Predicting Cartels

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Executive Summary

1. Introduction

Cartels are agreements between firms to reduce the level of competition between them with the aim of raising prices and profitability. In modern times these agreements are frequently verbal, can be very harmful to competition but are often very difficult to detect. In the UK, the Enterprise Act has recently given strong powers to the competition authorities to help stimulate competition. Part of this policy has involved the introduction of criminal proceedings for those perpetrating cartels in the UK.

Although past evidence of cartel detection provides some indication of where cartels may exist, it would be helpful to understand more fully the factors that lead to cartel formation and use this information to identify the location of the cartels that have not yet been identified. Clearly, many of the critical factors will depend on the specifics of the individuals' involved and unique features of the case but there may be common economic factors that can help inform the process of deciding where to allocate effort in the detection process. This paper is concerned with this question.

The paper follows three approaches. One is a study of the economic theoretical literature to see what factors have proved useful in the modelling of cartel stability and formation. The second approach is empirical. We use existing recent evidence of legal cases and economic data to identify factors that are relevant to the identification of cartels and then to use the economic model to provide predictions of the probability of cartels within each of a large number of industry classifications. Finally, a number of case studies are undertaken. The findings of the three approaches are then brought together to provide an overall assessment that can be applied to any market to indicate how likely it is that the market contains a cartel.

2. Factors that facilitate or hinder collusion – the economic literature

The theoretical literature on cartels is primarily concerned with the compliance of independent firms with agreements that reduce competition within a market. Because anticompetitive practices are illegal, these arrangements cannot be the object of legal contracts and, as a consequence, can only exist if they are self-enforcing. Indeed, this is the way in which economists understand the term "collusion": as a cooperative arrangement, that is self-enforced. To model self-enforcing agreements, economists have borrowed from the theory of repeated games. At the most general level, the sustainability of collusion depends on the interplay of the size of the (short-lived) gain that can be obtained by deviating from the collusive agreement, and the (long-run)

cost of the resulting reversion to non-cooperative interaction (punishment). In particular, collusion is sustainable only when the potential short-term gain from a deviation is outweighed by the long-run losses from price competition.

The literature identifies several factors as facilitating cartel behaviour. In particular the theoretical literature suggests that:

- a smaller number of firms in the market facilitates collusion
- higher entry barriers facilitate collusion
- excess capacity and stocks are important variables and are generally thought to help sustain collusion
- persistent demand instability in a market is thought to hinder collusion
- demand growth facilitates collusion
- frequency of interaction favours collusion
- market transparency favours collusion
- private information limits collusion
- cost asymmetries and quality differences restrict collusion
- horizontal product differentiation is important but its effect on collusion is ambiguous
- large, powerful buyers make collusion harder to sustain.

Section 2 of the paper provides a detailed discussion of the economics underlying these theoretic predictions.

The relationship between the theoretical literature review and the regression analysis and case studies is complex. One reason is that the theoretical literature on collusion has, until recently, underestimated or ignored the role communication plays in the sustainability of cartels. Insufficient emphasis has been placed upon the role of communication, and the exchange of information among firms, as the vehicle through which cooperation is achieved and sustained. In contrast, the legal literature qualifies as collusive only those agreements that are jointly arrived at, as a result of explicit communication. This creates a potential dichotomy between theoretical speculation, on one hand, and practical concerns, on the other. The need for cartel members to communicate intensifies precisely when collusion is harder to sustain. This observation suggests that parties might be more likely to engage in overtly collusive practices specifically in those circumstances that are predicted by the theory as being adverse to collusion. This suggests that there is unlikely to be a straightforward

relationship between the theory and the empirical studies, and that the marrying up the evidence from the three approaches is not straightforward.

3. Empirical analysis

To undertake an empirical investigation a (dependent) variable is required that measures the extent of cartelisation in each industry sector. In this study we use the incidence of cartels in an industry as the measure of cartelisation, based on evidence drawn from EC and US cases. It is almost certainly the case that there are cartels that have yet to be discovered or indeed may never be discovered. For this reason the data used as the proxy for cartelisation suffers from an errors in measurement problem. That is, we only observe a selection of the evidence, namely those cartels that have already been discovered and prosecuted. Implicit in the approach is the assumption that the location across industries of known cartels is informative about the whereabouts of other cartels, or more precisely, informative about the whereabouts of cartels that can be discovered and prosecuted.

The investigation employs cartel evidence using EC cases from 1990 to the present and the US Department of Justice cases of horizontal price fixing from 1994 to the present. We construct, for each jurisdiction, an index that gives the number of cartel cases discovered in that industry during the periods noted above. Despite the fact that less than 20% of the cases are common between these two jurisdictions there is a strong positive correlation between the data sets. Having allocated the cartels to SIC three-digit classification we find the correlation between US and EU cartels is 0.68.

The statistical analysis is approached at a very disaggregated level (three-digit industry classification). In part this is necessary to obtain sufficient industries to conduct a meaningful cross section investigation. However, it is also necessary if predictions are to bring significant additional insight to the evidence that can be gleaned directly from case studies and simple ‘eye-balling’ and manipulation of the data. Identifying, say, six specific industries where cartels may be particularly prevalent is more informative if these six are drawn from a classification with over one hundred categories than if they are drawn from, say, ten categories. There are obvious data problems in conducting the exercise due to measurement error and random industry factors. This makes it far harder to identify the significant variables and have confidence in the results. However, at a more fundamental level it is not obvious that, even with perfect data, economic factors ‘work’ at this level of disaggregation. That is, the ‘economic’ differences between, say, manufacturing and transport may be significant in determining cartel formation but it is not obvious

whether the differences in manufacturing at a very disaggregated level (e.g., separating manufacture of knitted and crocheted fabrics from manufacture of knitted and crocheted articles as we do in the analysis) will be relevant. This may be because, at this level of disaggregation, any mismatch between markets and industry classification is marked and the differences between industries may become too fine to significantly influence cartel formation, and hence identification. The main message from the analysis is that the approach does work at this level. That is, despite the data problems and the level of disaggregation we are able to find strong significant patterns in the data.

There are several clear messages that arise from the series of models we investigate. One is that demand factors are very important and follow the theoretically predicted pattern. That is, variability in growth is shown to have a negative impact on cartels. This is an extremely robust result holding in all models. Similarly, growth in turnover has a positive impact on cartel formation and again is extremely robust. In contrast, traditional entry barriers (measured in gross capital expenditure per firm, the level of stocks per firm and the level of R&D per firm) have little effect. The cost disadvantage ratio (a measure of economies of scale) is the sole entry barrier that is significant in explaining cartel presence, i.e., the higher economies of scale the more cartels. However, as indicated above, the interpretation of the lack of empirical evidence supporting the role of entry barriers requires care. The theory indicates that entry barriers should ease cartelisation. However, the data we are concerned with here is based on cartels that have been discovered. It may be the case that whenever entry barriers are weak a cartel will have to act to prevent entry from competitors and this increases the chances of being discovered. Therefore, one might expect to see mixed evidence on entry barriers. Interestingly there is some evidence drawn from case studies that also suggests that this may be the case. The regressions also show that scale, in the form of turnover in the industry, and concentration matters.

An interesting feature of the analysis is that the results indicate that elements of employment also seem to matter, i.e., employee costs are significant. These factors do not arise in the theoretical literature, possibly because there is no obvious reason why they should be critical for collusion. However, there are sensible reasons why they might matter for cartel detection. For example, industries with higher employment cost per employee may be more likely to have higher paid staff (who may, as a result, be privy to better information). Other things being equal, this may increase the likelihood of a cartel being discovered and the relevant evidence being uncovered. To the extent that employees as opposed to shareholders carry much of the legal risks associated with setting up a cartel that may be detected (since they tend

to be formed by management not shareholders) then this risk needs to find financial compensation. This provides a separate argument why there might be a positive correlation between employee costs and cartels, albeit with an opposite causation. However, while this is a robust theoretical explanation, it is hard to believe that such an effect will have a large impact on the total remuneration in a sector. Finally, the (logit) regressions typically explain somewhere between 14% to 24% of variability in the data on the location of cartels. That is, the economic variables explain about one fifth to one sixth of the variability in the cartel data. Given the measurement error problems in the data this is not an unreasonable figure.

The main purpose of this part of the report is to investigate whether econometric techniques can provide useful information as to where cartels may be located. Several models are used, all of which contain variables that are significant in explaining the location of cartels. One useful way to present the results is to provide for each industry a prediction of the probability that a cartel exists in that industry and then rank all industries. Then remove from the list any industries that already have had a cartel. The Table below shows the top 30 industries in this final list (drawn from the three models), along with a prediction of the probability that they have a cartel.

The benefits of the approach become apparent when one compares the predictions with the raw cartel data. The allocation of EC and US cartels to SIC classification shows the well-known concentration on manufacturing and transport. Using this evidence as the basis for future investigation would imply a focus on manufacturing and transport sectors. The econometric approach allows a more detailed assessment. The econometric predictions of the most likely locations for cartels that may be convicted does indeed include several manufacturing industries where cartels have not yet been found (e.g., manufacture of aircraft and spacecraft, manufacture of paper and paperboard, manufacture of weapons) but significantly throw up other industries as being prime candidates that would not have arisen from a simple non-econometric interpretation of the data. For example, secondary schools, auditing and tax consultancy, architecture and related consultancy, and telecommunications all come out extremely high on the ‘hit list’. The stability of the schools market appears to be a factor that contributes significantly to its appearance towards the top of the list (this is also the case for auditing but the scale of the industry also appears to contribute). There has been significant media coverage of potential school cartels. The fact that schools are not present in the cartel variable and yet are thrown out as highly likely to contain cartels by the econometric analysis highlights the use of a disaggregated econometric approach.

	Ranking of industries where no cartel(s) have yet been discovered	Prob.
1	Telecommunications	0.84
2	Manufacture of aircraft and spacecraft	0.65
3	Manufacture of grain mill products, starches and starch products	0.61
4	Legal, accounting, bookkeeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy	0.55
5	Cargo handling and storage	0.50
6	Activities of travel agencies and tour operators; tourist assistance activities	0.46
7	Publishing	0.44
8	Manufacture of railway and tramway locomotives and rolling stock	0.44
9	Other land transport	0.43
10	Recycling of metal waste and scrap	0.40
11	Manufacture of articles of paper and paperboard	0.40
12	Manufacture of weapons and ammunition	0.39
13	Radio and television activities	0.39
14	Processing and preserving of fruit and vegetables	0.38
15	Manufacture of motorcycles and bicycles	0.38
16	Quarrying of sand and clay	0.37
17	Manufacture of prepared animal feeds	0.35
18	Non-scheduled air transport	0.34
19	Manufacture of domestic appliances not elsewhere classified	0.34
20	Mining and agglomeration of hard coal	0.34
21	Manufacture of glass and glass products	0.33
22	Other computer related activities	0.32
23	Architectural and engineering activities and related technical consultancy	0.30
24	Manufacture of cutlery, tools and general hardware	0.29
25	Other recreational activities	0.28
26	Manufacture of other chemical products	0.28
27	Printing and service activities related to printing	0.27
28	Secondary education	0.27
29	Manufacture of bricks, tiles and construction products, in baked clay	0.27
30	Postal and courier activities	0.25

4. Case studies

We have investigated many cartels including those in the two industries where they are most prevalent – shipping and basic chemicals. Here we summarise some common themes that emerge.

Demand factors, capacity and intensity of competition

Many of the case studies indicate that demand factors are important in the formation of cartels. However, it is extremely hard in the case studies to identify whether

demand factors are the direct cause or whether demand works through other mechanisms. In particular 'negative' demand factors create excessive capacity and it may be the latter that is important in cartel formation. It is clear, however, that cartel formation appears to be generally linked with a decline in prices. This can take many forms, notably an abrupt price plunge that is triggered by a negative demand shock, or a gradual price decline. The latter may be caused by prolonged adverse demand conditions or intensified competition.

There are several examples where abrupt changes have triggered a cartel. For example, the Ferry Operators – Currency Surcharges Case (97/84/EC) fits this model very clearly. This case concerns five ferry operators and the driver here was the devaluation of sterling in September 1992, which had a detrimental effect on revenues for the five operators. Despite the differing impact on the companies they each announced identical surcharges in response to the devaluation with a common introduction date and common method of calculation. The French Beef (2003/600/EC) and German Banks (2003/25/EC) are other good examples.

The impact of prolonged adverse conditions is exemplified in many cases, e.g., Petrochemicals (94/599/EC), Seamless Steel Tubes (2003/382/EC) and Graphite Electrodes (2002/271/EC). In these cases the protracted nature of the adverse demand conditions typically resulted in the emergence of excess capacity, industry restructuring and exit. Sometimes the cartel manipulated and enforced the excess capacity. For example in the Trans-atlantic agreement (TAA) case (94/980/EC) differences in utilisation of the west and east bound routes were a factor in generating the excess capacity that was at the core of the cartel. The aim of the agreement was to limit the supply of transport on the market without reducing the real available capacity of ship-owners. Specifically, the ship-owners agreed not to utilize an agreed part (up to 25 %) of their available capacity.

Several cases also exhibit intense competition that precedes cartel formation. This was typically generated by the expansion – through acquisition and/or the building of new capacity – of one of the incumbents, or by a large new entrant. Citric Acid (2002/742/EC), Methionine (2003/674/EC), Soda Ash (2003/5/EC), Vitamins (2003/2/EC), and Plasterboard (2001/./EC) are good examples.

Barriers to entry

Unfortunately, the legal cases at our disposal tend not to provide direct information on the scale of barriers to entry within the markets under inspection. The cases indicate that entry/potential entry is disruptive in that it destabilises the collusive agreement,

often leading to the breakdown of the cartel (which we think of as 'internal' failure) and/or results in the cartel being discovered (which we think of as 'external' failure). Good examples of internal failure arise in the Methionine, Lysine, and Vitamins cases. In the Methionine case, for instance, after an initial smooth period that lasted from 1986 to 1989, the cartel became unstable in 1990, mainly owing to new entry. In Vitamins, in at least two cases (vitamin B6 and vitamin C), the cartels were eventually dismantled as a consequence of the fierce competition from Chinese importers, who disrupted the cartel agreements with their "low prices and increasing volumes".

In contrast in shipping, much of the activity is to prevent entry rather than to police cartel members. The main market for the provision of sea and coastal water transport can be broken down into liner transport and tramp vessel transport. A liner service is the transport of goods on a regular basis on specified routes. Sailing is almost invariably timetabled and advertised in advance. In contrast, a 'tramp vessel service' is the transport of goods in bulk in a vessel chartered to shippers on the basis of a voyage or time charter for irregular and/or non-advertised sailings. Liner cartels need to exclude tramp services. A good example of this exclusionary behaviour is the Cewal, Cowac and Ukwal Case (93/82/EEC) relating to sea transport of general cargo between France and several West and Central African countries. A meeting of the Special Fighting Committee would be convened to decide who would offer reduced 'fighting rates', below the independent's rates, and these ships sailed close to the date that the outsider was scheduled to sail. With regard to the lost revenues, all conference members contributed to the cost of the fighting ships. These cartels provide examples of what we think of as external failure. The activities of the cartel, designed to exclude potential competition, provide evidence and raise complaints from other suppliers. Here entry barriers are not driving cartel formation; frequently it appears almost the reverse.

We can conclude that entry and potential entry is damaging, in that it is destabilising of cartels and increases the incumbents' need to coordinate their activities, thereby making their collusive agreement more explicit and easy to prove. This argument corroborates the theoretical view that an increase in the number of market participants, either in the present or in the future, renders collusion harder to sustain. Without new entry (or the possibility of new entry) agreements existing among the incumbents are less likely to become sufficiently explicit to allow a case to be built against them.

Transparency and communication

Here there are two potential scenarios that might arise. One is that the need for transparency is so strong that one will never sees a cartel unless there is significant transparency in the market. An alternative is that cartels act to improve the transparency and hence one might expect that where cartels are convicted they have played an important role in the exchange of information over sales and price figures. There are many examples of the latter case.

For instance, in the Organic Peroxide case, meetings and information exchanges were very institutionalised. "Swiss consultancy Treuhand played a key role in the cartel from 1993 organising meetings, often in Zurich, producing 'pink' and 'red' papers with the agreed market shares which could not be taken outside Treuhand's premises and even reimbursing the travel expenses of participants to avoid leaving any traces about the illegal meetings". Similarly, in the Citric Acid cartel, the companies held regular and frequent meetings, which were the hallmark of the cartel's organisation. A sophisticated monitoring system was established, whereby each company would report its monthly sales figures to Hoffman-La Roche, who would then contact the companies and provide each company's sales figures for the corresponding month. The data were subsequently compared to the aggregate sales figures published by European Citric Acid Association Manufacturers (ECAMA). Because the cartel members made up a significant part of total ECAMA sales, any cheating would be quickly identified.

Shipping is different from many markets in that an element of transparency and communication, indeed what one might think of as cartel-like behaviour, is sanctioned.[1] The problems in these markets appear to arise most frequently from these conferences and consortia overstepping the mark in terms of agreements, in particular entering into agreements that limit competition and/or raise prices in a manner that harms users rather than providing benefits to them.

The case studies appear to suggest that cartel behaviour is more common in markets that are not fully transparent. The apparent contradiction with the theoretical analysis is the result of two conflicting forces, which influence the relationship between

[1] The EC provides block exemptions for certain agreements in this market.

transparency and the incidence of convicted cartels in opposite ways. On one hand, transparency facilitates collusion, as it makes it easier for the cartel members to monitor each other's activities. This observation suggests that we should expect collusion to be more likely in markets characterized by transparency. On the other hand, however, the cases indicate that many cartels were convicted thanks to the lack of transparency within their market, and their resulting need for frequent and institutionalized communication.

Size

The case studies confirm the theoretical prediction that the likelihood of collusion is inversely correlated with the number of firms and the degree of concentration in the market. However, a note of caution is needed in that the EU cases almost by definition are dealing with large firms. This may bias the evidence in favour of large firms. An industry with large firms does not have to exhibit high concentration, since the former is an absolute scale measure of a company whereas concentration is a relative measure within the industry. Thus the EU focus on large firms does not necessarily also bias the cases towards more concentrated industries. However, one should expect some bias of this type. Hence one has to be careful in using the case studies to indicate that cartels arise where one has large firms with high market shares. However, it is interesting that case studies are drawn from industries where there are few players.

Asymmetries

Different sizes between companies in a market is often taken as an indication that there are cost asymmetries between the parties. Cost asymmetries are frequently seen as making cartels less stable and difficult to form. Therefore, one may have expected to find a low correlation between industries with cartels and heterogeneous market shares of the leading firms. However, we clearly observe a considerable heterogeneity in the market shares held by cartel members. For instance, the citric acid case, the Methionine cartel, the Far Eastern Trade Tariff Charges and Surcharge Agreement (FETTCSA) case (2000/627/EC) and the Ferry Operators – Currency Surcharges case (97/84/EC) all exhibit considerable diversity of market shares between members of the cartels. This may suggest that the any relationship between cartel formation and homogenous shares is weak, although one always has to bear in mind that the cartels we observe are biased towards those that are unstable.

Another basic asymmetry between parties that could arise is in the products that they sell. Product differentiation has been thought of as an important issue but that no clear picture has emerged as to the effect on cartel formation. Most of the cases we are dealing with have relatively homogeneous products. Shipping has limited product differentiation and this is mostly true of basic chemicals. Exchanging Eurozone currencies, French Beef, Plasterboard, Steel Tubes, Carbonless Paper, Petrochemicals - the list of cases where there is limited scope for differentiation in the product is large. R&D is often taken as a measure of product differentiation, i.e., high R&D expenditures in an industry imply high product differentiation. We do not have a formal measure of product differentiation but the evidence on R&D for the industries covered in the case studies implies that R&D expenditures as a percentage of turnover were typically well below average.

5. Assessment

Using the evidence from the three approaches, what have we learnt in terms of assessing whether a market is likely to have a cartel that may be discovered and convicted? Each approach brings different insights and these need bringing together and balancing. Theory, the case studies and, in a limited sense through the R&D findings, the econometric analysis suggests homogeneous products are important. Similarly, the three approaches suggest sustained volatility is not likely to be associated with cartel behaviour. Finally, theory and the case studies indicate that stability among the leading players is important. We can think of these three features as fundamental characteristics. Then there are other features that are identified as important in some of the approaches. We can think of these as providing collaborative evidence. Finally, there are certain features that may give insight into when a cartel is likely to be formed. Here we pull these three (i.e., fundamental background, collaborative evidence and why and when) together in a sequential manner.

Clearly, each situation will be special and economic factors are only one part of the story. However, while it is a mistake to think that observable economic factors can define cartel location, it is clear from the three approaches that common factors emerge that will help inform whether a market is likely to have a cartel. We identify critical areas of assessment and group these into three sections – the fundamental background, the collaborative evidence and the why and where factor.

As indicated, the fundamental background reduces to three core issues – product, volatility and company criteria. The first core question is whether the industry has a homogeneous product or not. Cartels are far more likely if the product is fairly homogeneous between companies in the market. Considerable product differentiation has the opposite effect. Second, does the industry display volatile turnover over a sustained period of time? Cartels are more likely if output and market conditions are normally stable. This does not preclude occasional shocks to the market but these are not the norm. Also the lack of volatility does not imply a constant turnover but when there is decline it is likely to be persistent and relatively constant. Finally, are the leading players in the market large and relatively constant? If there are significant changes in market shares or regular exits and entrants then cartels are less likely. If year-on-year most of the players in the market remain constant then the opposite follows. Note, that this is long run relationship and they may be occasional years (possibly preceding cartelisation) when firms leave the industry.

We see these three factors as almost basic requirements for cartel formation so when considering whether the fundamental background of a market is consistent with cartel behaviour we suggest from our analysis that a market needs at least two high scores out of three to be likely to favour collusion.

The research has identified a series of factors that are associated with cartelisation or to be more precise discovery of cartels. None of these are essential but have been shown to be relevant factors. These are:

- Transparency – What is the level of transparency? If there is almost no transparency then cartels are less unlikely.

- Payroll effects – The statistical modelling identified payroll effects, i.e., relatively high payroll per employee, as factors. If these are comparatively high in the market then cartels are more likely.

- Big firms/number of firms in industry. Cartels more likely if concentration is large and/or there are relatively few firms in the market/industry.

- Barriers to entry – High barriers to entry, or the ability to construct such barriers, make cartels more likely.

- Capacity – Evidence of excess capacity makes cartels more likely. If capacity is apparently being used to the full with little scope for extra production then the opposite holds.

- Ranking in econometric model

Overall a market that scores highly on these collaborative factors indicates that cartels may be present, however, we would suggest that there is little scope for trade-off between fundamental background and collaborative factors.

If a market has the fundamental background and strong collaborative evidence then the question why and when still needs to be addressed. Are there good reasons for these particular companies to be colluding at the present time? What is the key factor? These questions are the hardest to answer. Clearly, higher and safer profit relative to the counterfactual is at the core of any cartel but this is not hugely informative. However, it does lead on to the question – why is higher and safer profit an issue for this market at this time? We see this as a more productive question in the context of identifying cartels. The question tends to focus on demand factors and we know these have been identified in the research as very significant.

There are two categories where there is good evidence: (i) where there been a long run decline in demand and/or prices affecting all or almost all companies and (ii) where there is a sudden market shock that affects all companies in the market.

The idea that these will bite in markets that score highly in the three fundamental background tests is both believable at an intuitive level and is strongly backed up by the case study evidence. Where products are relatively homogeneous, there is little volatility in demand and the parties are familiar with each other the drive to jointly address a relentless trend in the market is shown to be strong.[2] Similarly, if all companies are hit by a sudden shock that clearly requires response then the drive to find out how others are thinking of responding and to take the next step of co-ordinating responses will be strong. Therefore it makes sense to look for a decline or shock to the industry to highlight whether and when a cartel may have originated. Aside from these factors the research also indicates that the why factor should consider the need to build transparency in the market and improve entry barriers

[2] Note, that this conflicts somewhat with the theory and the econometric analysis although to some extent this issue is about when a cartel is formed, something that the econometrics is ill equipped to deal with. The effect is so prevalent in the case studies that it is hard to ignore.

where they are weak. Focusing on these questions may throw light on why a market needs to explicitly cartelise to achieve common objectives. However, in general, with the exception of demand factors the research provides less productive answers to the why and when question.

Overall, the three approaches taken in the report provide a framework that can help identify whether a particular market is likely or less likely to have a cartel. The three categories above provide help in assessing markets but one ought to emphasise again that economic factors can only provide part of the answer. In particular the why and when category can only focus on some factors that will be critical. The absence of these factors does not imply that a cartel is unlikely. That is, whereas the fundamental background and collaborative evidence could almost take the form of a 'tick list', the why and when questions should not be interpreted this way.