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Contents

Abstract

This paper analyses the interaction between profit maximization and aggregate demand through two alternative theories of price and output adjustment. According to the neo-classical interpretation, excess aggregate demand drives up price, which in turn reduces the real wage rate to induce profit-maximizing firms to produce more. In the alternative view, excess demand generates non-price signals like decumulation of inventories to induce directly the firms to produce more. Higher marginal cost at higher production is covered through upward price adjustment, making real wage an outcome, but not a determinant of the output level. The disregard of this latter view has led to logically inconsistent constructions like aggregate demand/supply analysis of many recent textbooks, and misleading 'monetarist' interpretation of the Phillips curve.

Keywords: Aggregate demand (AD), aggregate supply (AS), concept of derived aggregate demand (DAD), aggregate demand versus profit maximization, output versus price adjustment

JEL classification: A10, B41, E12, E13

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1 Inconsistency in AD/AS analysis

Although the Keynesian framework assigned unambiguously a central role to aggregate demand for determining output, it was grafted onto the Marshallian microfoundations of profit maximization in the General Theory (Keynes, 1936, p. 5). This has led to continuing debate, specifically because it could be interpreted to imply that higher output is achieved only through a reduction in the real wage rate to induce profit-maximizing firms to produce more. Such an interpretation gives prominence to the supply side decisions by the firms, and tends to shift the focus away from the central role played by aggregate demand in the determination of output in the Keynesian scheme.

An interesting case, highlighting the problem, in this respect is the aggregate demand/aggregate supply (AD/AS) analysis. It is used in many recent textbooks to allegedly convey the basics of Keynesian analysis of aggregate demand in conjunction with the profit maximization postulate as characterizing the aggregate supply side (cf. Baumol and Blinder, 1998; Mankiw, 1998; Stiglitz, 1997). It is now also widely recognized that this construction suffers from logical inconsistency (cf. e.g. Hall and Treadgold, 1982; Rao, 1991; Bhaduri, Laski and Riese, 1994, 1995; Colander, 1995). It arises fundamentally from the fact that the assumption of profit maximization by the firms as a constraint on the 'supply side' is not easy to reconcile with the Keynesian postulate of output constrained by aggregate demand.[1] The inconsistency stems from the fact that two different supply responses by the firms are implied by the two constraints. For instance, at any given price, firms follow the rule of maximizing profit by adjusting output along the AS curve. At the same time, however, they would have to follow a different rule if they adjust output exclusively according to demand along the AD curve. This boils down to the inconsistent position of assuming two different

[1] For instance, the distinction between 'Classical' and 'Keynesian' unemployment drawn by Malinvaud (1977) depends on treating profit maximization or aggregate demand as the binding constraint. And, the distinction disappears if both the constraints are simultaneously binding, i.e. where AD and AS intersect.

responses yielding two different levels of supply by the firms at each out-of-equilibrium price (Bhaduri, Laski and Riese, 1995; Colander, 1995). Thus, under the usual assumption of a falling AD and a rising AS curve with given money wage, at all prices except at the intersection point, a higher price should induce firms to produce more along AS, according to the profit maximization rule, but it should also induce them to produce less along AD. Only at the point where the AD and the AS curve intersect this contradiction is hidden: elsewhere it is apparent.

It might be interesting to speculate why such an inconsistency not only crept into the analysis, but proliferated through so many textbooks. At the more obvious level, the temptation to present the macroeconomy as just any normal market regulated through the price mechanism with a rising supply and a falling demand curve must be strong. This temptation might not be merely on account of the pedagogical simplicity of this construction. It also strengthens the comforting thought that the price mechanism works economywide in some rough and ready manner told by the parable of AD/AS.

At the analytical level, however, the inconsistency arises from a lack of appreciation as to how the circular flow of national income affects aggregate demand in the macroeconomy. Precisely because of the circular nature of this flow, the expenditure by firms on the wage bill accrues as income to households. Consequently, households consume more out of their higher income through the consumption function to drive the multiplier mechanism, only if the firms offer more employment to generate higher income for the households. In this way the supply response of the firms enters in an essential manner in the demand for goods by the households to drive the multiplier mechanism.[2] Since the construction of the AD curve entails this multiplier mechanism, it is a mistake to argue that at any given level of investment, the AD curve concerns exclusively the 'consumers' or households, but not the firms as 'suppliers', which appear only through the AS curve. The dichotomy between demand and supply, typical of partial equilibrium analysis, breaks

[2] In other words, except for the initial impulse of a higher level of investment, all the successive rounds of the multiplier in the convergent geometric series are driven by higher expenditure out of higher incomes received by the households as wage, and by the firms as profits. Consequently, at each round of demand expansion it is being assumed that the firms are responding simply to that higher demand, without assigning any clear role to profit maximization.

down in the case of circular flow in the macroeconomy, because the income of the households derives from how much firms decide to supply.[3]

The recognition of this logical inconsistency of the conventional AD/AS analysis has attracted a considerable amount of research (cf. inter alia Hall and Treadgold, 1982; Rabin and Birch, 1982; Fields and Hart, 1990; Perry, 1991; Rao, 1991; Allen and Stone, 1993; Dalziel, 1993; Colander, 1995; Colander, 1997). It is not the aim of the present paper to fully discuss this literature. What we try in the rest of the paper is to further analyse one prominent line of reasoning followed by several authors (Fields and Hart, 1990; Colander, 1995), viz. to abandon the conventional AD curve altogether and replace it by a construct which seeks to remedy the inconsistency. As we will show this is achieved by assigning the central role to the supply side and profit maximization and relegating the role of effective demand in output determination to the background. By studying the dynamics of this approach and contrasting it to an alternative dynamic interpretation which we believe to be more in line with original Keynesian ideas, we highlight the respective roles of profit maximization and the principle of effective demand in these different interpretations.

2 Alternative dynamics of adjustment in output and price

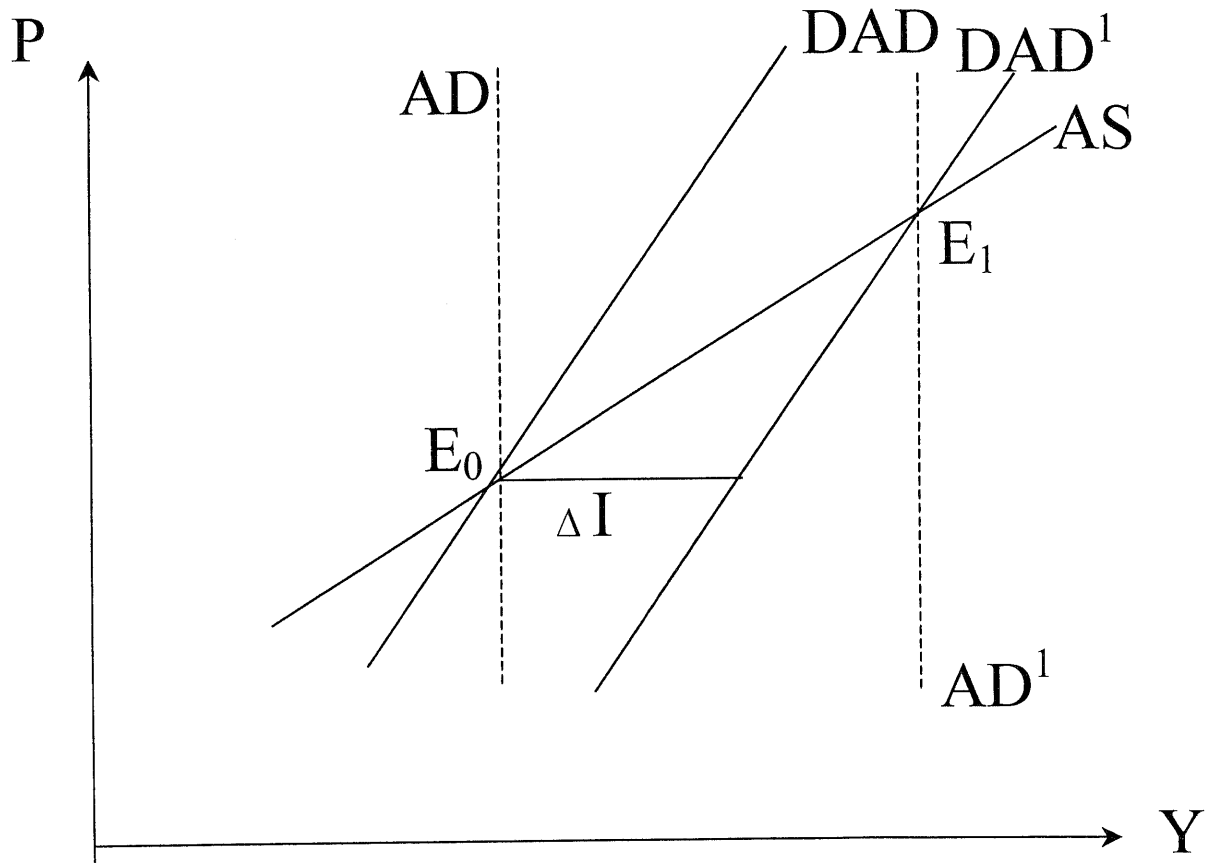
The above-mentioned group of authors (Fields and Hart, 1990; Colander, 1995) propose a construct which shows the level of demand that would result at each price due to profit maximization by the firms. This could conveniently be called the 'derived aggregate demand' (DAD) curve, which emphasizes that aggregate demand is derived simply from profit-maximizing output at each price (Bhaduri, Laski and Riese, 1994). In general, this curve will be positively sloped, because it is derived from the profit maximizing AS curve which is also positively sloped in the (Y, P) plane, and steeper than the AS curve.[4] Figure 1 exhibits the mechanics of this construction, where the

[3] The idea that AD/AS is just a scaled-up version of partial equilibrium demand and supply analysis is most transparent in the exposition of Baumol and Blinder (1998, pp. 519-520).

[4] For details of this geometric construction in an elementary textbook fashion, see Bhaduri, Laski and Riese (1994; 1995).

Figure 1

Aggregate Supply (AS) and Derived Aggregate Demand (DAD) curves



profit-maximizing AS curve is coupled with a 'derived aggregate demand' (DAD) curve. If the original equilibrium E_0 is disturbed by, say, an increase in investment ΔI, the DAD curve is shifted to DAD′ by exactly the same amount. The resulting gap between investment and savings drives prices up, inducing profit-maximizing firms to adjust output upwards. The process of price adjustment continues until the narrowing investment-savings gap is eliminated at equilibrium E_1. The adjustment described here heuristically resembles only superficially the rounds of the multiplier process. Because, in contrast to the original Kahn–Keynes multiplier, where quantity adjustment is driven directly by excess demand, the process here is driven by profit-maximizing supply responses of the firms which adjust output to the changing real wage, arising from constant money wage rates and a price level that changes according to excess demand.[5]

This process of adjustment, in which output and employment are driven by profit maximization and price is driven by excess demand for goods (at constant money wage), corresponds to the 'derived aggregate demand' (DAD) model outlined above. The dynamics can be represented formally by a system of equations:

$$X = f(L), \quad f' > 0, \; f'' < 0 \qquad [1]$$

$$\frac{dL}{dt} = a\left[pf'(L) - \overline{w}\right] \quad a > 0 \qquad [2]$$

$$\frac{dp}{dt} = bp\left[I - sf(L)\right] \quad 1 > s > 0 \qquad [3]$$

where equation [1] represents the production function in the short period, with capital stock given, and output (X) is a function of employment (L) only, with usual properties. Equation [2] shows how employment is driven by profit maximization, with p as the price level and $w = \overline{w}$ as the given money wage rate; a is some constant speed of adjustment. Equation [3] describes how price

[5] See also footnote 2. Since the changing price level affects output adjustment by changing the real wage rate, the argument is considerably simplified by assuming a constant money wage rate (as in most textbook expositions). However, this assumption is not strictly necessary, and section 3 of the appendix shows how the relative adjustment between a variable money wage rate and the price level affects the argument through 'money illusion' or 'unanticipated inflation'.

responds to the excess demand gap for goods created by a discrepancy between investment (I) and saving, sf(L), where s is the constant average (and marginal) propensity to save, and b is the constant speed of adjustment.[6] Assuming a non-trivial equilibrium – i.e. $L^* \neq 0, p^* \neq 0$ – to exist for this system [1] to [3], it can be shown by routine calculation that the equilibrium is locally stable (see appendix).

In contrast to the above system, in the alternative interpretation of the Keynesian system, excess demand plays a direct role in driving output, i.e.

$$\frac{dX}{dt} = f'(L)\frac{dL}{dt} = \alpha\left[I - sf(L)\right] \quad \alpha > 0 \qquad [4]$$

The profit maximization condition is satisfied in this system by price adjusting to equate marginal cost to marginal revenue, i.e.

$$\frac{dp}{dt} = \beta\left[\overline{w}/f'(L) - p\right] \quad \beta > 0 \qquad [5]$$

with α and β as the arbitrarily given constant speeds of adjustment. Again, assuming an equilibrium to exist for the system [1], [4] and [5], routine calculation shows this equilibrium to be also locally stable (see appendix).

Although the assumption of profit maximization is maintained in both systems depicted by equations [1], [2] and [3], and alternatively by equations [1], [4] and [5], it implies very different economic causation in the two systems. In the neo-classical interpretation of Keynes, encapsulated in equations [1], [2] and [3], profit maximization drives output adjustment (equation [2]) through a reduction in the real wage rate. In contrast, in the alternative system price adjustment in [5] ensures profit maximization by covering marginal cost; whereas marginal cost adjusts corresponding to adjustment in output, which is governed directly by effective demand in equation [4]. In this sense, in the alternative Keynesian system of equations [1], [4] and [5], variation in the real

[6] Whereas the DAD framework views the investment-savings gap to influence price via a Walrasian adjustment mechanism, it does not make a fundamental difference if this influence is modelled along Marshallian lines as in Dutt (1997): here firms decide upon output by maximizing profit under the assumption that an *expected* price prevails. If the produced output cannot be sold at this expected price, price adjusts and this new price governs price expectations for the next period.

wage is not a cause, but the consequence of output adjustment, despite the condition of profit maximization being satisfied.

That adjustments in the real wage rate emerge not as the cause, but as the *consequence* of output adjustment is of central importance.[7] The point can be highlighted further by considering other rules of price adjustment which would all share the common characteristic as being broadly 'cost-determined' (Kalecki, 1971), but leave room for output to be determined directly by aggregate demand. These rules may or may not entail *precise* profit maximization; instead, some may look upon profit seeking as a 'satisficing' behaviour consistent with 'bounded rationality' (Simon, 1979; Conlisk, 1996). The essential point of the alternative Keynesian system is that all such rules of cost-based price adjustment, with or without precise profit maximization, are compatible with a more fundamental principle of output being governed directly by aggregate demand (e.g. in equation [4]). Thus, instead of equation [5], the adjustment in price may be postulated to either cover average variable cost with a constant mark-up m on it (equation [5a]), or maintain a fixed proportional mark-up on marginal cost (equation [5b]).

$$\frac{dp}{dt} = \beta\left[(1+m)\overline{w}L/f(L) - p\right], \quad \beta > 0 \qquad [5a]$$

$$\frac{dp}{dt} = \beta\left[(1+m)\overline{w}/f'(L) - p\right], \quad \beta > 0 \qquad [5b]$$

Again, routine calculations would show that equations [1] and [4] combined with either [5a] or [5b] yield locally stable equilibria (see appendix), provided such equilibria exist.[8]

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[7] It may be recalled that in his debate with Pigou, Keynes emphasized this distinction. Moreover, when faced with empirical data which did not show any systematic negative relation between the real wage rate and the level of economic activity, Keynes emphasized again the unimportance of the real wage rate as a causal factor for his theory of output determination through aggregate demand.

[8] Note from the appendix that the systems [1], [4], [5a] and [1], [4], [5b]. have exactly the same necessary and sufficient conditions for local stability as the system [1], [4] and [5].

3 Implications of the analysis

The logical inconsistency that arises in the elementary textbook construction of the aggregate demand/supply (AD/AS) analysis also provided us with a convenient basis to demonstrate how the assumption of profit maximization is used in the 'modern' neo-classical interpretation of Keynesian economics to negate the role of aggregate demand in determining directly the level of output. Because, if the assumption of profit maximization is used as the driving force behind output adjustment (e.g. equation [2]), excess demand in the commodity market, caused by investment-savings disequilibrium, affects only the price level (equation [3]) in a Walrasian manner; in turn this affects output indirectly through profit maximization. The consequences of setting the Keynesian analysis in this particular dynamic perspective are twofold. First, as exhibited by our elementary 'derived aggregate demand' (DAD) analysis in Figure 1, aggregate demand in this particular formulation has to be derived merely from the profit-maximizing level of output that is produced and sold by firms at each price level. This leaves no room for aggregate demand to influence output, except indirectly through changing the price signal (given money wage) received by the firms. Second, it implies that the real wage rate becomes the causal variable driving profit-maximizing firms, so that no adjustment in output is possible, unless the real wage rate changes in the opposite direction.[9]

To make room for output to be influenced *directly* by aggregate demand (equation [4]), which we believe to be the central feature of Keynesian analysis, firms must be viewed as responding to changes in the reported inventory levels by adjusting output. This implies moving away from a framework in which variations of the price level provide the sole signal for adjustment in output. However, it can still be reconciled with profit maximization if prices move in relation to marginal cost, while marginal cost adjusts due to adjustment in output and employment (equation [5]). This implies that real wage is no longer the causal variable driving output, but an outcome of the adjustment in the price level in relation to marginal cost. This

[9] Thus, in this (DAD) framework, if we consider an arbitrary increase in aggregate demand *without* any change in the price–money configuration (i.e. given the real wage rate), firms would have no incentive in terms of profits to move from their initial profit-maximizing equilibrium. The neo-classical story of adjustment in output can only be told through a change in the price level in relation to the money wage rate.

is almost certainly the causation Keynes himself had in mind in the General Theory.[10] And, it comes out far more sharply in Kalecki's formulation of the theory of effective demand (Kalecki, 1971), in which marginal cost remains constant for any given money wage rate over the relevant range, and price is set as a constant proportional mark-up on that constant marginal cost. Any proportional change in price is associated with a corresponding proportional change in the money wage rate (and vice versa), leaving both the real wage rate and mark-up unaffected. In this starkest formulation of the principle of aggregate demand, real wage, being a constant, plays no role in determining output, and precise profit maximization is dispensed with. Instead, total profit increases with higher output produced in response to higher aggregate demand signalled by inventory change, and firms are viewed as price-setters, guided by the 'bounded rationality' of profit seeking through maintaining a constant proportional mark-up on constant marginal and average variable cost.[11]

It must be insisted that the difference between the dynamic perspectives implied in the two contrasting models (equations [1], [2] and [3] versus equations [1], [4] and [5]), is not merely or even primarily a matter of the correct textual interpretation of the Keynesian theory. Its ramifications are much wider, and permeate through several controversial areas of modern macroeconomics. For instance, all recent monetarist reinterpretations of the Phillips curve in its earlier or later versions (Friedman, 1968; Phelps, 1970; Tobin, 1972; Barro, 1993; Lucas, 1981) accept the real wage rate as the causal

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[10] On this point, Keynes writes, '...the price level will only change in the short period to the extent that changes in the volume of employment affect marginal prime cost.' (Keynes, 1936, p. 270)

[11] With constant marginal (and average) labour productivity, f'(L) = k > 0 some arbitrary constant, equation [5b] becomes

$$\frac{dp}{dt} = \beta\left[\frac{(1+m)\overline{w}}{k} - p\right]$$

Consequently, an initial equilibrium price level p* is also defined entirely with respect to the given money wage rate $\overline{w}$, at constant mark-up m, i.e.

$$p^* = \frac{(1+m)\overline{w}}{k}, \quad \text{for } dp/dt = 0$$

The implied real wage, $\overline{w}/p^* = k/(1+m)$, remains constant, so long as the mark-up m is constant, although price and money wage may change by the same percentage.

variable determining the level of employment.[12] These reinterpretations and economic explanations may become open to question if the real wage rate is treated as the consequence, but not the cause of movements in output as suggested by the alternative Keynesian dynamic perspective advocated in this paper.

[12] In the earlier monetarist version, it is the real wage rate perceived by the firms that governs output adjustment through profit maximization, more or less in the manner described in this paper. In the later monetarist version, it is the real wage rate perceived by the households that determines their labour supply decisions, blurring the distinction between 'voluntary' and 'involuntary' unemployment.

Appendix

1. Assuming an equilibrium to exist at (L*, p*), the Jacobian of partial derivatives of the system [1] to [3], evaluated at equilibrium, yields

$$J_{1,2,3} = \begin{bmatrix} apf'' & af' \\ -bpsf' & 0 \end{bmatrix}$$

which has trace $$T = apf'' < 0 \qquad [1.1]$$

and determinant $$D = abps(f')^2 > 0 \qquad [1.2]$$

Hence, the system is locally stable.

2. Again, assuming an equilibrium to exist at (L*, p*), and evaluating at equilibrium the Jacobian of partial derivatives of the system [1], [4] and [5], we have

$$J_{1,4,5} = \begin{bmatrix} -\alpha s & 0 \\ -\dfrac{\beta \bar{w} f''}{(f')^2} & -\beta \end{bmatrix}$$

with trace $$T = -(\alpha s + \beta) < 0 \qquad [2.1]$$

and determinant $$D = \alpha\beta s > 0 \qquad [2.2]$$

Hence, the system is locally stable. It can be checked by similar routine calculation that, although the relevant Jacobian is slightly different for the systems [1], [4], [5a], and [1], [4], [5b], they have exactly the same trace and determinant as [2.1] and [2.2] guaranteeing local stability.

3. Finally, it should be noted that all the relevant Jacobians in the text are calculated on the assumption of a constant money wage rate, $w = \bar{w}$. If this assumption is relaxed to permit feedback from price to money wage, the local

stability conditions would be modified accordingly. For instance, so long as 'money illusion' or 'unanticipated inflation' operates as a mechanism depressing the real wage rate, the system would be stable. Formally, on simple manipulations, the Jacobian matrix of the system [1] to [3], evaluated at equilibrium, would yield,

trace $$T = apf'' < 0$$

and determinant $$D = abps(f')^2(1-e)$$

where, e is the elasticity of money wage with respect to price, i.e.

$$e = \frac{p}{w}\frac{dw}{dp}$$

evaluated at equilibrium. Consequently, the system is locally stable so long as $1 > e > 0$, i.e. the per cent rise in the money wage rate is less than that in the price level.

The alternative system [1], [4] and [5] with the same feedback from price to money wage would yield a Jacobian matrix, evaluated at equilibrium, with

trace $$T = -[\alpha s + \beta(1-e)]$$

and determinant $$D = \alpha\beta s(1-e)$$

So that $1 > e > 0$ again emerges as the necessary and sufficient condition for stability.

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