Economics Matters



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Mind the Gap: How to solve Peru's \$180bn 'infrastructure gap'.

George Vlachonikolis



The profit maximising firm

By Robert Nutter and Simon Harrison

In theory a firm achieves short run profit maximisation when marginal cost (MC) equals marginal revenue (MR). Marginal cost measures the increase in total cost as a result of producing one more unit of output and comprises of variable costs such as raw materials and labour. The marginal cost curve at first falls in the short run due to increasing returns to a factor i.e. labour and then rises as a result of diminishing returns. Marginal revenue is the addition to total revenue as a result of selling one more unit of output and in a perfect market MR is constant and equal to average revenue (AR) as firms are price takers and can sell as much as they want at the market price. In an imperfect market MR is downward sloping and falls because in order to sell an additional unit of the product price will have to fall as the demand curve (AR) is downward sloping. MR falls faster than AR because when price (AR) is cut to sell an additional unit, the price has to be cut for all the other units as well, meaning that the increase in total revenue is less than the price of the additional unit.

Perfect and imperfect markets are shown in Figures 1 and 2 below with the profit maximising output in both shown at qx, which is where MC=MR.



Why do firms maximise profit where MC=MR? Looking at both diagrams above suppose output is at q1 then by increasing output to qx profit must rise because each additional unit of the product sold will add more to revenue than it does to costs (MR>MC). The units between q1 and qx are still adding to total profit as can be seen in Figure 3. However, if output was increased beyond qx towards q2 each extra unit sold will add more to costs than it does to revenue (MC>MR) causing profit to fall. At the output level qx MC=MR and thus the marginal profit on the last unit sold is zero although profits are maximised (Figure 3).



However, do firms in the real world ever use this marginal approach to profit maximisation? Often information on marginal revenue and marginal cost is difficult to obtain with precision, making it impossible to exactly determine the point of profit maximisation. Firms are assumed to be aware of their future demand and cost conditions and to have full and perfect knowledge of market conditions – this is unlikely. Even if they had all this information they would find it difficult and expensive to change the profit maximising price with every market and cost fluctuation. Changes in marginal cost will change the profit maximising position. In Figure 4 a fall in marginal cost has reduced the theoretical profit maximising price but firms in reality may be reluctant to do so, especially if they think that the fall in marginal cost is only temporary (for example as a result of exchange rate fluctuations).



Firms are more likely to use cost plus pricing to profit maximise which is where a firm sets the price for its product by adding a fixed percentage profit margin or mark up to the average cost of production (Figure 5). Although this might not maximise profit, it should ensure that a profit is made and in fact, it may be possible that in the real world such an approach would lead to a higher level of profitability than an approach that expends a lot of money trying to get full information on MC and MR.

Because average total cost varies as the quantity of output produced changes, the firm's determination of the per unit cost requires the specification of an output level. The size of the profit margin set may depend on factors including the level of competition and the strength of demand. Cost-plus pricing is common in markets where a few firms dominate, such as in an oligopoly where the firms have similar production costs. In this case, cost-plus pricing provides a convenient rule for firms and reduces the risks associated with price competition such as price wars.





The following equation illustrates how to determine price using cost-plus pricing.

P is the product's price, ATC is the average total cost or cost per unit, and the mark-up is the percentage added to average total cost.

 $P = ATC \times (1 + mark-up).$

Thus if ATC = £80 and the mark-up is 25% (expressed as 0.25) then the price would be:

 $P = \pounds 80 \times 1.25 = \pounds 100.$

The mark-up will include within it a desired rate of return on the firm's investment although this will depend on the volume of sales. A criticism of cost-plus pricing is that it focuses on average costs rather than marginal costs. As profit maximisation requires marginal cost equals marginal revenue, cost-plus pricing may not result in profit maximisation. For example cost-plus pricing ignores demand conditions which could result in the firm setting a cost-plus price that's above the equilibrium market price, resulting in a surplus or excess supply. As a consequence, the firm doesn't sell all the units it produces and profits are not maximised.

However, cost plus pricing can under certain circumstances lead to profit maximisation in the long run. This requires the price elasticity of demand for the product to be introduced into the calculation of the mark-up which takes the calculation beyond the mathematics required at A level. Suffice it to say that if the price elasticity of demand is calculated correctly when setting the mark up then cost-plus pricing will achieve profit maximisation.

Profit maximisation and the shutdown decision

As noted above, in principle a firm's profits will be maximised at the output at which MC=MR. However producing at this output does not guarantee that any profits will actually be made! All it means is that **if** the firm chooses to operate, this output will give the best financial outcome – hence it will either maximise profits or minimise losses once the decision to produce has been taken.

It might seem that if every unit for which the extra revenue is greater than the extra cost is made, then this will guarantee a profit, but this ignores the issue of fixed cost. Marginal cost looks only at the additional cost of making each unit – hence it is by definition a type of variable cost (if you add all the marginal costs together for a certain number of units, this will give the total variable cost of producing those units). Therefore, the profit maximising output simply guarantees that the gap between total revenue and total variable cost will be as big as it can be (a concept that business students will be familiar with as 'contribution').

Output/month	MC	MR
0	-	-
1	£100	£150
2	£75	£150
3	£100	£150
4	£125	£150
5	£150	£150
6	£175	£150

Suppose a perfectly competitive firm faces the following situation:

The profit maximising output is 5 units – if the firm made the 6th unit, profits would be smaller because the extra cost is above the extra revenue. Across the 5 units produced, the firm has 'made' £200 (the gaps between MC and MR), but this isn't profit. If the firm's fixed costs were £150, then the firm would have made a profit of £50, but if fixed costs were £250, then the firm would have lost £50.

Options for loss-making firms.

In the long run, a firm which is failing to make at least normal profit (the output at which TR=TC (where TC includes the opportunity costs of the entrepreneur's time) will close – factors of production will be better used elsewhere.

In the short run, however, the situation is complicated by the fact that the firm cannot immediately exit the industry. The reason for this is contained in the definition of the short run; the period of time in which at least one factor of production is fixed – if you don't have the factor of production you can't get it (which is why barriers to entry exist in all market structures in the short run)

but if you do have it, you can't get rid of it! A good way of thinking about this is a business which has a 6-month lease on a building – it is committed to paying the lease each month for the next 6 months whether or not it uses the building. So if the firm is making a loss, should it close immediately?

Superficially, the answer would seem to be 'yes', but the decision to close may actually only be the financially most sensible one in the long run.

Suppose the firm in the numerical example above is the firm with the 6-month lease, and the lease costs £250/month. The firm is therefore losing £50 per month. What are the options facing the firm?

Obviously it could try to renegotiate the lease, which might work, it might look for other areas of inefficiency to reduce costs to allow it to become profitable or it might look for other sources of revenue. But let's suppose that it tries all this without success. Now what?

The firm basically has two options. Stay open for 6 months or close immediately. If it closes immediately, then it will lose £250/month – it will still have to pay the lease, but will have no revenue at all (and no variable costs either). If it stays open, it will lose £50/month – revenue will be £750, variable costs are £550 (£100 + £75 + £100 = £125 + £150) and fixed costs are £250/month giving total costs of £800.

Therefore, given the choice of losing £50/month for 6 months or losing £250/ month for 6 months the firm should stay open. If nothing has changed by the end of the 6-month lease, it should then close, because it doesn't have to take on another lease – there is no barrier to exit.

Should the firm ever close immediately?

The answer to this one is yes! If the loss from staying open would be bigger than the loss from closing immediately, then the firm should obviously shut down at once. Suppose that the firm's cost structure looked like this:

Output/month	MC	MR
0	-	-
1	£200	£150
2	£185	£150
3	£120	£150
4	£145	£150
5	£150	£150
6	£175	£150

At the profit maximising output of 5 units the firm now faces the following situation:

Revenue/month:	£750
Variable costs/month:	£800
Fixed costs/month:	£250

The firm is losing £300/month by staying open (£750-£1050). If it was to close, then it would only pay the lease each month of £250/month. Therefore, it would make more sense to close immediately.

The key to the decision is therefore variable cost. In the second example, the problem that the firm faced was that it couldn't even generate enough revenue to pay its variable costs, let alone fixed costs – its contribution to fixed costs was negative – therefore there was no point even in attempting production.

In the first case, revenue was more than variable costs meaning that the firm had some extra cash (contribution) to put towards at least partly paying its fixed costs, meaning that it would lose less money by staying open in the short run.

This can be summed up as follows:

AR equal to or greater than ATC (or TR equal to or greater than TC)	Open in SR and LR
AR less than ATC but equal to or more than AVC (or TR is less than TC but equal to or more than TVC)	Open in SR but close in LR
AR less than AVC (or TR is less than TVC)	Close in the short run (and LR, obviously)

Further reading:

1

Managerial Economics for Dummies by Robert Graham. <u>https://www.dummies.com/education/economics/how-to-use-cost-plus-pricing-in-managerial-economics/</u>

2

Principles of Economics by D.N.Dwivedi (2nd Ed) Pages 302-305.

3.

http://www.economicsdiscussion.net/elasticity-of-demand/relationship-amongar-mr-and-elasticity-of-demand/16920

Mind the Gap: How to solve Peru's \$180bn 'infrastructure gap'.

By George Vlachonikolis

This article has been written to be accessible to Year 12 economics students but is concerned with Year 13 themes.

Peru has enjoyed 5% average growth rates since the turn of the century. But to what extent can this be maintained? A high growth rate can often be a doubleedged sword: on the one hand, it is a quick barometer for living standards but, on the other hand, it can be the first indicator of high inflation to come. If a country's aggregate demand outstrips its aggregate supply, the growth rate cannot be maintained indeterminately. The only outlet is high inflation. Therefore, Governments of fast growing countries need to worry about their supply-side as much as they should about the demand-side.



SOURCE: TRADINGECONOMICS.COM | INSTITUTO NACIONAL DE ESTADÍSTICA E INFORMÁTICA (INE)

"Infrastructure gap" is a relatively new economic concept. It is meant to illustrate the amount of money that a Government will have to spend on infrastructure, above their current level, to maintain a consistent level of growth. In Peru, the infrastructure gap has been estimated to \$180bn (over 90% of its GDP). In other words, Peru's high levels of growth are finally catching up with it. The country is reaching its PPF. Unless the Government looks to improve its infrastructure and shift its PPF outwards, Peru will not be able to grow at the same rate in the future.

Infrastructure is the fundamental facilities and systems serving a country, city, or other area, including the services and facilities necessary for its economy to function. Infrastructure is composed of public and private physical improvements such as roads, bridges, tunnels, water supply, sewers, electrical grids, real estate, oil and gas, mining, telecommunications (including Internet connectivity and broadband speeds).

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Infrastructure is important for all countries because it helps to reduce transaction costs and logistic costs, which increases competitiveness and increases productivity. Without a decent level of infrastructure, businesses soon hit a wall; a limit to their growth and their level of output.

So what does the country need to do to sustain its growth rate? The Peruvian Government has committed to a strategy of PPP (Public Private Partnerships) projects. These are projects in which money from the private sector is used in conjunction with public money to fund Government projects. Peru currently has over 50+ PPP projects on the go.

PPP projects have the obvious advantage over government works programmes, in that only some of the money comes from the public purse. Peru has a relatively low national debt of \$48bn (24% of GDP) so it has some spending capacity. But it certainly does not have the ability to spend \$180bn nor the inclination to service such high a debt thereafter.

The knack to PPP projects is finding enough investors. Peru will constantly need to attract foreign investment to meet its infrastructure requirements. To some extent, Peru has it all in-place already. It is publicly committed to free-market macroeconomic policy: keeping an open market, creating a friendly business environment for foreign investors and maintaining a very strict and disciplined fiscal stance. In addition, Peru has a successful 20-year economic history to look back on. It has enjoyed high growth and low inflation at a time when many countries in Latin America like Argentina or Brazil have struggled. All long-term investors will measure the various political risks and the certainty of returns when choosing to put their money into a country. On both counts, Peru can legitimately claim to a be an attractive destination.

Given the magnitude of the infrastructure gap, however, Peru cannot afford to rest on its laurels. It needs to constantly seek out new money. As a result, the Government is looking to identify and then cut back on any overly bureaucratic procedures. Peru has scrapped capital controls of any sort and the constitution itself has been amended so that, legally, domestic and foreign sources of investment are treated equally.

Interestingly, PPP also demands a social aspect. Foreign investors are more sensitive than ever to the impact of their investment on local communities. Social media and the 24-hour news cycle means that firms are wary of being portrayed as exploitative. The Peruvian Government, therefore, has committed to employing at least one person per PPP project whose role is to look at the social dynamics in the local area. This goes hand-in-hand with environmental issues because most of the time it is environment issues that worry the communities. By ensuring that the project is conducted with the local population on-side, the Government ensures that project can be delivered without delay and without PR damage. These are highly attractive to any foreign investor.

All in all, Peru is clearly doing a lot to maintain its current high rate of growth. It has a long way to go but the most optimistic commentators are beginning to think that Peru may not only be able to sustain its current growth rate but, if it gets its PPP strategy right, it may be able to grow at an even faster rate.

Image	Acknowledgements
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