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The Simple Analytics of Aggregate Supply Demand and Structural Adjustment

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Abstract

The paper attempts to first, build aggregate demand and supply curves for the non-agricultural sector of the Indian economy. Second, use these to briefly analyze demand and supply shocks, including the structural adjustment program (SAP). Third, shed new light on the inflationary process in the Indian economy. We obtain a direct Phillips curve type relationship between inflation and the unemployment rate of capital, that helps to explain stagflation. As the underutilization of capital increases so does the rate of inflation. The nominal standard is the price of food, which is normally rising in such episodes. We bring out inconsistencies in the SAP that arise from ignoring dynamics and multiple equilibria, and suggest efficiency enhancing modifications.

Keywords: Aggregate demand and supply; structural adjustment; Indian inflation; dynamics; multiple equilibria.

JEL Classification: 011, E10.

1. Introduction

The paper attempts to do three things: First, to build aggregate demand and supply curves for the non-agricultural sector of the Indian economy. Second, it uses these to analyse effects of demand and supply shocks, including the nineties structural adjustment. The perspective from the microfoundations of an adjusting representative firm, allows us to put some structure on an untidy debate. This way of looking at the problem is particularly apt, as one of the main objectives of the structural adjustment program (SAP), is to lower costs and improve the

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efficiency of Indian industry. We take a medium-run focus that is the correct one for an analysis of a SAP. Some interesting methodological issues arise that are explored.

Third, it attempts of shed new light on the inflationary process in the Indian economy. The Phillips curve forms an important part of any aggregative story of inflation. It has been found difficult to derive a Phillips curve for a labour surplus dualistic economy such as India has. Instead of a Phillips curve type inverse relationship between the rate of inflation and unemployment, we obtain a direct relationship between inflation and the unemployment rate of capital that helps to explain stagflation. As the underutilization of capital increases so does the rate of inflation. The nominal standard is the price of food, which is normally rising in such episodes.

The plan of the paper is as follows: in the next section the derivation and use of aggregate demand and supply in the macroeconomics literature is briefly examined and our model motivated. Section three goes on to develop the variants of the former used. Section four demonstrates the usefulness of the new approach in classifying different kinds of demand and supply shocks, and analyzing their interdependencies and effects, including those on inflation. The final section makes some concluding observations. Derivations are in appendices.

2. Aggregate Demand and Supply in the Literature

In the current western macroeconomics literature the workhorses of applied macroeconomics, the IS/LM, and aggregate demand and supply curves are being resurrected. The microfoundations movement of the seventies questioned the usefulness of such aggregative curves because, first, they could not be simply derived from first principles of individual maximization. The bible according to Lucas said, "Thou shalt work with Euler equations derived from individual maximization", never mind if the individual in question happened to be a representative one. Second, bringing in dynamic issues of stock adjustment and rational expectations was expected to make the curves highly unstable so that their usefulness as pedagogical devices would be seriously impaired.

Macroeconomic textbooks of the nineties, however, adopted aggregate demand-supply analysis in a big way. The reason was partly, the realization that it was necessary to systematically analyze the effects of supply shocks that were neglected in the earlier overemphasis on demand. The surge in international oil prices was the catalyst. Others were advances in industrial organization that opened new insights on the effects of industry structure on aggregate supply.

In the New Keynesian stream, even the recent advanced, microfoundations based, macroeconomic textbook Blanchard and Fischer (1989), after devoting nine dense chapters to issues of theoretical foundations, come finally in the penultimate chapter to "some useful models", including IS/LM and aggregate demand-supply models, on which they admit much of macro-policy continues to be based. Stiglitz (1991) derives shifting interdependent aggregate demand and supply curves from imperfect capital markets affecting risk-averse symmetric firms.

The New Classicals have mixed reactions. McCallum (1989) believes that aggregative curves can be derived from microfoundations for limited purposes[1]. While King (1993) emphasizes the shifting of such curves arising from rational expectations, many authors note that the latter would help to choose unique equilibria.

Our model meets some of the criticisms regarding instability of such curves. As the stress is on the medium-run, quantities are normalized by the capital stock. This makes less serious some of the causes of instability of short-run IS/LM curves, while allowing us to neglect very long-run issues. Temporary stochastic processes impinging on both the numerator and the denominator would be neutralized, and very short-run uncorrelated shocks can be ignored, as they would not persist into longer periods. The focus of analytical attention is the effect of multiple equilibria. Stock adjustment is likely to affect both classes of such equilibria in the same way. The nature of the dynamics, helps to generate robust qualitative results.

Modern work on time series, has led to the recognition both that growth can take the form of fluctuations and of the difficulties in separating fluctuations from trend. The New Classicals viewed growth as driven by technology or supply shocks, and spawned an enormous unit roots literature. In our model, growth is affected by changes in demand induced by diverse

[1] According to him as monetary policy does not influence the capital stock, stock adjustments can be safely ignored in the analysis of the former.

shocks. The model is based on microfoundations of a profit maximizing firm. In a sense, Keynesian macro effects arise, and the representative firm is a valid analytical construct, precisely because of the multiple equilibria. The latter imply macroaggregative variables influence the firm's decision process. Summers (1991) writes that multiple equilibria are essential for the effects of demand shocks to persist in the long-run. Otherwise changes in demand would cancel out over the cycle.

The aggregate demand/supply framework has provided an enduring and generally accepted mainstream explanation of inflation in the developed countries. The explanation works with three factors; demand, supply and inertia, all three subsumed in the modern version of the Phillips curve. Such a framework, suitably adapted, might hopefully provide a similarly acceptable explanation of inflation in a labour surplus developing country such as India. Among the necessary modifications is finding a substitute for the Phillips curve. Unemployment cannot be satisfactorily defined in such an economy, and taking potential output growth as given as is the norm in Western models, is extremely unsatisfactory. The idea of development is to expand potential output, and the interesting question is the interaction between growth and inflation in the process.

In line with our accent on microfoundations of firm behaviour, we find that the relation between nominal and real rigidities helps explain inflation. This approach to the problem is common in New Keynesian Theories. We find, in particular, that rigidities in some real prices create complementarities between them, so that they move together, explaining periods of acceleration and deceleration in inflation. These rigidities in real prices are explained by the dynamics of the system.

3. The Building Blocks

3.1 Aggregate demand

Figure 1 graphs the IS\LM relation as a function of the mark-up τ and output-capital ratio u, which functions as a proxy for capacity utilization. This is nothing but the goods market equilibrium condition, giving the equality of investment and savings, assuming a constant real rate of interest. It is standard IS\LM analysis curve, with a few differences. First, output is normalized by capital, so that it refers to the medium-run. Second, Keynesian multiplier instability can arise. Its implications are examined later. Third, the real interest rate is exogenous as a simplification. Endogenizing it would not materially affect the results.

The last assumption is vindicated if the LM curve is horizontal. One way in which such an LM curve can arise is if it captures credit rather than money market equilibrium. The real rather than the nominal interest rate then becomes the relevant variable. This is compatible with the accent on the medium-run and on firm rather than consumer decisions. The nominal interest rate would have had time to adjust to the rate of inflation. Banks find it profitable to fix the real interest rate and ration credit, if necessary. The reason is that if they increased the interest rate the proportion of bad loans and risky borrowers may rise.

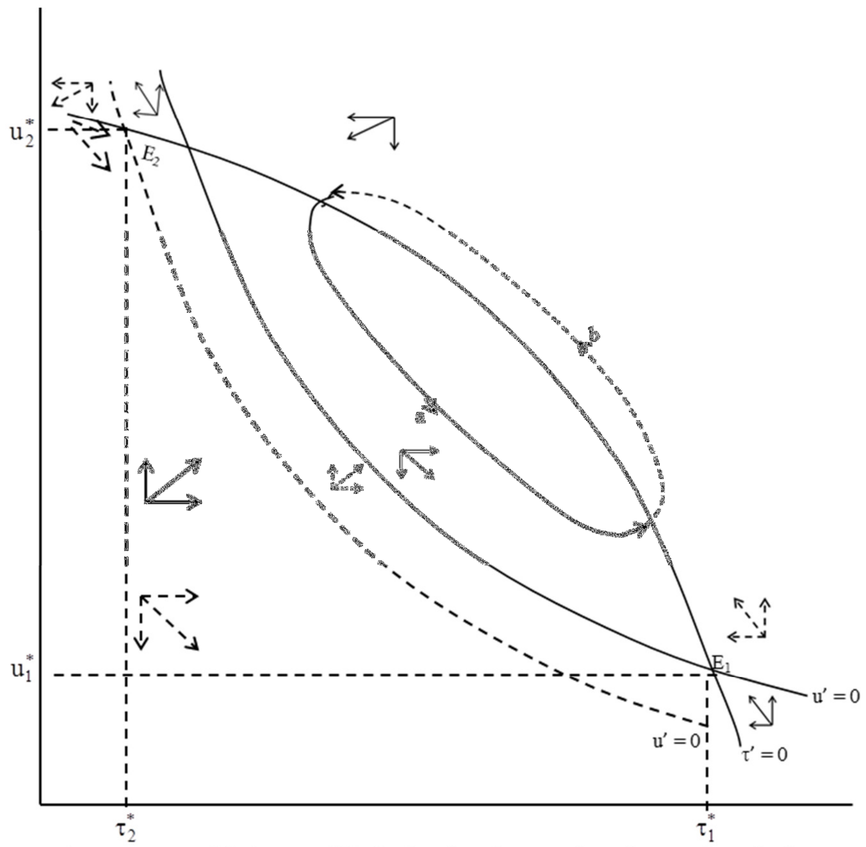

Figure 1: Multiple equilibria in the demand and supply relations

Second, in a more open economy the real interest rate cannot differ for long from the international rate, and the latter does not show much variation. So it becomes a variable that is exogenous to changes in domestic capacity utilization. Third, in India often credit stringency has acted directly on demand, for example through reducing the budget deficit and public investment, rather than affected the price of credit. If credit stringency leads to a compensating downward shift of demand, the interest rate would be unchanged even with an upward rising supply of credit curve. In this case there would be no need for rationing of credit.

Finally, as the proportion of inside money rises, with changes in banking technology, (for example, increased computerization), adjustment of money supply to changes in individual portfolio demand become less costly. Changes in the demand for money can be accommodated without leading to any change in the real interest rate. Ordinarily, this requires perfect substitutability among assets. Here it occurs because of the opening of a new margin of adjustment—namely, the fall in the cost of providing a variety of near monies. So, we are justified in ignoring both money and credit market issues, as a first approximation, in order to focus on the deeper underlying variables that actually determine both.

The arguments we have made for a horizontal LM curve range from those based on features of the credit market, to the institutional structure of the Indian economy, to pragmatic arguments based on neglecting unimportant aspects.

Inflation is a parameter causing shifts in the IS curve. With a higher level of inflation, the IS curve will shift downwards. The reasons are the negative effects of inflation on public investment and of adverse terms of trade shocks on the worker's income and consumption of industrial goods because of an inelastic demand for food. Investment expenditures are the easiest to cut in a democracy. These are the first to be touched when the government wants to impose measures of economy. The experience of the nineties demonstrates this once more. Such a pattern of shifts would imply the negative slope for the aggregate demand (AD) curve in πu space, derived in Figure 3 from Figure 2. Note that the curves are all drawn for the nonagricultural sector only. Agricultural output is taken to be exogenous.

In addition in the Indian economy, the LM curve normally shifts up when the IS curve shifts down, making for a flatter AD curve[2], If the LM curve is upward sloping, the derived AD

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[2] Such a pattern is expected in the Indian economy, because as we see below a downward shift of the IS curve is likely to be a period of high inflation, and lead to credit squeeze and other measures that raise the implicit cost of capital. The model can handle an exogenous rise in the rate of interest.

curve would be steeper. Output would be stimulated by the fall in the interest rate as the IS curve shifts leftwards, but AD would still have the requisite slope.

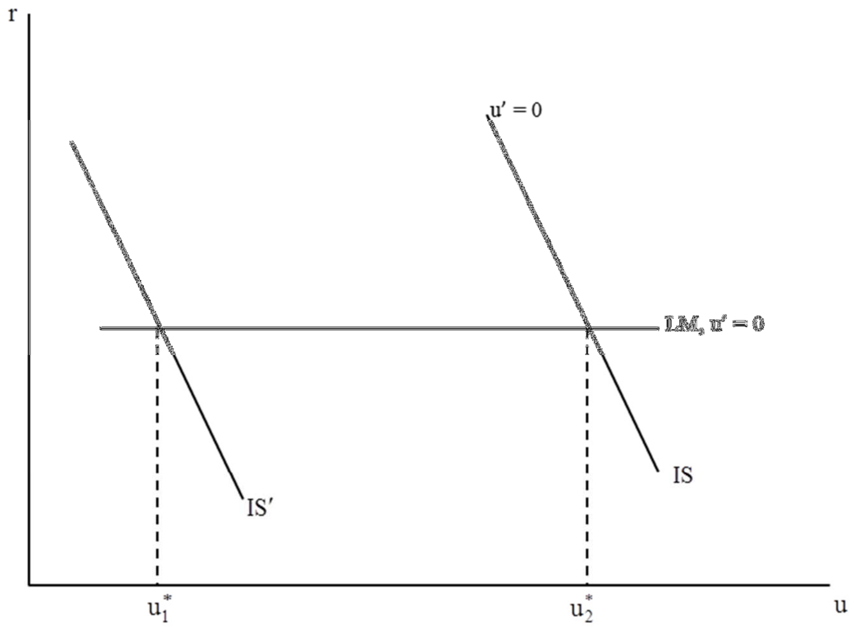

Figure 2: The IS/LM curves

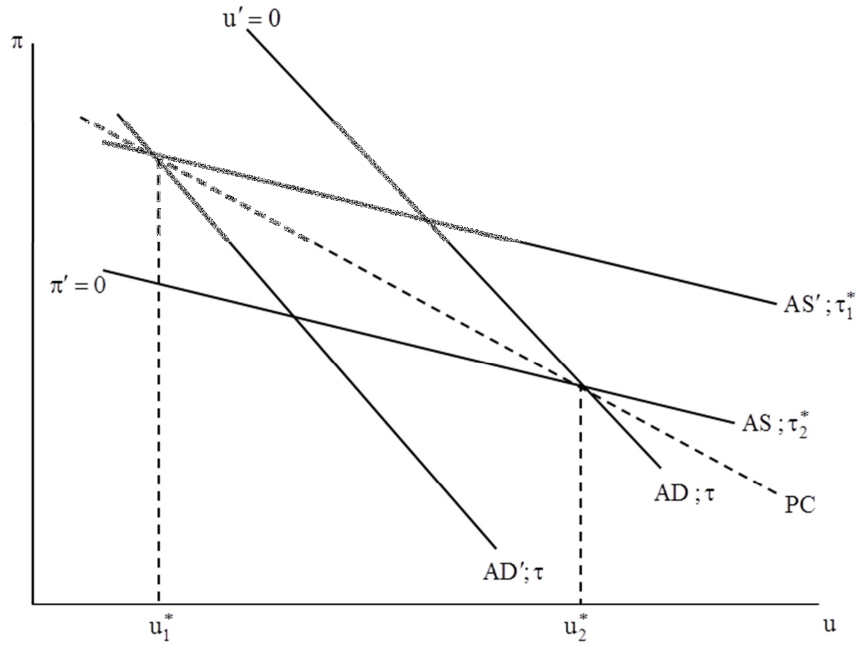

Figure 3: Aggregate demand, supply and the Phillips curve

What happens in the case of Keynesian multiplier instability? In Goyal (1993, 1994b) we show that a risk averse representative firm would maximize expected profits along dynamic adjustment paths by setting mark-ups so that they varied inversely with respect to themselves and to u. Figure 1 shows the equilibrium combinations of τ and u that maximize the firm's profits. That is, a supply relation in a τ and u space. The IS\LM relation also represented in the similar space depicts zero excess demand in the goods market, or the combinations of τ and u where the goods market is in equilibrium. These combinations will be unstable with the economy tending to shoot off away from the curve, in either direction, if induced demand injections into the economy exceed the leakages. Induced demand includes investment, consumption and exports, while the leakages are savings and imports.

However, the mark-up setting behaviour modelled above, reimposes stability, and allows multiple medium-run equilibria, and unique adjustment trajectories approaching them to exist. The multiple medium-run equilibria are of two generic kinds, the "bad" *E1*, and "good" *E2*. The former (latter) has low (high) capacity utilization and high (low) mark- ups. Both can have excess capacity. In the medium-run the economy moves along the high and low growth paths *b* and *a*, respectively, approaching these equilibria. Along these paths τ and u move in opposite directions. While τ moves countercyclically, the profit rate τu is constant or procyclical as the adjustment in u will exceed that in τ (Goyal 1994a). The mark-up includes an excess payment to cover the fixed cost involved in carrying excess capacity. This fixed cost is countercyclical. While monopolistic competition and product variety are a possible explanation of fixed costs and positive mark-ups, our model is more general and is not restricted to this specific industry structure.

The stabilizing effects of adjustments in the mark-up ensure that the IS curve of Figure 2 and the aggregate demand curve of Figure 3 are stable. At any point off the curve market adjustments would tend to bring the variables back to the curve. As output would be increasing with both τ and u, for excess demand to be zero, one of the variables must fall if the other rises. This is demonstrated formally in Appendix A. The AD curve would shift with τ, until an equilibrium was reached. The counter-cyclical movement of τ along the trajectories *a* and *b* means that the AD curve would shift downwards with a rise in τ.

3.2 Aggregate supply

Aggregate supply (AS) in elementary macroeconomic textbooks, is derived from three elements: (ii) a production function relating employment to output (ii) a fixed mark- up pricing rule, and (iii) a Phillips curve relating wage inflation to unemployment and expectations. We consider the modifications we want to make it in each, one by one, in the general perspective of the profit maximizing decisions by the representative, or any number n of symmetric firms.

The simplest kind of model (see Dornbusch and Fischer 1990) postulates a fixed capital-output ratio A, from the production function Y = AK. We envisage a more realistic production function, a nested Cobb-Douglas, that allows for substitution both between raw materials and value-added, and between labour and capital as components of the latter. By imposing an externality carried by capital stock, or intermediate inputs, the production function can be reduced to the simple fixed coefficient type we started out with, $A = \bar{u}$ where the latter is full capacity output. In endogenous growth theories the growth comes from constant returns to the accumulatable factors, that can be capital, human, physical or knowledge. However, as outlined in the section above, the dynamics keep the economy at less than full capacity.

We also assume that technical progress improves the efficiency of labour, that is, it is Harrod Neutral. With Harrod neutrality of technical progress, the profit share or mark- up τ is constant and wages rise in proportion to the rise in labour productivity. An economic mechanism ensuring this is free entry of firms driving down excess profits. In the model presented in this paper, the counter-cyclical movement of the mark-up would cause the procyclical rise in wages to exceed that in labour productivity[3].

The level and the rate of change of the mark-up comes from the dynamic model described above. Coming to the last component, it is impossible to define a natural unemployment rate, or find a tradeoff between money wages and unemployment in a labour surplus developing country. Recently, a number of inadequacies in the Phillips curve have been pointed out for

[3] Shapiro (1989) presents some evidence that in American industry labour productivity varies not only with technical progress, but with the level of activity itself, and measured high capacity utilization is not an indicator of high unit costs.

developed countries also. It could be regarded as modelling the behaviour of trade unions in the labour market, or the firm's response to alternative labour market conditions. The lack of clarity about whose behaviour it represents has been a weakness of the Phillips curve. The use of unemployment as a demand pressure variable has been questioned as it includes structural as well as cyclical factors.

The New Classicals expect a vertical Phillips curve at the natural rate of unemployment in the long-run, from the labour supply response. Other criticisms come from the New Keynesians, who point to the hysteresis effects occurring in Europe in the eighties. The Phillips curve disappeared, and instead there was higher unemployment and higher inflation. They explain this by multiple equilibria resulting from persistent effects of cyclical changes. For example, wages demanded by trade unions may permanently increase as members (insiders) shrink after a recession (Blanchard and Summers 1986). Multiple real wage equilibria mean that there is no longer a unique natural rate of unemployment. The normal downward sloping Phillips curve implies that cumulating over a number of periods, the summation of the gap or increase in output is a function of past inflation. With multiple equilibria it need not be the case that policies raise output only at the cost of inflation (Summers 1991). Our model has generic "good" and "bad" equilibria, and government policy by helping to drive the economy towards one or the other, can have long-run effects on both output and inflation, compounded by externalities carried by capital.

Instead of the Phillips curve, we model the firm's decision as determining nominal wage inflation as a positive function of agricultural price inflation, and a structural shift factor capturing increase in productivity. In a labour surplus developing country, the more realistic assumption to make is that the firm is on its supply curve of labour. The labour market is buyer's market. In India only four percent of the labour force is unionized and minimum wage laws are not strictly enforced. COLA or automatic cost of living adjustments, widespread in Latin America, are rare (Banuri and Amadeo 1991). If real wages are rigid, in terms of food, it is because poor nutrition leads to a drop in worker efficiency. Of course, we are talking of average wages. There can be sectors where either shortage of skills, higher productivity, or union activity leads to wages that are much higher than average, but unless these sectors are expanding in employment average wages will not be affected. In India, nominal wages were rising in the organized sector, in the eighties, but there was a contraction even in the absolute numbers employed. In our aggregative analysis we abstract from compositional effects, except for whatever is captured by the shift term in the nominal wage inflation.

Do nominal wages adjust to expected rise in food prices, or is there lagged adjustment to past prices? Appendix B elaborates on this. There is likely to be inertia in wage adjustments to price shocks, with an initial decline in real wages in response to adverse shocks. Even so, we largely ignore such lags because of the medium-run perspective.

We now have three required components for our AS curve. Namely, the marginal productivity equation derived from the production function, the mark-up from the dynamic model, the link of nominal wages to the price of food. We obtain a downward sloping AS curve in π (inflation rate) and u space (Figure 3). It gives the rate of inflation necessary or the firm to be willing to supply at all. The countercyclical movement of the mark-up will reinforce the term containing u, thus accounting for the downward slope. At the same time it will impose constant returns, ensuring that excess profits are just sufficient to cover fixed costs or the costs associated with excess capacity. This is proved formally in Appendix B. While the proof is complicated, the intuition can easily be grasped by considering the first order condition of the firm under increasing returns. The AS curve in πu space could become vertical when the full capacity level u-is reached.

Multiple equilibria imply that τ^* can take low and high values associated with the "good" and "bad" equilibria respectively. While τ is not an argument of the AS curve, τ^* is, and the AS would shift up when τ^* rises.

The AS curve in πu space would shift upwards counter-cyclically. It would be constant only at an equilibrium, where τ' (the time derivative of τ) is zero, and a constant relationship exists between the other constituent rates of inflation. In such an equilibrium, inertial lags in the adjustment of relative prices would be worked out and inflationary expectations realized. Under the countercyclical mark-up and reinforcing procyclical productivity, any substantial and prolonged adverse supply shock affecting costs will escalate the rate of inflation, shifting the supply curve upwards, until a new core rate of inflation is established. At the same time the demand curve will also shift leftwards with the rise in inflation, compounding the stagflationary outcome of falling u and rising inflation. As the dashed curve in Figure 3 shows, we get an inverse Phillips curve type of relationship between a real and a nominal variable. The Phillips curve basically performs the function of relating the change in nominal prices to some output gap, so, it is justifiable to call our curve a Phillips curve.

4. The Analysis

4.1 Shocks

The AS relation in τu space, shown in Figure 1, may also shift with a change in costs. The shift could be for three reasons (1) the figure shows the value added mark- up. This will change with shocks to intermediate input prices, unless the elasticity of substitution between gross output and value added, σ, is one. If σ is less (greater) than one, under generalized diminishing (increasing) returns, the share of raw materials would go up (down) after an oil price shock, and the share of profit or τ will fall (rise), at every u, leading to a substitution in favour of labour. (2) If prices are changed with a lag, for reasons of customer markets or menu costs, the immediate effect of a supply shock would be a sharp fall in the mark-up. Inflation would accelerate or decelerate gradually as the mark-up adjusted back to its desired value. (3) A change in the real interest rate, r, would require a rise in desired τ at every u, such that the approximate equality between τu and r is maintained. A rise in monopoly power would have a similar effect. (4) A major change in the organizational structure of the economy, the tax regime facing the firm or in the quality of infrastructure. An improvement in the aspects would lead to a downward shift in the τ' curve.

If we ignore shifts due to (1) as small, and r and monopoly power is constant, shifts in the τ' relation caused by (2) will be temporary. As σ changes from less to greater than unity, we may be justified in taking it as unity in the medium-run. Factor (4) will enter the picture only in periods of major change. If we assume that both cyclical and random improvements in technology are Harrod-Neutral, so that they enhance labour productivity, the τ' curve would be constant in spite of any changes in productivity. This is in line with stylized growth facts, where growth the world over has been accompanied by enormous rise in labour productivity and wages, while the return to capital has not shown much variation.

With the simple analytical apparatus derived, we can obtain interesting classifications of demand and supply shocks, their interactions and persistence.

In the literature, shocks impinge on linear models, and their effects can approach those observed in the real world only if they are very large and correlated over time. In our model the changes in induced demand can amplify even small shocks.

A device often used to separate demand from supply shocks, following Blanchard and Quash (1989) is to assume that demand shocks have temporary and supply shocks persistent effects on output while unemployment comes back to its natural level. The former are normally taken to be changes in the money supply giving an impulse to demand, and the latter are changes in technology. With multiple equilibria, unit roots can be explained through demand changes and we do not need to impose unrealistic restrictions on the structure of supply shocks. If demand can affect growth the latter would be cyclical.

A richer menu of demand and supply shocks is obtained, both of which can have permanent effects. Supply shocks could be changes in wages, interest rates or other nominal input prices, technology or organization, availability of resources, for example through variations in foreign inflows. Demand shocks would affect the components of aggregate demand, consumption, investment or exports. Changes in policy regimes could be a cause of shocks. If money supply is endogenous, it cannot be an independent source of shocks. Even so, endogenous money does not mean an accommodating money supply. Adverse supply shocks can lead to adjustments in demand that we directly model, and these adjustments in turn would imply a contraction of the money supply.

We make a distinction between multiplicative and linear shocks. Multiplicative demand shocks would alter the direction and slopes of the trajectories in Figure 1. Persistent shocks would cause a permanent shift in the curves in Figure 3, while those of Figure 1 would remain relatively unaffected. Vice versa while the curves of Figure 1 may shift in the short-run, or due to temporary shocks, those of Figure 3 need not necessarily shift. This could provide a more satisfactory way of distinguishing growth from fluctuations, instead of using the empirically elusive unemployment rate as in the Blanchard and Quah paper.

What are the results of different kinds of shocks? A temporary shock is likely to have minimal effect in the medium-run. While prices may be constant if there are menu costs to changing them, output would adjust.

A permanent supply shock will have only marginal effects on the τ' curve in the medium-run, but will affect the demand coefficients and growth paths or adjustment trajectories. The constancy of the τ' curve means that there is no change in the level of τ or excess profits required for the firm to carry different levels of excess capacity. That is the firm's aggregate supply relation in τu space remains unchanged, in response to the supply shock.

There is a shift in the trajectories, however, and there may even be a bifurcation from a high to a low growth trajectory. The actual levels of both τ, τ^* and u would change, and the AD curve in πu space would shift.

The endogenous amplification after the shock will be particularly large if a bifurcation occurs between the two paths. A positive supply shock on a low growth path may at first only moderate the fall in u and rise in τ, and only later lead to a reversal. A major shock would normally cause a bifurcation to a high growth trajectory, with falling τ, that would reinforce the fall in costs. This accounts for widely observed corridor effects, where while inflation is rising at low rates of growth, it falls at high growth rates. In addition, together with lags it accounts for delays in the impact of positive supply shocks on inflation. While an adverse shock may once again lead to a switch in the opposite direction, the impact on the level of output would persist.

The shifting of the curves does not make an analysis based on them useless, because the direction of change is known, for persistent shocks that affect the medium- run dynamics. Theory gives sufficient restrictions to structure the data. Economists are afraid of acknowledging multiple equilibria, but as long as the direction of change is known, such equilibria need not make comparative static or dynamic analysis invalid.

4.2 The structural adjustment program

Using this apparatus, we can understand better the nature of a composite shock such as the current SAP, and some puzzling features are explained. The SAP combines opposite demand and supply shocks, and policies, that are likely to neutralize each other, explaining the pattern of industrial growth and inflation over 1991-1995 in the Indian economy.

First, the SAP has involved, on balance a favourable supply shock in the sense that most firms have found a reduction in their costs of production. Some elements such as reduction in tax rates, new international norms of calculation of depreciation allowances, lowering of transaction costs associated with quantitative restrictions, the ability to switch to foreign lower interest cost sources of funds have meant a direct reduction in costs. There were initial adverse supply shocks, such as the steep rise in interest rates and import prices. Restructuring and rationalization resorted to by many firms has meant a fall in costs and a rise in productivity. The factors making for falling costs probably outweigh those tending to increase them. Among the latter are increase in administered and import prices, in nominal wages and in salaries. It should be noted that not even all supply shocks are in the same direction.

While there has been some rise in sales in the latter half of 1994, it remains true that as yet the growth in profitability far exceeds that in sales. Initially, the profit share or τ has risen, but in the medium-run the fall in costs should be passed on to the consumer. Depending, of course, on what happens to monopoly power. Free entry combined with reform in regulatory agencies are essential to ensure that monopoly power does fall. To be effective, the supply side policies need to be complemented by rising demand. Is this occurring?

Historically public investment has accounted for a large percentage of total investment. The freeze in this following the philosophy of minimizing government intervention amounts to an adverse multiplicative shock to aggregate demand in Figure 1. The expected compensatory rise in private investment has not materialized so far.

Some increase in exports has taken place in 1994, but this is largely in low value added items and in agricultural commodities. The latter, by contributing to the rise in domestic prices of agricultural commodities, is likely to worsen the squeeze in domestic demand for broad based manufactures. Considerable investment and facilitation of technology absorption is required for costs to fall. Rodrick (1994) has recently argued that incentives for export were not sufficient to lead to the boom in South-East Asia. It was rather incentives to raise investment that made the difference. Policies that work through lowering domestic absorption are likely to be counterproductive, by lowering domestic output and investment, and adversely affecting export competitiveness through rising costs and mark-ups.

The government's policy regarding the agricultural sector has lead and is likely to continue to lead to a steady rise in agricultural prices. At the best this will cause inflation and at the worst, if manufacturing demand is adversely affected, stagflation. The stimulus to consumption demand coming from the fall in prices as the supply relation shifts down with the regime changes outlined in (4) would be partly offset.

Demand side policies have to some extent neutralized positive measures on the supply side explaining the tardy revival of investment and continued inflation.

If all the framework did was to help in classifying the different forces, it would not be so useful. It can also help in suggesting efficiency enhancing modifications to the SAP, and ensuring the consistency of policy. Examining dynamic factors and acknowledging multiple equilibria, allow us to isolate more dimensions in which policies could be countering each other, and to suggest changes that would shift the economy to a high growth path. In microeconomic work, the dimension that is emphasized is the consistency of policy which individual incentives. We do not neglect this aspect, but focus more on incentives of the firm, to accumulate capital and to lower prices, arising from the macro dimension. The major problem areas that remain are the nexus between policy, investment and inflation.

4.3 Inflation

Structuralist theories on inflation, particularly those applied in Latin America, build upon income distributional conflict. In India the role of rising agricultural prices, is perhaps more important. Where prices are set with a fixed or counter-cyclical mark-up in industry, real wages in terms of industrial product and the terms of trade of the agricultural sector will improve only when τ is falling. Inflation occurs since rising agricultural prices normally lead to a rise in nominal wages and in τ as demand falls. The dynamics is the deeper cause of the rigidities in relative prices. Both the rigidity in real wages in terms of agricultural prices and the relative rigidity in the mark-up is coming from the firm's maximizing decision. The conclusion follows that any factor favourably affecting the dynamics and increasing productivity would lower the rate of inflation.

Leaving out the crisis years at the end of the decade, inflation had been about 7 percent in the eighties compared to about 10-11 percent in the nineties. This validates our inverse Phillips curve as the rate of growth was higher in the former period compared to the latter. There is also evidence that real wages were rising in the eighties, even in the informal sector (Vaidyanathan 1994).

The close link of agricultural prices to wages, implies that the former serve as the nominal standard. The crucial role of the agricultural rate of inflation means that there is an inconsistency involved in the current policy of allowing agricultural prices to approach world prices. Administered rises in foodgrain prices with this end in view are self-defeating. Such a rise, as it led to higher inflation, would imply a real appreciation of the exchange rate. A devaluation may then become necessary to maintain export competitiveness. This will further raise the gap between home and world foodgrain prices and set the whole cycle going once again. India has a low trade share, so that the exchange rate by itself is not a nominal standard, but linking food prices to the exchange rate would make it into a nominal standard. The contribution of food articles to inflation was higher in the first two years of the reform. In the next two years manufacturing prices rose more as predicted by our model.

Contrariwise, a lower rate of inflation in agricultural prices would accompany rising u, real wages, and falling τ, in response to a demand stimulus. This means the relative price of agricultural commodities would actually be rising. Accepting a slower rise in nominal agricultural prices would then be in the best interests of farmers. This is noteworthy since the farm lobby is partly said to be behind the steep escalation in procurement prices in the first years of the reforms. The price rises were supposed to make possible a reduction in fertilizer subsidy, but that has been found to be politically infeasible. Incentives should rather be given to them in the form of a rise in public investments in agriculture, this would lower their costs, and by developing the required infrastructure permit a partial diversion to high value export crops. There is a widely noted complementarity between private and public investment, and especially so in agriculture. Measures are urgently required to raise productivity in pulses, vegetables and fruits. Such commodities have contributed in large measure to the inflation in 1995.

The large foreign inflows provide an opportunity to increase public investment even while maintaining fiscal discipline. It could be partly financed by a restructuring/sale of equity in PSEs (public sector enterprises), which would, at the same time, raise their efficiency. Additional tax and other incentives should be given for private investment. This argument is consistent with stabilization. There should be continual pressure to reduce the revenue deficit.

5. Conclusion

The analytical framework developed in this paper brings out many of the intricate ways in which demand and supply interact in the Indian economy. Policy design in the absence of such an understanding can be seriously flawed. In the current SAP, supply side stimuli have often been nullified by demand side adverse shocks. If sharp contractionary measures are taken to bring inflation down to single digits in 1995, not realizing that the inflation is largely due to lagged adjustment to earlier steep increments in food prices, the nascent industrial recovery will be quelled.

The possibility of multiple equilibria, provides a theoretical foundation for common widely observed complementarities between key macro variables. In quantities: public and private investment. In relative prices: real wage rate, profit rate, (πu), and agricultural terms of trade. Policies that use such complementarities can bring about large welfare gains, with a minimum cost of adjustment. Just relying on micro efficiency enhancing policies will not be enough, attention has to be paid to macro variables. The idea of development after all, implies the possibility of more for all.

In the Lewis-Kalecki framework, profits are squeezed as wage good prices rise relatively. This is because such models have either a short or a long-run perspective and ignore a medium-run where investment-savings dynamics, strengthened by externalities, make multiple equilibria and high and low growth paths possible. In traditional models with demand determined equilibria, investment, the main autonomous component of demand, plays an important role in determining equilibria. This model endogenizes investment. So that exogenous supply shocks become the major determinants of the model outcomes. However, induced demand components respond to these shocks because of changes in expectations, and other institutional features, so that demand still plays a major role.

The stress on supply decisions of the firm and on dynamics echoes the Marxist tradition of competing capitalists, but multiple equilibria, allow cooperative solutions to exist. Enhanced coordination can improve prospects for all, as against the Marxian dilemma of conflict and exploitation.

Serious policy practitioners, find that the Neo-Classical approach is too supply oriented and long-run to be useful, the Keynesian too short-run and demand oriented. In the course of a structural adjustment, the first approach ignores real short-run costs adjustment that can have persistent effects, and the second by neglecting supply issue often has perverse inflationary outcomes. We try to provide a via-media that by maintaining links in optimizing theory, may escape the charge often made against macro-oriented policy work. Namely, that it is ad-hoc, and the riposte by applied researchers that theory is useless for policy. In addition, the dynamic medium-run approach adopted while remaining tractable, gives insights that tend to be overlooked in the normal static steady-state analysis.

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Appendix A

Each of the multiple equilibrium in Figure 1, are stable. The dynamics have been examined in Goyal (1993, 1994). The interesting thing is that this immediately puts restrictions on the dynamic systems in Figures 2 and 3.

The IS (or goods market equilibrium) curve in Figure 2 can be represented as:

$$u' = \phi\left(\underset{-}{u}, \underset{-}{r};\right) = 0 \tag{A.1}$$

That is, excess demand is a negative function of both *u* and *r*. This follows as *u* is the supply variable and demand is a positive function of *u* and negative function of *r*, the real interest rate. The dash denotes the time derivative. The LM, or credit market equilibrium is:

$$r' = \psi\left(\underset{0}{u}, \underset{-}{r};\right) = 0 \tag{A.2}$$

Our assumptions in the text ensure that even though the demand for credit may rise with *u*, the supply response neutralizes it. The demand for credit falls with *r*, explaining the negative sign.

The curves may be non-linear, but they can be linearized around the equilibrium point. This gives a valid picture of the local dynamic flow, as long as the trace of the Jacobian (the matrix of first order derivatives) is not zero. Restrictions on the signs of the latter are required to prove the stability of the equilibrium. The trace (*tr*) must be negative and the determinant (*det*) positive.

The Jacogian J_2 is shown below:

$$J_2 = \begin{vmatrix} \phi_u & \phi_r \\ <0 & <0 \\ \psi_u & \psi_r \\ 0 & <0 \end{vmatrix} \tag{A.3}$$

Subscripts indicate partial derivatives. The signs of the partial derivatives ensure that the stability conditions are met.

$$tr = \phi_u + \psi_r < 0$$

$$det = \phi_u \ \psi_r - \psi_u \ \phi_r > 0 \tag{A.4}$$

The restriction $\phi_u < 0$, even in the case of induced spending exceeding induced leakage, comes from the adjustment in mark-ups detailed in Figure 1. We can easily prove this by a small counter-factual experiment.

If $\phi_u > 0$ we have, in the vertical direction across the IS or $u' = 0$ curve:

$$\frac{\partial u'}{\partial u} = \phi_u > 0 \tag{A.5}$$

This implies that excess demand will change from negative to positive as we cross the $u'= 0$ curve; or that there is excess supply below and excess demand above the curve. In that case, *u* would continuously fall below and rise above the curve. This is incompatible with the existence of stable equilibria in *u* and *r* in Figure 2.

Similar arguments establish the stability of the equilibrium in Figure 3. The equation of the

AD or $u' = 0$, or goods market equilibrium curve can be represented as:

$$u' = x(\underset{-}{u}, \underset{-}{\pi};) = 0 \qquad \text{(A.6)}$$

Where the signs below the variables are justified by the theoretical arguments made above and in the text.

The equation of the AS curve is

$$\pi' = g(\underset{-}{u}, \underset{-}{\pi};) = 0 \qquad \text{(A.7)}$$

This curve is derived in detail in Appendix B. Once more, the stability condition is satisfied:

$$tr = x_u + g_\pi < 0$$
$$det = x_u\, g_\pi - g_u\, x_\pi > 0 \qquad \text{(A.8)}$$

Det > 0 if $x_u\ g_\pi > g_u\ x_\pi$. This is also the condition for the AD curve to be steeper than the AS curve. It will be satisfied as the expected parameter values in our model will lead the trace to be strongly negative[4].

Appendix B

We show first that if fixed costs lead to increasing returns at a particular output level, a positive and countercyclical mark-up can reimpose constant returns, such that excess profits are zero in equilibrium. The proofs in Appendix B are extensions of analysis in Rotemberg and Woodford (1991, 1993).

Equation B.1 defines the price (P), marginal cost (MC) ratio η, which is more convenient for the derivations. The equation shows that it is monotonically related to τ, so that arguments made using either, are valid for both. Equations B.2 and B.3 define average and marginal cost for the generalized Cobb-Douglas technology. The level of output is symbolized by *Y*. Fixed cost is *F* and *C* is a constant. The sum of the input shares, *d*, would be one if there were constant returns and marginal cost would then be fixed and equal to average cost. Equation B.2 shows that if the firm is carrying fixed costs, that may be due to dynamic considerations, there will be increasing returns with $s(.) > 1$, unless $\eta > 1$, or price exceeds marginal cost. Furthermore, unless movements in η offset those in *Y*, excess returns will occur during upswings. The Euler equation B.5 shows this once again. Unless $\eta > 1$ there will be excess

[4] The condition requires that demand responds less than supply to a unit fall in inflation, or that AD(AS) responds more (less) to u than to π

profits under increasing returns with *s (.) > 1*. The rental rate of capital is *r* and *w* is the real wage rate, so that factor payments add up to less than the value of output, unless $\eta > 1$. Entry (exit) occurs, or in our aggregative model investment adjusts, until the point where η^* just covers fixed costs and the zero profit condition is satisfied. Only in equilibrium will excess profits be zero, out of equilibrium there will only be a tendency to remove them.

$$\eta = 1/(1-\tau) = P/MC \qquad (B.1)$$

$$e(Y^*) = AC/MC = 1 + \frac{F}{Y\eta C} \qquad (B.2)$$

$$AC\,(Y) = CY^{\frac{1-d}{d}} + \frac{F}{Y} \qquad (B.3)$$

$$MC(Y) = \frac{CY^{\frac{1-d}{d}}}{d} \qquad (B.4)$$

$$s(.)\,Y = \eta(r_t\,K_t + w_t\,H_t) \qquad (B.5)$$

Second, we derive aggregate supply in π and *u* space in the presence of fixed costs. We proceed by examining first the case where fixed cost consists of only labour, H^-, then only capital, K^-, and impute the result for the in between case. The superscript - denotes the available supply.

We work with three equations: the production function B.6, the marginal productivity equation B.7, and the Euler equation allowing for fixed labour costs, B.10. We do not restrict ourselves to the Cobb-Douglas production function. Subscripts to *F* denote partial derivatives of the production function. F_H is equal to zF_2, where *z* is the productivity shock. Equation B.8 defines the share of capital and labour in output. Factor payments are multiplied by equilibrium mark-up η^*. The production function and marginal productivity equations are log linearized around steady-state high and low growth equilibria, with u^* and τ^* or η^* corresponding to equilibria E_2 and E_1, so that *H* grows at the same rate as H^-, and *K* and *Y* grow[5] at the same rate as *zH*. The superscript ~ on lower case variables denotes log deviations from trend. Subscript *t* is time.

$$Y_t = F[K_t, z_t(H_t - H_t^-)] \qquad (B.6)$$

$$\eta_t = \frac{F_H[K_t, z_t(H_t - H_t^-)]}{w_t} \qquad (B.7)$$

[5] In a labour surplus economy especially the rate of growth is not limited by the rate of growth of labour. Moreover, endogenous growth theory shows that with constant returns to the accumulateable factor, growth would be positive even with no growth in labour.

$$F_1\ K/Y = \eta^*\, s_K \quad , \qquad zF_2\ H/Y = \eta^* s_H \tag{B.8}$$

$$\eta^*\, s_K + \eta^*\, s_H\ \frac{H - H^-}{H} = 1 \tag{B.9}$$

We want to remove $z^{\sim}$ in order to be left with measurable variables. In order to do this we obtain a value for $z^{\sim}$ (Equation B.10), by substituting the Euler equation in the linearized production function. This procedure also removes the procyclicality in residuals arising from the presence of fixed costs. B.11 is the log linearization of the marginal productivity equation B.7. The elasticity of substitution between *H* and *K*, *e*, occurs in the equation because of the substitution $e = (F_1\ F_2)/(F_{12}\ Y)$. Replacing real wages *w* with nominal wages *W* from B.12, and $z^{\sim}$ from B.10 in B.11 we get equation B.13, for log deviations in non-agricultural prices P_m.

$$z_t^{\sim} = \frac{y_t^{\sim} - \eta^*\, s_K\ k_t^{\sim} - \eta^*\, s_H\ h_t^{\sim}}{1 - u^* S_K} \tag{B.10}$$

$$\eta_t^{\sim} = z_t^{\sim} - w_t^{\sim} + \frac{\eta^*\, s_K}{e}\left(k_t^{\sim} - z_t^{\sim} - \frac{\eta^*\, s_H}{1 - \eta^*\, s_K}\ \tilde{h}_t\right) \tag{B.11}$$

$$w_t^{\sim} = W_t^{\sim} - P_{mt}^{\sim} \tag{B.12}$$

$$P_{mt}^{\sim} = \eta_t^{\sim} + W_t^{\sim} - \frac{e - \eta^* s_K}{e - e\eta^*\, s_K}\ y_t^{\sim} - \frac{(1-e)\eta^*\, s_K}{e - e\eta^*\, s_K}\ k_t^{\sim} + \frac{\eta^*\, s_H}{1 - \eta^*\, s_K}\ h_t^{\sim} \tag{B.13}$$

Equations B.14 to B.19 perform a similar derivation for the case of capital as the fixed cost.

$$Y_t = F[(K_t - K_t^-), z_t\ H_t] \tag{B.14}$$

$$\eta_t = \frac{F_H\,[(K_t - K_t^-), z_t\, H_t]}{w_t} \tag{B.15}$$

$$\eta^*\, s_K\ \frac{K - K^-}{K} + \eta^*\ s_H = 1 \tag{B.16}$$

$$z_t^{\sim} = \frac{y_t^{\sim} - \eta^*\ s_K\ k_t^{\sim} - \eta^*\, s_H\, h_t^{\sim}}{u^*\, s_H} \tag{B.17}$$

$$\eta_t^{\sim} = z_t^{\sim} - w_t^{\sim} + \left(\frac{1 - \eta^*\ s_H}{e}\right)\left[k_t^{\sim}\left(\frac{\eta^*\, s_K}{1 - \eta^*\, s_H}\right) - z_t^{\sim} - h_t^{\sim}\right] \tag{B.18}$$

$$P_{mt}^{\sim} = \eta_t^{\sim} - \left(\frac{e - 1 + \eta^*\ s_H}{e\ \eta^*\ s_H}\right)\ y_t^{\sim} - \frac{\eta^* s_K(1-e)}{1 - \eta^*\, s_H}\ k_t^{\sim} + h_t^{\sim} + W_t^{\sim} \tag{B.19}$$

In order to interpret the equations B.13 and B.19 we first note that in the case of $e = 1$ the coefficient of $y^{\sim}$ becomes unity and that of $k^{\sim}$ zero. The latter follows since only if *e* is different from unity will $k^{\sim}$ affect the marginal product of labour. As we consider the medium-run and moreover there is excess capacity we expect $e > 1$. In that case a rise in $k^{\sim}$

will raise prices, because marginal productivity of labour will fall relatively more, procyclically.

η* is a shift variable. With a higher equilibrium mark-up ceteris paribus, prices would rise to cover the higher fixed cost. In B.13, a higher η* lowers the coefficient of the negative terms and raises that of the positive one. If we substitute the countercyclical relationship of η to y that we have from the dynamics, the negative relation between $P^{\sim}$ and $y^{\sim}$ is further enhanced, and dominates the positive one between $k^{\sim}$ and $P^{\sim}$ so that we may expect a negative relation between $u^{\sim}$ and $P^{\sim}$. Equation B.20 gives the functional form for $P^{\sim}$ after making these substitutions. The equation is also a hybrid, with both H and K as part of fixed cost. The actual rate of inflation would be a weighted sum of $P^{\sim}$ and the core or expected rate of inflation π*.

The latter would be realized only in equilibrium (B.21) and could be rational (forward looking) or adaptive (a function of past inflation). Equation B.22 makes inflation in both sectors a weighted sum of past inflation and of expectations, including a random shock, v. Putting in all this and remembering that aggregate value added price[6] is a sum of the two sectoral prices, and that the rise in nominal wages is linked to agricultural prices we get the final specification of the AS function B.23, where the shift variables influencing the core rate of inflation are shown separately. The former could include z , despite its earlier removal, if there is an externality in the production function.

$$P^{\sim}_{mt} = f_t(\eta^*)h^{\sim}_t - f_2\,(\eta^*)\,u^{\sim}_t + \,w^{\sim}_t \qquad \text{(B.20)}$$

$$\pi_t = \pi_{t+1} = \pi^e = \pi^* \qquad \text{at } E_1, E_2 \qquad \text{(B.21)}$$

$$\pi_{it} = \alpha_i\,\Pi_{t-1} + (1 - \alpha_i)\,\pi^e_t + v_i \quad i = a, m \qquad \text{(B.22)}$$

$$\pi' = g\left(\underset{-}{u}, \underset{-}{\pi};\right) \qquad \pi^* = f\left(\underset{+}{\eta^*}, \hat{v}, \underset{-}{z}\right) \qquad \text{(B.23)}$$

[6] In section 3.2 we have made assumptions that ensure that value added mark-up will not be influenced by changes in intermediate goods prices. The value added mark-up will exceed the mark-up on gross output by a constant amount. There will be a bias but it will be small.