Economist’s Note

Mergers between Backward Integrated Firms: Insights from BASF/Solvay’s Polyamide Business†

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I. Introduction

On 19 September 2017, BASF publicly announced that it had agreed to purchase Solvay’s polyamide business, and the transaction was notified to the European Commission on 22 May 2018. After opening an in-depth investigation on 26 June 2018 and receiving an offer for commitments on 10 October 2018, the Commission conditionally cleared the transaction on 18 January 2019. In announcing the approval of the deal, Commissioner for Competition Margrethe Vestager hailed the ‘creation of a significant European player’ in the polyamide industry.

According to the press release on the opening of the in-depth investigation, the Commission’s initial market investigation raised a set of traditional horizontal and vertical concerns throughout the polyamide value chain. In addition, ‘[t]he initial market investigation […] showed that competitors of the merged entity fear that it would stop supplying them with these essential inputs because of its own increased needs downstream.’ Members of the Chief Economist Team of DG Competition may have also been referring to this transaction when they wrote that in 2017/2018 ‘[t]he CET was involved in all of these second-phase investigations as well as in some complex first-phase investigations, with a focus on specific topics such as […] horizontal effects in seemingly vertical transactions that involve integrated firms […]’.

Indeed, the length of the polyamide value chain, the differential presence of the merging parties along it and the possible existence of a capacity constraint at the top render this transaction a complex one, combining possible horizontal, vertical and what we are going to call non-traditional effects. These effects call for a consistent analysis.

In the remainder of this article, we set out to illustrate these effects and raise some questions on the Commission’s assessment of the case. Against the background of the key facts of the transaction, which are

Key Points

- When a supplier has multiple uses for its product, its sales-based share in a market may provide more useful first indications of its market power in that market than its production- or capacity-based share.
- In particular, the small sales share of a supplier in a market suggests that its effective incremental cost of serving that market, which is the cost of foregoing the best alternative use for its product, is large and its market power in that market is small, irrespective of the size of its overall production or capacity.
- When the products that are manufactured with the internally sourced input are in direct competition in the downstream market with the products that are manufactured by the upstream market’s customers, internal sales of the upstream product may constitute, by increasing demand elasticity in the upstream market, an indirect competitive constraint on it.
- If the elimination of double marginalisation creates the incentive for the merged entity to expand production, a capacity constraint upstream may be reached, giving rise to effects that, being neither horizontal nor vertical in nature, we consider non-traditional.

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1 BASF/Solvay’s EP and PE1 (‘Polyamide’) Business (Case M.8674).
2 See the European Commission’s press release IP/18/4291 of 26 June 2018 on the opening of the in-depth investigation of BASF/Solvay’s Polyamide Business.
II. Key facts of the case

As originally envisaged, the BASF/Solvay’s Polyamide Business merger entailed the acquisition of assets across the polyamide value chain, ranging from what we refer to as Level I (ADN) at the top of the value chain to what we refer to as Level V (PA6.6 EP) at the bottom. Figure 1 depicts the different levels of the polyamide value chain, showing BASF’s and Solvay’s presence in terms of both capacity/production and (merchant) sales.4

At the bottom of the value chain are PA6.6 EP, which are used in a variety of applications in the automotive, consumer and industrial goods, and electrical equipment segments. Among the suppliers of PA6.6 EP count firms with a varying degree of backward integration, ranging from pure ‘compounders’ to partially backward-integrated firms, such as BASF, and a fully backward-integrated firm, Solvay.

At the top of the value chain is ADN, which can be manufactured with the C3 technology (with primary feedstock propylene) and the C4 technology (with primary feedstock butadiene). In light of the historical relative price of these two inputs, the C4 technology, which is exclusively owned by Invista, tends to be more cost-effective. In the EEA, ADN is produced only by Butachimie, which is a joint venture between Invista and Solvay that produces ADN based on Invista’s technology. Through the transaction, BASF replaces Solvay as Invista’s partner in Butachimie.

This overview highlights a number of facts that are key for the competitive assessment of the merger. First, by replacing Solvay as Invista’s partner in Butachimie, the merged entity obtains access to a cost-effective ADN source. Second, to the extent that BASF does not materially participate in a merchant market, it is unclear how the transaction, as originally envisaged, could raise horizontal concerns and strengthen the incentive to foreclose input to rival suppliers in that market.

If so, it would appear as if the case turns on the PA6.6 EP market, and in particular on the evaluation of any horizontal and vertical effects in this market (in which both merging parties have a moderate market share) and of the extent to which the elimination of double marginalisation,5 possibly limited by the existence of a capacity constraint upstream, would outweigh these effects. This is, however, not quite how the Commission’s review of the case unfolded, in that not only were efficiencies largely ignored but additional concerns regarding the upstream/midstream markets were also raised.

III. Horizontal effects

According to the Commission’s horizontal merger guidelines, “[m]arket shares and concentration levels provide useful first indications of the market structure and of the competitive importance of both the merging parties and their competitors.”6 The Commission has traditionally used (merchant) sales to measure market shares but in a number of recent cases it has also considered production- and capacity-based measures.7

In BASF/Solvay’s Polyamide Business, the Commission raised horizontal concerns not only with respect to the downstream product PA6.6 EP, of which both merging parties are significant (merchant) suppliers, but also with respect to upstream and midstream products that BASF produces largely for internal consumption.8 For such products, the combined share of the merging parties in terms of production and capacity was significantly higher than in terms of sales, leading to significantly different presumptions about the merger’s horizontal effects.

Notwithstanding that market shares provide only first indications of the horizontal effects of a merger, we are not convinced that a shift from sales- to production- or capacity-based measures in the calculation of market shares improves on these indications. To understand our doubts, let us go back to the model of Cournot (quantity) competition. In light of the homogeneity of the upstream/midstream products covered by BASF/Solvay’s Polyamide Business and the positive profit margins earned on their sale, this fundamental model of competition is a fitting starting point.

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4 In this article we concentrate on the value chain between ADN and PA6.6 EP, ignoring AA, which is used in combination with HMD to produce AH Salt. The European Commission also raised competition concerns with respect to AA. See the European Commission’s press release IP/19/522 of 18 January 2019 on the conditional approval of BASF/Solvay’s Polyamide Business.

5 We define elimination of double marginalisation in Section 4.


7 Beside BASF/Solvay’s Polyamide Business, see for example Outokumpu/Inoxum (Case M.6471), Ineos/Solvay/JV (Case M. 6905), HeidelbergCement/Schweng/Cemex Hungary/Cemex Croatia (Case M. 7876) and ArcelorMittal/Ivva (Case M.8444). In these other cases, however, the focus of the competitive assessment seems to have been more on downstream than on upstream (merchant) markets.

8 In fact, the Commission’s horizontal concerns stretched back to the market for ADN, where BASF does not even own any production capacity.
The Cournot model predicts that the market power of a supplier is proportional to its market share.\(^9\) In particular, because with homogeneous products the price prevailing in the market is uniform across suppliers, a supplier’s market share is inversely proportional to its manufacturing costs. The higher its share, the lower its manufacturing costs. It is the Cournot model that informs the reliance of the Commission and other competition authorities on the Herfindahl index (also known as HHI)\(^10\) of market concentration and its merger-generated change (also known as delta).\(^11\)

The Cournot model, however, is a model that does not feature capacity constraints and alternative product uses. The question raised by BASF/Solvay’s Polyamide Business is, then, whether the Cournot model can be adapted to such circumstances, thereby preserving the relevance of sales-based market shares. We argue that this is the case.

In particular, we argue that the sales share of a supplier in the merchant market continues to reflect its effective incremental cost of serving that market and, therefore, its market power. If so, the small sales share of a supplier such as BASF in an upstream/midstream market must mean that its effective incremental cost of serving that market is large and that, therefore, its market power is small, irrespective of the size of its overall production or capacity. In this sense, the only change called for by the presence of capacity constraints is the interpretation of the effective incremental cost: Without capacity constraints, the effective incremental cost is the cost of manufacturing the product, whereas with capacity constraints the effective incremental cost is the ‘opportunity cost’ of foregoing the best alternative use for the product.

Indeed, as BASF/Solvay’s Polyamide Business illustrates, there may be multiple alternatives to a product’s sale in the domestic (merchant) market, such as its internal sale to a downstream division or its sale in the export market. As long as the price in the export market is ‘exogenously’ determined and, therefore, independent of the quantity exported by the domestic suppliers, we can distinguish between two scenarios, depending on the level of the export price.

In the first scenario, the export price is high enough that a domestic supplier will want, after serving the merchant market and its internal requirements, to also serve the export market. In this case, both the merchant market and the internal requirements are optimally served in light of the export price, which constitutes the opportunity cost of foregoing sales in the export market. There is no trade-off between making merchant and internal sales: Should the marginal revenue from making either of them rise, the product would be diverted not from the other domestic use but from the export market.

In the second scenario, the export price is not high enough, and only the merchant market and its internal

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9 In particular, market power is equal to its market share divided by the price elasticity of market demand. Market power is measured by the Lerner index, which is defined as the difference between the price and the manufacturing cost, divided by the price.

10 In particular, the weighted-average Lerner index in the market is equal to the Herfindahl index divided by the price elasticity of market demand. The Herfindahl index is defined as the sum of squared market shares across suppliers.

requirements are served. In this case, merchant and internal sales may be set at a suboptimal level, in the sense that it may not be possible for the firm to maximise the profitability of both at the same time and the firm will instead content itself with equalising their incremental profitability. There is then a trade-off between making merchant and internal sales: Should the marginal profitability from making either of them rise, the product would be diverted from the other domestic use until the equality in marginal profitability is restored.

It is clear that, irrespective of the scenario we are in, capacity constraints create an opportunity cost in serving a market. Once this opportunity cost replaces the total capacity of the other firms, the traditional, sales-based, initial analysis of the horizontal effects of a merger continues to apply.

Admittedly, the Cournot model can be re-interpreted to account for situations where capacity constraints create an opportunity cost for serving a market but may not be able to account for situations where capacity constraints are so tight that even serving that market is not possible to the fullest extent. Tight capacity constraints are captured by the so-called Bertrand-Edgeworth (BE) model. In the BE model, equilibria in which firms choose a unique price do not exist and in fact there may exist multiple equilibria, in each of which firms consider a range of prices.

Despite these analytical challenges, the BE model has been used by the Commission and merging parties in the evaluation of horizontal mergers, building on the BE model’s insight that the equilibrium price range in a market is determined by the capacity of the largest firm in comparison to the total capacity of the other firms. This implies that a horizontal merger is predicted by the BE model to have effects only if it involves the creation or strengthening of the largest firm in the market. In turn implies that no continuous relationship between a horizontal merger’s effects and the merging parties’ capacity shares is predicted by the BE model to hold. In any case, because the BE model does not feature vertical integration, capacities would need to be calibrated to reflect the capacities that, by some measure, are available for the merchant market. In summary, also the BE model does not enable us to draw clear-cut conclusions from the merging parties’ capacity shares, certainly not in the presence of alternative product uses.

So far, our discussion has implicitly focussed on the role of free capacities and a product’s alternative uses, including internal sales, as direct competitive constraints on the upstream market. Internal sales, however, may play a dual role along the value chain: not only as a direct competitive constraint on the upstream market but also as an indirect competitive constraint through competition in the downstream market.

Internal sales of an upstream product constitute an indirect competitive constraint on the upstream market when the products that are manufactured with the internally sourced input are in direct competition in the downstream market with the products that are manufactured by the upstream market’s customers. When this is the case, and there are no capacity constraints, the costs of the backward integrated suppliers in the downstream market are decoupled from price changes in the upstream market. In comparison to a situation where all downstream suppliers source their input externally, this has the effect of increasing the elasticity of demand in the upstream market, thereby exerting downward pricing pressure in that market.

The Cournot model predicts that, for any given market shares of the merging parties, the higher the elasticity of demand, the weaker the effects of a horizontal merger. If so, for any given merchant sales-based market shares of the merging parties, internal sales are predicted, by increasing the elasticity of demand, to weaken a horizontal merger’s effects. This is precisely the opposite of the conclusion one would reach if, in BASF/Solvay’s Polyamide Business, one replaced the merging parties’ sales shares with their production or capacity shares, as the Commission suggests doing. Indeed, because there are upstream/midstream products that BASF produces largely for internal consumption, the combined capacity or production share of the merging parties for these products is higher than their sales share. As a result, by considering the merging parties’ production or capacity shares instead of their sales shares, one is misled into thinking that internal sales worsen rather than improve the merger’s horizontal effects.

Of course, internal sales may also play a role in the assessment of input foreclosure and the elimination of double marginalisation, as well as of what we call non-traditional effects. These are separate effects, though, and we consider them in the next two sections.

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12 See, in particular, Oulokampu/Inoxum (Case M.6471) and Ineos/Solvay/JV (Case M. 6905).
14 This observation is also made in Annex B to Ineos/Solvay/JV (Case COMP/M. 6905) Commission Decision [2014].
15 This can alternatively be interpreted as the scenario with exports.
16 For the derivation of this result, see, for example, R Inderst and T Valletti, ‘Indirect versus direct constraints in markets with vertical integration’, (2009) 111 Scandinavian Journal of Economics 527. This result, and their model, is further discussed in Sections 4 and 5 of this article.
**IV. Vertical effects**

According to the press release on the conditional approval of BASF/Solvay’s Polyamide Business, after the transaction, as originally envisaged, “[t]he merged entity would also have the ability and incentive to restrict its competitors’ access to essential inputs.”

As a precondition for a transaction to raise input foreclosure concerns, the transaction must create or strengthen the ability or the incentive of the merging parties to foreclose. In particular, if before the transaction one merging party is already present in both an upstream and a downstream market, the transaction must strengthen its presence in either the upstream market (for the ability prong of the test) or the downstream market (for the incentive prong of the test). If so, our discussion in the previous section suggests that the transaction, as originally envisaged, would not have effectively altered the market power of the merging parties in any market along the ADN – PA6.6 EP value chain, with the possible exception of the downstream market for PA6.6 EP. This implies that the transaction, as originally envisaged, would not have altered the ability of the merging parties to foreclose input in any market and might have increased the incentive to do so only in the market for PA6.6 EP, leaving this as the only market where input foreclosure might have been a concern.

Even in this market, however, the assessment of input foreclosure, also known as raising rivals’ costs, is complex and cannot be limited to the measurement of market shares in the upstream and the downstream market, regardless of whether they are defined in terms of sales, production or capacity. The reason why the assessment of input foreclosure is complex is because this theory of harm rests on the internalisation by the merged entity’s upstream division of the consequences that its actions have on the profits of the downstream division.

Following this fundamental economic principle, vertical integration is likely to simultaneously affect the behaviour of the merged entity in multiple ways. In particular, it may create not only the incentive to raise rivals’ costs but also (and more directly) the incentive to lower the costs of its own downstream division. This implies that, as indicated in the Commission’s non-horizontal merger guidelines, the consequences of rivals’ possibly higher costs need to be balanced, in the downstream market, with the consequences of the merged entity’s own possibly lower costs. This also implies – and this is a result that is less appreciated – that rivals’ costs and input prices may not rise to begin with.

To illustrate the multiple forces at work in vertical integration, we use a model developed by Inderst and Valletti (2009). This model extends the model we introduced in the previous section by featuring both an upstream and a downstream market. In both markets firms compete in quantities (à la Cournot) but, whereas the product offered in the upstream market is homogeneous, the products offered in the downstream market are differentiated, very much like PA6.6 EP in BASF/Solvay’s Polyamide Business.

Firms in the upstream market do not face any capacity constraints.

The consequences of vertical integration can be assessed in this model by working out how equilibrium outcomes change when one upstream firm and one downstream firm merge. When this happens, the downstream division of the merged entity stops purchasing the input in the upstream market and starts sourcing it internally, at a transfer price that is lower than the merchant price. This is because, in setting its transfer price, the upstream division internalises the profits earned by the downstream division when its costs (the transfer price) decrease. The upstream division is therefore willing to charge to its downstream division a lower price than it charges in the merchant market. This is known as the elimination of double marginalisation.

The withdrawal of the downstream division of the merged entity as a customer in the upstream market, in addition to the elimination of double marginalisation, implies that input demand by the remaining downstream firms becomes more elastic. Indeed, before the merger, all downstream firms are equally affected by an increase in the input price, making the elasticity of demand in the upstream market a simple reflection of under the Council Regulation on the control of concentrations between undertakings’, [2008] OJ C265/6.

21 Downstream firms manufacture their products by transforming one unit of input, which they purchase in the upstream market, into one unit of output.

22 This can alternatively be interpreted as the scenario with exports described in the previous section. The model is solved by: (a) first, deriving equilibrium outcomes for the downstream market, conditional on a price for the input; and (b) then, on the basis of the resulting relationship between the input price and demand for the input, deriving equilibrium outcomes for the upstream market.
the elasticity of demand in the downstream market. After the merger, on the other hand, the costs of the downstream division of the merged entity are insulated from the price prevailing in the upstream market, such that the pass-through of an input price increase by the remaining downstream firms causes the diversion of sales not only away from the downstream market but also towards the downstream division of the merged entity, whose costs have not increased.

For given cost and competitive conditions, a more elastic demand in the upstream market implies a lower equilibrium price. Using the language of Inderst and Valletti, we say that vertical integration creates an indirect competitive constraint in the upstream market.

In the same spirit in which the merged entity internalises the benefits to its downstream profits of charging a lower transfer price to its downstream division, the merged entity also internalises the benefits to its downstream profits of charging a higher price in the merchant market. This is because, confronted with a higher input price, the independent downstream firms will raise their price and some of their sales will be diverted to the downstream division of the merged entity, on which a profit margin is earned. This is what we define as the incentive to raise rivals’ costs, which reduces the direct competitive constraint exerted by the merged entity on the upstream market.

In Inderst and Valletti’s model, the net effect of the creation of indirect competitive constraints and the reduction of direct competitive constraints is a decline in the price in the upstream market following vertical integration. This effect holds regardless of the degree of product differentiation in the downstream market. Indeed, when product differentiation is high, the indirect competitive constraint created by vertical integration is weak but so is the reduction in the direct constraint. On the other hand, when product differentiation is low, the reduction in the direct competitive constraint is strong but so is the indirect constraint created by vertical integration. With the costs of the downstream division of the merged entity and the costs of its rivals declining, prices in the downstream market will decline as well. This is not to say that input foreclosure is never a concern but to call for a thorough analysis of the circumstances of the individual case.

V. Non-traditional effects
In addition to horizontal and vertical concerns, “[t]he initial market investigation also showed that competitors of the merged entity fear that it would stop supplying them with these essential inputs because of its own increased needs downstream.” These concerns of the Commission are motivated by the possibility that the merged entity would have faced a capacity constraint in the production of upstream/midstream products, in particular ADN.

To better understand these concerns, we extend Inderst and Valletti’s model as follows. In the extended model, the upstream merging party faces a capacity constraint that allows it to produce the pre-merger equilibrium quantity but not the unconstrained post-merger equilibrium quantity, which is larger. What this implies is that, following vertical integration, the merged entity will internalise the benefits of selling the input to its downstream division at a lower (transfer) price and will start expanding its production accordingly. Unlike in the unconstrained case of the previous section, though, in the constrained case this expansion will come to a halt once the capacity constraint is reached. At this point, a rebalancing process will take place between the merged entity’s sales to the merchant market and internal sales. At the end of this process, the merged entity will be indifferent between on the one hand selling an extra unit of input in the upstream market and on the other hand transforming it and selling it in the downstream market.

This discussion shows how the decision problem of the merged entity in the post-merger equilibrium differs between the constrained case of this section and the unconstrained case of the previous section. In the unconstrained case, the merged entity anticipates that,

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23 This incentive has been analysed extensively in the context of, among others, the Competition and Markets Authority’s review of Tesco/Booker (decision of 20 December 2017). This traditional incentive to raise rivals’ costs is analogous to but distinct from the incentive to raise rivals’ costs arising in the Nash bargaining models used in the assessment of AT&T/Time Warner in the U.S. and other vertical media mergers, including Liberty Global/Corelia/We-W/De Vijver Media (Case M.7194) in the EU. In these models, the incentive to raise rivals’ costs comes from the greater bargaining leverage (in particular, the higher walk-away value) attained by the content owner through forward integration, which is in turn based on the diversion of downstream sales towards its affiliated content distributor in the event that the downstream rival failed to obtain the bargain-over content. In summary, whereas the traditional incentive to raise rivals’ costs is sparked by diversion in downstream sales following a cost-induced increase in prices, the incentive to raise rivals’ costs in Nash bargaining models of media markets is sparked by diversion in downstream sales following a disagreement-induced reduction in the size of the content bundle.

24 See the European Commission’s press release IP/18/4291 of 26 June 2018 on the opening of the in-depth investigation of BASF/Solvay’s Polyamide Business.

25 In the alternative interpretation of the scenario with exports described in Section 3, the expansion of production can be interpreted accordingly as the replacement of exports with domestic sales.
by reducing its sales in the upstream market, the input price will rise. This will force the customers in the upstream market, who may be rivals of the merged entity in the downstream market, to raise their prices, losing some of their sales to the merged entity's downstream division. This reasoning is different from the reasoning that the merged entity goes through in the constrained case. In that case, the merged entity is confronted by the simple technological reality that each unit of input it sells in the upstream market is a unit it cannot transform and sell in the downstream market, regardless of the consequences of its behaviour for the input price.

When it comes to evaluating the merger’s impact on market outcomes, three scenarios can be distinguished, depending on the tightness of the capacity constraint. When the constraint is loose, the merger effects in the constrained case are qualitatively the same as in the unconstrained case, such that the price in the upstream market declines and consumer surplus increases. When the constraint is intermediate, the price in the upstream market increases, but the higher downstream output of the merged entity outweighs the higher costs of its rivals and consumer surplus increases. When the constraint is tight, not only does the price in the upstream market increase, but the higher downstream output of the merged entity is also not sufficient to outweigh the higher costs of its rivals and consumer surplus declines.

We consider these effects non-traditional because, unlike traditional horizontal and vertical effects, they are not based on the recapture of lost sales between the merging parties in response to a unilateral price increase, as measured by sales diversion ratios. In the analysis of horizontal effects, which stem from the loss of competition between the merging parties in a market, the relevant diversion ratio measures the fraction of sales lost by the merging party that would be recaptured by the other merging party in the same market. In the analysis of vertical effects, which stem from the incentive to raise rivals’ costs, the relevant diversion ratio measures the fraction of sales lost by the merging party in the upstream market that would be recaptured by the other merging party in the downstream market, through the recapture of some of the sales lost by its rivals following the pass-through of higher input prices.

Clearly, the effects we illustrated in this section do not belong to either of the two categories of traditional effects. They are not horizontal effects, because they are not about the loss of competition between the merging parties in a market. They are not vertical effects either, because they are not about raising rivals’ costs. In fact, these effects are, if anything, more likely to arise if customers in the upstream market are not in competition with the merged entity in the downstream market. These effects simply emanate from the impossibility for the merged entity to serve both the upstream and the downstream market to the fullest extent, raising the question as to whether they can be considered competitive effects at all.

VI. Conclusions

In this article we illustrated economic issues that arise in the evaluation of mergers between differentially backward-integrated firms, reaching the following conclusions. When a supplier has multiple uses for its upstream product, its sales-based share in an upstream market may provide more useful first indications of its market power in that market than its production- or capacity-based share. In particular, the small sales share of a supplier in a market suggests that its effective incremental cost of serving that market, which is the cost of foregoing the best alternative use for its product, is large and its market power in that market is small, irrespective of the size of its overall production or capacity. When the products that are manufactured with the internally sourced input are in direct competition in the downstream market with the products that are manufactured by the upstream market’s customers, internal sales of the upstream product may constitute, by increasing demand elasticity in the upstream market, an indirect competitive constraint on it. If the elimination of double marginalisation creates the incentive for the merged entity to expand production, a capacity constraint upstream may be reached, giving rise to effects that, being neither horizontal nor vertical in nature, we consider non-traditional.

In BASF/Solvay’s Polyamide Business, the remedies accepted by the Commission to remove the competition concerns it identified include the divestiture to a single suitable buyer of not only Solvay’s assets at the downstream level (Level V) but also at the midstream/upstream level (Levels II – IV), in addition to a long-term ADN supply agreement with the same entity. Our

26 Consumer surplus is defined as the sum, across customers in the downstream market, of the difference between their willingness to pay for a product and the price they pay for it.
28 In this case, the higher consumer surplus in the downstream market of the merged entity might have to be traded against the lower consumer surplus in the downstream market of its upstream customers.
discussion suggests that horizontal concerns in upstream/midstream markets may not have been warranted and that any vertical and non-traditional concerns might have been allayed as soon as their origin, namely the increased presence of the merging parties in the downstream market, had been eliminated. At the same time, the accepted remedies recognise the competitive significance of backward integration and, with it, the need to replace a (partially) backward integrated player like BASF with a commensurate new player.

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