufficient condition for equilibrium is market clearing: quantities supplied and demanded must be equal. In contrast, in the daily market production and consumption never actually match. In the daily market there is no clearing, which is the same as to say that in the daily market, when real transactions are carried out, there is no equilibrium between supply and demand; accordingly, there is no daily market supply curve. This distinction between non-clearing daily market and clearing equilibrium market is important also because data on real transactions are observed and collected for statistical and analytical purposes only in the daily market when there is no equilibrium between supply and demand: real data are disequilibrium data.

Producers make decisions when the market is outside equilibrium; however, this is not a disequilibrium approach: the lack of equilibrium in this model is associated with actual transactions realized during the daily market period, and this feature stems basically from the behavior of the exogenous variables, costs and demand, which are continuously varying. This model allows market to be always moving towards equilibrium, but it would reach this situation only if the exogenous variables were constant during a certain minimal period of time. Equilibrium here is a theoretical construction, an abstraction: "the normal or natural value of a commodity is that which economic forces tend to bring about in the long run (...) if the general conditions of life were stationary for a run of time long enough" (MARSHALL, 1890, page 289).

5. WHY SUPPLY CURVE STILL MATTERS

5.1. THE STATE-OF-THE-ART

A rising aggregate supply curve seems to be a natural component of the theory developed by Keynes, who concluded thereof by the statement of the ascendancy of demand management in economic policy. In fact, for aggregate demand to be relevant in

economic policy, it must interplay with an aggregate supply curve that slopes upwards. For instance, if the aggregate supply curve were vertical, as classical writers propose and Keynes intended to dispose, aggregate demand would have no other role than determining price. In this case, long run production would be fixed at the maximum capacity level and some Keynesian economic policy recommendations - typically fiscal policy - would make no sense because it would be unable to create more employment. If the aggregate supply curve were vertical, only new technology or any kind of cost reduction, and the elimination of rigidities or any kind of human "imperfection", could lead to more production. Moreover, a positive slope aggregate supply curve seems to be a necessary condition for the Keynes' statement that employment and price are the outcome of the interaction of supply and demand.

In the *General Theory*, autonomous upward shifts of aggregate demand lead to higher price-level and larger aggregate production, that is to say, to new points on the aggregate supply curve in the right direction. Of course the contrary holds: if aggregate demand curve is shifted downwards then the price-level, the aggregate production - and the employment - will fall. Therefore, the slope of the aggregate supply curve is straightforward important for economic theory and policy: a Keynesian fiscal policy to expand employment will be of any effect only if there is an aggregate supply curve which displays a positive slope. A striking implication of the aggregate supply slope stems from a type II error: if aggregate supply slopes upwards, but neo-classical-driven policy-makers outlaws fiscal policy, consequently freezing aggregate demand on the grounds that it only inflates prices, economic policy risks freezing the economy as a whole. In this case inflation may possibly be put under control, but low aggregate demand will certainly induce rising unemployment levels.

Furthermore, historically speaking it is possible that former neo-classical theorists mistakenly identified an undesirable call for intervention in Keynes' rhetoric. However, it seems to be excessive to say that Keynes proposed government to rule the economy, imposing to firms how much to produce of what product which should be sold at this or that price. The strong policy implication of Keynes' work is that exogenous variables, among them economic policy variables, set the levels of aggregate supply and aggregate demand curves. This means that economic policy is partially responsible for the level of employment and price. However, this fact is in itself insufficient to derive a recommendation that a central entity like government should control the entire economy.

What has possibly been wrong with supply-and-demand analysis, especially with the aggregate supply curve, is the method followed, not only by Keynes but also by Marshall and other theorists, in the search for a model to properly represent the supply-and-demand theory. Maybe Keynes himself, using a method which is obviously neo-classical, introduced some confusion on the matter. Perhaps Keynes tried not to "create too much" and used marginal terms hoping that the end would justify his means. Instead of abandoning the model itself one could think of looking for a better method to demonstrate that there is an aggregate supply curve which slopes upwards and, definitively, is not vertical. It may possibly be quite near the horizontal line, but one may expect it, under normal conditions, to be very far from the classical vertical position, as indicated by the few empirical information available. On the other hand, it would certainly be unfair to discuss supply behavior without making reference to Keynes.

History tells us that Keynes came and go and classical theory survived. More than this, neo-classical theorists gave it new support to restate the aggregate supply curve as a

vertical line, but now specifically "in the long run". Furthermore, neo-classical equilibrium is the same as full, or natural, or NAIRU, or maximum, employment level. Consequently, when in equilibrium production and employment are at the highest level possible and demand management nothing can do about them. Coincidence or not, verticality of the aggregate supply curve matches the neo-classical refusal of fiscal policy and the prominence of monetary policy. However, at present even neo-classical writers recognize that a vertical aggregate supply curve is not sufficient to support the view that neo-classical aggregate supply-and-demand analysis is *the* macro-theory. Accordingly, in recent years mainstream textbooks have given more and more space to Keynesian-like aggregate supply curves, although always acting cautiously for not to deny the classical long run verticality. In the neo-classical strand Keynes' supply has misleadingly been associated with wage and prices rigidities, a species of "imperfection" that could be eliminated "in the long run" by a "good and severe economic policy". Accordingly, a positively sloped supply curve is there admitted only as a short term phenomenon. This is the present state-of-the-art at the macroeconomic level.

At the microeconomic level a rising supply curve implies that prices are influenced by both demand and costs, and not exclusively by the cost of production or exclusively by the demand. Theoretically, two possible sufficient condition for supply to be positively sloped are that, given an upward shift of the demand curve: 1) richer consumers are inclined to pay more to be granted priority in the limited supply, and 2) normally, more financial capital is required for production to grow. Given that retained profits is the major source of financial capital for firms to invest and increase production, they may raise such funds by increasing the price trough a larger mark up. This is in line with the post-Keynesian approach proposed by Eichner, in which the mark up is a function of firm's investment plans.

On the neo-classical side the story may go back to COURNOT (1838), who first formalized the demand curve and the neo-classical paradigm. Cournot demonstrated that the outcome of the differential calculus for profit maximization is, ceteris paribus the cost of production, a relation between price and production that may play the role of a supply curve. He also created the perfect competition (*concurrence indéfinie*) environment, in which the price would be equal to the marginal cost. Cournot presented an analysis of the incidence of a tax on a certain commodity using a pioneering kind of supply-and-demand model, but he did not gave it this name: this was done some years later, in MARSHALL (1890). Stressing the shortcomings of the differential calculus, Marshall proposed the supply and demand theory as a "Fundamental Idea", in which demand plays a leading dynamic role. For him, producers adjust supply to demand through marketing and production. Considering that adjustment of supply price and production cannot be simultaneous because production always takes time, demand growth could therefore leads to non-contemporaneous greater supply price and larger production. This process gives rise to a supply curve, but an *ex post* supply curve with a general positive slope.

Despite these contributions, emergent neo-classical doctrine was successful in its attempt to avoid the embarrassing implications of Cournot's work, reducing him to a simple historical curiosity by imparting to his model a certain naïveté associated with its assumption of independence between producers' decisions. Influent neo-classical writers have also "marginalized" Marshall's *Principles*, retaining from it only what would be adequate to support "the paradigm", and despising its critical statement about the differential calculus in economic life. However, neo-classical doctrine is itself

incompatible with the notion of supply curve. Despite Cournot's findings, the outcome of modern differential calculus to maximize profit is not defined as a supply curve, except if one is running a perfect competition hypothetical situation. Therefore, in general the neo-classical version of the law of demand-and-supply cannot be represented in a simple diagram with two crossing lines in the space **P** x **Q**.

The neo-classical paradigm of profit maximization through differential calculus is a short run device which depends crucially on the hypothesis that production capacity is given. This means that there would be no capital mobility, at least between the real and the financial sides of the economy; there would not be the Keynesian speculative demand for money. On the other hand, in their long run situation neo-classical statements are put forward loosely, there is no rigorous differential calculus there. The hypothesis that capacity is given implies that investment, typically an endogenous variable, must logically be seen as an exogenous, not explained, variable in the neo-classical context. For a firm to maximize profit in the long run the rule would be to restrict production to the available capacity and certainly not to invest to increase capacity.

Accordingly, in a complete price-and-production neo-classical model there is no formal equation stating that investment, and hence capacity, be functions of the endogenous variables profit and, thereof, price. Neo-classical theorists reinvented Cournot to say that, at the microeconomic level, there is no supply curve outside the artificial world of perfect competition. However, once financial capital is allowed to move, then even the perfect competition version cannot be defined as a supply curve because it would be continuously shifted by the investment induced by higher profits and prices caused by demand shifts. For this to be the case, among other problems, supply behavior would be governed by the demand. This is the present state-of-the-art at the microeconomic level.

Unable to deal with investment, that is, unable to deal with competition, neo-classical textbooks have been forced to deny the existence of the supply curve, being therefore unable to deal with a general supply-and-demand model. The neo-classical approach allows no general micro-theory of supply behavior and proposes an aggregate supply curve which states that producers do not decide how much to produce; they just produce the maximum given by available technology and natural resources. Therefore, it remains a mystery why supply and demand analysis has been widely viewed as a neo-classical concern, because there is no general neo-classical microeconomic supply theory, but a plethora of models which deny the existence of a supply curve, nor the hypothesis that aggregate production is exogenously given at the full capacity level can exactly be considered as a macro-theory.

5.2. FROM MICRO TO MACROECONOMICS

A key element in Keynes' theory is private investment, which is partially a function of expected profits. Accordingly, to be realized the investment depends upon the mobility of financial capital. Given that the financial capital is free to move, then the existence of a speculative reserve fund implies that all productive sectors have had exactly the amount of financial capital which stems from the respective supply and demand interactions. Mobility of capital may thus be seen as the interface between the industrial productive sector and the Keynesian reserve fund associated with the speculative demand for money, it relates the real and the monetary sides of economics, connecting micro and macroeconomics. This implies a positive-slope aggregate supply curve: first demand grows and then price and profit increase, then larger financial capital moves to the real sector and, finally, production

is allowed to grow. This means that the world is, as Marshall and Keynes stated, demand-led. In this case producers adjust to demand in such a way that, for production and employment to grow, demand must rise first. As a consequence, the price will also rise, "walking upon" the supply curve. However, one may say that there will be "pure" inflation only if monetary policy issues more money than the amount which matches the increase in aggregate demand and production stemming from a realistic expansive economic policy, for instance a fiscal policy.

This paper deals with the supply-and-demand theory, developing a microeconomic model in which the short run supply behavior leads to an *ex post* supply curve with a general positive non-anticipated slope. It is suggested that this supply notion matches sufficient requirements to be taken as the counterpart of the Keynesian aggregate supply curve. This model is intended to be an alternative microeconomic basis for a Keynesian demand-oriented economic policy. Main features are as follows:

1) the demand curve is stated in an apparently ad hoc fashion but it is not supposed that it stems from utility maximization;

2) the model dispenses with profit maximization through differential calculus;

3) producers make decisions when the market is in an out-of-equilibrium situation;

4) prices and production rise with demand;

5) the model has no ad hoc special equilibrium levels such as full capacity utilization or full employment, and displays no tendency towards doing so in the long run. It is not an equilibrating device in the sense that a situation with some kind of "social justice" would eventually emerge;

6) given the economic policies at the micro and macroeconomic levels and other exogenous variables, interaction of supply and demand could theoretically lead to some "intrinsically economic" solution for price and production which is defined as a theoretical "market solution". This would therefore be a theoretical construction of some hypothetical "equilibrium" price and "equilibrium" production which would correspond to some kind of expectation, for instance the expected profit which will guide firm's investment decisions;

7) there are (short and long run) inventory of finished goods and industrial idleness;

8) investment and hence production capacity are endogenous variables like the wage at the macroeconomic level; they are never supposed to be given for any run of time;

9) government plays an important role in the determination of the positions of both supply and demand curves. Therefore, economic policy does matter in the outcome of any branch. Economic policy shares with producers the responsibility on price and production determination.

6. SUMMARY AND CONCLUSIONS

This paper develops the supply-and-demand theory starting from the outline of a dynamic decision-making model on price and production in the daily market period, when real transactions are made and actual prices are observed for statistical and analytical purposes. This model of out-of-equilibrium short run supply behavior has two parts: the supply price setting and the production decision. Dynamics of the model allows for constructing a long run theoretical abstract equilibrium status in which it is defined a theoretical supply curve at the microeconomic level. Joining together with the demand

curve, which has not been associated with the notion of utility maximization, this theoretical approach leads to a supply-and-demand model. The equilibrium situation of this model is not a special situation like for instance full capacity utilization which could be defined ex ante. Therefore, this model may also be seen as a sound evidence that the good old idea of supply-and-demand is not an exclusive neo-classical concern.

The theoretical and empirical methods here followed allow simultaneously for producers to decide outside equilibrium in the real world and for analysts to deduce an ex post supply curve in a general, not full-employment, theoretical equilibrium situation. The lag structure permits to deal with non-contemporary price and production decision outlets, with short run disequilibrium and, at the same time, with expectations. Real data here are not equilibrium data; equilibrium in this case is just an abstract theoretical construction. The supply curve does not exist in itself, in the sense that price would explain production directly, or vice versa. It is a kind of a first step reduced equation, thus being not a direct behavioral function but the ex post resultant of two producer's behavioral functions: mark up setting and the decision of investing in production. The supply curve is only a deduction, but an useful abstraction for analytical purposes.

This approach dispenses with the hypothesis that capacity of production should be exogenously given. Capacity stems from investment, which is an endogenous variable because it depends partially on the endogenous variable profit margin. Being endogenous it cannot be supposed to be given; it will vary with profits realized in a branch, leading therefore to the mobility of financial capital among all the branches of the real sector. Furthermore, financial capital may move between the real and the monetary sides of the economy, in such a way that the mobility of capital becomes the interface between the real industrial productive sector and the monetary Keynes' reserve fund. Capital mobility provides the link between microeconomics and Keynesian macroeconomics. An empirical application of the aggregate supply-and-demand approach may be found in LIMA (1996). This approach is in line with the "anti-Say" notion, defended by Keynes and Marshal, that the economy is pushed by demand, thus inducing individual producers to adjust supply to demand, following a convergent decision-making process.

The supply-and-demand theory states in essence that, given the positions of supply and demand curves, the interaction of producers and consumers allows for a theoretical equilibrium level of the endogenous variables, for instance price and production. The process of interaction is itself insufficient to make the system be self-righting because the positions of supply and demand are determined from outside the model: these positions depend entirely on the level of the exogenous variables set. Therefore, the equilibrium level varies with the level of the exogenous variables, amongst them the economic policy variables. Exogenous variables may be "neutral" if they are associated with facts of the real living world. The challenge stems from the economic policy variables which play a leading and striking role because their values may be modified by human persuasion. Economic policy is the visible hand which commands supply and demand. This matches Keynes' statement that if just let to themselves producers will find an equilibrium situation which is not full employment. One should not despise the possibility that, respecting restrictions from the real living world, and without any kind of intervention to rule agents' behavior, economic demand-oriented policy may induce investment in the real sector and, consequently, increase employment.

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