

Anticipated acquisition by Advanced Micro Devices, Inc. of Xilinx, Inc.

Decision on relevant merger situation and substantial lessening of competition

ME/6915/20

The CMA's decision on reference under section 33(1) of the Enterprise Act 2002 given on 29 June 2021. Full text of the decision published on 16 July 2021.

Please note that [X] indicates figures or text which have been deleted or replaced in ranges at the request of the parties or third parties for reasons of commercial confidentiality.

SUMMARY

1. On 26 October 2020, Advanced Micro Devices, Inc. (**AMD**) agreed to acquire sole control of Xilinx, Inc. (**Xilinx**) (the **Merger**). AMD and Xilinx are together referred to as the Parties and, for statements referring to the future, as the **Merged Entity**.
2. The Competition and Markets Authority (**CMA**) considered whether the Merger may give rise to a substantial lessening of competition (**SLC**) as a result of conglomerate effects. AMD supplies central processing units (**CPUs**) and Xilinx supplies field programmable gate arrays (**FPGAs**) globally. These products can be used by common customers in both datacentre and certain non-computer (so-called 'embedded') applications.
3. The CMA therefore considered firstly whether the Merged Entity could use its substantial position in the supply of FPGAs for datacentre applications (**Datacentre FPGAs**) to 'bundle' or 'tie' the sale of these with its CPUs for datacentre servers (**Datacentre CPUs**), thereby encouraging customers of Datacentre FPGAs to also purchase its Datacentre CPUs, at the expense of rival Datacentre CPU suppliers' ability to compete effectively.
4. The CMA believes that as the large majority of Datacentre CPUs are not acquired with Datacentre FPGAs, the Merged Entity will have neither the

ability nor the incentive to foreclose Datacentre CPU suppliers globally. Therefore, the CMA believes that the Merger does not give rise to a realistic prospect of an SLC as a result of conglomerate effects in the supply of Datacentre CPUs.

5. The CMA also considered whether the Merged Entity could use its substantial position in the supply of FPGAs for embedded applications to foreclose rival suppliers of CPUs for embedded applications (**embedded CPUs**) through a similar bundling and/or tying strategy. However, as embedded CPUs and FPGAs for embedded applications are also infrequently used together, the CMA believes that the Merger does not give rise to a realistic prospect of an SLC as a result of conglomerate effects in the supply of embedded CPUs. Finally, the CMA does not believe the Merger will give rise to a realistic prospect of an SLC as a result of any other theories of harm.
6. The Merger will therefore **not be referred** under section 33(1) of the Enterprise Act 2002 (the **Act**).

ASSESSMENT

Parties and transaction

7. AMD is a global semiconductor company, headquartered in California, United States and listed on NASDAQ.¹ AMD's turnover in 2020 was approximately £7.64 billion worldwide and approximately £[£] in the UK.² AMD is primarily active in the supply of CPUs based on the x86 instruction set architecture, and the supply of graphics processing units (**GPUs**).³
8. Xilinx is a global semiconductor company headquartered in California, United States and listed on NASDAQ. Xilinx's turnover in 2020 was approximately £2.5 billion worldwide and approximately £[£] in the UK.⁴ Xilinx is primarily active in the supply of, *inter alia*, FPGAs.⁵
9. The Parties entered into a transaction agreement on 26 October 2020 in which AMD has agreed to acquire sole control of Xilinx in an all-stock transaction valued at approximately £27 billion.⁶

¹ Merger Notice, 6 May 2020 (**MN**), paragraph 25.

² MN, response to question 6.

³ MN, paragraph 26.

⁴ MN, response to question 6.

⁵ MN, paragraph 33. Xilinx is also active in, *inter alia*, the supply of Smart Network Interface Cards (**SmartNICs**).

⁶ Set out in the MN, paragraph 45 and 47, as \$35bn and exchanged to GBP using the Bank of England's 2020 average USD/GBP exchange rate.

Jurisdiction

10. Each of AMD and Xilinx is an enterprise. As a result of the Merger, these enterprises will cease to be distinct.
11. The turnover test set out in section 23(1) of the Enterprise Act 2002 (**the Act**) is met on the basis that:
 - (a) Xilinx is a 'relevant enterprise'⁷ undertaking an activity specified under section 23A of the Act, including through its activities consisting of or including the 'owning, creating or supplying intellectual property relating to the functional capability of computer processing units';⁸ and
 - (b) Xilinx's annual UK turnover exceeds £1 million (being approximately £[~~1~~ in 2020]).⁹
12. The CMA therefore believes that it is or may be the case that arrangements are in progress or in contemplation which, if carried into effect, will result in the creation of a relevant merger situation.
13. The initial period for consideration of the Merger under section 34ZA(3) of the Act started on 11 May 2021 and the statutory 40 working day deadline for a decision is therefore 6 July 2021.

Counterfactual

14. The CMA assesses a merger's impact relative to the situation that would prevail without the merger (ie the counterfactual).¹⁰
15. In this case, the CMA believes the prevailing conditions of competition to be the relevant counterfactual.

Frame of reference

16. The assessment of the relevant market is an analytical tool that forms part of the analysis of the competitive effects of the merger and should not be viewed as a separate exercise from the competitive assessment.¹¹ Market definition involves identifying the most significant competitive alternatives available to customers of the merger firms and includes the sources of competition to the

⁷ [Mergers: Guidance on the CMA's jurisdiction and procedure \(CMA2\)](#), December 2020, paragraph 4.4 and 4.5.

⁸ Section 23A(2)(c)(i) of the Enterprise Act 2002.

⁹ MN, response to question 6.

¹⁰ Merger Assessment Guidelines (CMA129), 18 March 2021 ([Merger Assessment Guidelines](#)), chapter 3.

¹¹ [Merger Assessment Guidelines](#), paragraph 9.1.

merger firms that are the immediate determinants of the effects of the merger.¹²

17. There are conglomerate relationships between the Parties as AMD supplies Datacentre CPUs and Xilinx supplies Datacentre FPGAs, and both products are purchased by common customers for use in datacentres. AMD also supplies, to a lesser extent, embedded CPUs and Xilinx supplies FPGAs for embedded applications for use in certain non-computer devices in which both CPUs and FPGAs are used.¹³
18. As the focus of the CMA's investigation of the Merger is on the supply of CPUs and FPGAs, the CMA has focused on these products in its assessment of the frame of reference. In line with the approach set out in the CMA's Merger Assessment Guidelines, the CMA's assessment of whether the Merger may be expected to result in an SLC in any market(s) in the UK does not depend on a highly specific description of any particular market definition (including, for example, descriptions of the precise boundaries of the relevant markets).¹⁴ The CMA has identified the appropriate frames of reference for its assessment of the Merger below in this context.

Product scope

CPUs

19. CPUs are the main semiconductor component in an electronic device (primarily, computer systems) and are responsible for processing tasks. They are a vital component across a range of applications, from datacentre servers to embedded applications. The Parties submitted that there is a distinct product market for CPUs, but that the question of whether this should be further segmented – including, so as to identify distinct markets for Datacentre CPUs and embedded CPUs respectively – can be left open.¹⁵
20. The CMA notes that the extent of CPU suppliers' activities can differ across fields of application, which indicates that the competitive dynamics between these may differ. For example, AMD generates a significantly larger proportion of its CPU revenues from Datacentre CPUs than from embedded

¹² [Merger Assessment Guidelines](#), paragraphs 9.2.

¹³ An embedded CPU is a CPU designed for use in an embedded application such as in aerospace, defence and medical imaging applications, as opposed to a PC, server, or mobile device. AMD's activities in embedded applications are limited, accounting for less than [0-5]% of AMD's total annual sales in 2020 (MN, Annex 21, paragraph 7.6).

¹⁴ [Merger Assessment Guidelines](#), paragraph 9.5.

¹⁵ MN, paragraph 138, page 70.

CPUs¹⁶ and not all suppliers supply both Datacentre CPUs and embedded CPUs.¹⁷ AMD's internal documents also distinguish between their CPU activities in different applications (including, as between datacentre and embedded applications).¹⁸ The Parties submitted that embedded CPUs also require certain technical characteristics that may limit demand-side substitutability.¹⁹

21. The CMA has, therefore, considered the impact of the Merger on the supply of each of Datacentre CPUs and embedded CPUs separately. However, it was not necessary for the CMA to reach a conclusion on the precise product frame of reference since, as set out below, no competition concerns arise on any plausible basis.

FPGAs

22. FPGAs are a type of programmable logic device that offer a wide range of logic capacity, features, speed, and voltage and can be programmed after fabrication to perform logic and processing task characteristics, including for the acceleration of CPUs to perform specialised functions. FPGAs can be interconnected with CPUs to accelerate certain tasks in both datacentre and embedded applications.
23. The Parties submitted that FPGAs comprise a distinct product market from other accelerators (including GPUs on the one hand, and other accelerators such as application specific integrated circuits (**ASICs**) and application specific standard products (**ASSPs**)).²⁰ The Parties further submitted that the product market for FPGAs should not be further segmented (including, by field of application) but that the exact scope of the product market definition for FPGAs can be left open.²¹
24. The CMA's merger investigation indicates that third parties consider that, although there may be a limited degree of substitution between FPGAs and other accelerators (such as GPUs, ASICs and ASSPs) for certain functions, each type of accelerator serves different customer needs, and the choice of accelerator is based on a customer's preference and requirements.
25. The CMA further notes that there is a degree of variation between the scope of some FPGA suppliers' activities across applications – including as between

¹⁶ In 2020, AMD generated approximately \$[REDACTED] from Datacentre CPUs compared to \$[REDACTED] from embedded CPUs (MN, Annex 23).

¹⁷ For example, certain CPU suppliers such as [REDACTED] supply CPUs for datacentres but have no activities in embedded CPUs (Embedded CPU competitor questionnaire, question 2).

¹⁸ For example, see [REDACTED].

¹⁹ Such as longevity and mechanical and thermal robustness (MN, Annex 22, paragraph 21.9).

²⁰ MN, paragraph 152, page 73.

²¹ MN, paragraphs 151 – 153, page 73.

Datacentre FPGAs and FPGAs for embedded applications – which indicates that the competitive dynamics between these may differ.²² Xilinx’s internal documents also distinguish between their FPGA activities in different applications (including, as between datacentre and embedded applications).²³

26. The CMA has therefore considered the impact of the Merger on the supply of Datacentre FPGAs and, separately, FPGAs for embedded applications. However, it was not necessary for the CMA to reach a conclusion on the precise product frame of reference, since, as set out below, no competition concerns arise on any plausible basis.

Geographic scope

27. The Parties submitted that the relevant geographic frames of reference for the supply of CPUs and FPGAs are global, in line with European Commission precedent concluding so on the basis of the global nature of supply and demand irrespective of the location of the component vendor or the location of the end customer.²⁴
28. The Parties’ submissions on geographic scope are consistent with the evidence received by the CMA. The CMA therefore believes that the geographic frame of reference is global.

Conclusion on frame of reference

29. For the reasons set out above, the CMA has considered the impact of the Merger in the following frames of reference:
- (a) the supply of Datacentre CPUs on a global basis;
 - (b) the supply of embedded CPUs on a global basis;
 - (c) the supply of Datacentre FPGAs on a global basis; and
 - (d) the supply of FPGAs for embedded applications on a global basis.
30. However, it was not necessary for the CMA to reach a conclusion on any of these frames of reference since, as set out below, no competition concerns arise on any plausible basis.

²² For example, certain FPGA suppliers such as Microsemi supply FPGAs for embedded applications but have more limited activities in Datacentre FPGAs (see <https://www.microsemi.com/>).

²³ For example, see [§].

²⁴ MN, paragraphs 154 and 155, page 73.

Competitive assessment

Conglomerate effects

31. The concern with a conglomerate theory of harm is that the merged entity may restrict its rivals in one market from accessing customers using its strong position in another related market. The merged entity could do this through linking the sales of the two products in some way, thereby encouraging customers to purchase these products together, at the expense of rivals. The CMA will typically use an ‘ability, incentive and effect’ framework to analyse a conglomerate theory of harm.²⁵
32. The CMA has considered whether the Merger may give rise to conglomerate effects through:
- (a) the Merged Entity leveraging its position in Datacentre FPGAs to bundle these products with its Datacentre CPUs, thereby restricting rival Datacentre CPU suppliers’ ability to compete effectively; and
 - (b) the Merged Entity leveraging its position in FPGAs for embedded applications to bundle these products with embedded CPUs, thereby restricting rival embedded CPU suppliers’ ability to compete effectively.²⁶

Potential foreclosure of rival suppliers of Datacentre CPUs

33. As noted above at paragraph 17, a conglomerate relationship arises between AMD and Xilinx as they supply Datacentre CPUs and Datacentre FPGAs respectively, both of which can be deployed in datacentres and purchased by common customers.²⁷ The Parties submitted that there is no possibility that

²⁵ [Merger Assessment Guidelines](#), paragraphs 7.30-7.32.

²⁶ As explained in more detail in the competitive assessment, the large majority of Datacentre CPUs are not acquired with Datacentre FPGAs, and the CMA therefore does not believe the Merged Entity could leverage its substantial position in the supply of Datacentre FPGAs ([50-60]% globally in 2020 (MN, Annex 23)), to foreclose Datacentre CPU suppliers. In light of AMD’s consistently substantially smaller share of supply of Datacentre CPUs ([5-10]% globally in 2020 (MN, Annex 23)) and the absence of evidence to indicate this share will materially change in the future, the CMA believes the Merged Entity would have neither the ability nor incentive to leverage its position in Datacentre CPUs to foreclose rival Datacentre FPGA suppliers. Similarly, in light of AMD’s consistently very small (<[0-5]%) share in the supply of embedded CPUs globally between 2018 and 2020 (MN, Annex 23) and the absence of evidence to indicate this share will materially change in the future, the CMA believes the Merged Entity would have neither the ability nor incentive to leverage its position in embedded CPUs to foreclose rival suppliers of FPGAs for embedded applications. With respect to the Parties’ share of supply estimates, the CMA notes that it has found some discrepancies between the Parties’ estimates and self-reported revenues from the Parties’ competitors. While some weight can, therefore, be placed on the relative magnitude of the Parties’ shares of supply estimates for the purpose of this decision, the CMA has put less weight on the absolute numbers.

²⁷ AMD also supplies GPUs for datacentres. However, in light of (i) AMD’s limited shares of supply in GPUs for datacentres ([0-5]% in 2020 (MN, Annex 23)), (ii) the lack of any evidence indicating that this will materially change in the future and (iii) the CMA’s understanding that as accelerators, FPGAs and GPUs can typically be used as alternatives (rather than complements) to each other for datacentre applications (MN, paragraph 13; [X])

rival Datacentre CPU suppliers would be foreclosed following the Merger because the majority of datacentre servers do not use FPGAs.²⁸

34. In light of Xilinx's substantial position in the supply of Datacentre FPGAs,²⁹ the CMA has considered whether the Merged Entity could have the ability to link the Parties' Datacentre CPU and Datacentre FPGA products through bundling or tying, to foreclose Datacentre CPU rivals from competing effectively.
35. The evidence the CMA received in its merger investigation indicates that the large majority of Datacentre CPUs are not used with Datacentre FPGAs.³⁰ Accordingly, as very few customers purchase both Datacentre CPUs and Datacentre FPGAs together, the CMA believes that Datacentre CPU competitors would not be deprived of a large volume of sales if the Merged Entity were to bundle/tie its offering.
36. In addition, all responding customers said that when designing a Datacentre server, their choice of Datacentre CPU supplier is much more important than their choice of Datacentre FPGA supplier.³¹ The CMA therefore believes that even if the Merged Entity pursued a bundling/tying strategy, customers would be unlikely to switch from their current Datacentre CPU supplier. This would limit the profitability of a foreclosure strategy because the Merged Entity would be likely to lose Datacentre FPGA sales rather than gain Datacentre CPU sales.³² In addition, the CMA did not see any evidence of a strategy to foreclose rival Datacentre CPU suppliers through tying or bundling in the Parties' internal documents.
37. The large majority of third party respondents did not raise concerns regarding any linkage of Datacentre CPU and Datacentre FPGA sales by the Merged Entity. Third parties also said that they would have sufficient alternatives to

questionnaire response), the CMA believes the Merged Entity would have neither the ability nor incentive to foreclose either (i) rival suppliers of GPUs for datacentres; or (ii) rival Datacentre FPGA suppliers by linking sales of these two product types.

²⁸ MN, paragraph 286. The Parties also submitted that a tying or bundling strategy by the Merged Entity would not be able to foreclose a sufficiently large fraction of sales of Datacentre CPUs to lead to anti-competitive effects on the tied market for Datacentre CPUs. MN, paragraph 277.

²⁹ [50-60]% in 2020, see MN, Annex 23. Xilinx's market shares for FPGAs overall have been persistently substantial at around [50-60]% between 2018 and 2020.

³⁰ Most third party respondents indicated that their Datacentre CPU purchases/sales were not used with Datacentre FPGAs. Of the minority of respondents that did use or sell these products together, only a small percentage of their Datacentre CPU purchases/sales were used with Datacentre FPGAs (eg '< 1%', '~10-15%' and a 'relatively low' percentage).

³¹ A number of customers contrasted the critical function of a CPU with the inessential role that an FPGA would perform in a server, with one customer [X] estimating that while a Datacentre CPU is present in over [90-100]% of servers for datacentre solutions, FPGAs are included in less than [1%] of datacentre solutions.

³² The CMA further notes in this context that AMD has a substantially more limited position in the supply of Datacentre CPUs and CPUs overall ([5-10]% and [0-5]% respectively in 2020 (MN, Annex 23)). The CMA has not received any evidence to indicate the Merged Entity would have a more attractive offering in Datacentre CPUs or CPUs overall than its Datacentre FPGA / FPGA offering.

the Merged Entity for both Datacentre CPUs and Datacentre FPGAs following the Merger, even if the Merged Entity were to engage in a bundling and/or tying strategy.³³ Intel is currently the largest supplier of Datacentre CPUs³⁴ and could offer a competing bundle in the event of the Merged Entity engaging in a bundling and/or tying strategy, as it offers its own Datacentre FPGAs.

38. For the reasons outlined above, the CMA therefore believes the Merged Entity would have neither the ability nor incentive to leverage its position in Datacentre FPGAs to foreclose suppliers of Datacentre CPUs through a bundling/tying strategy. In particular, the CMA considers that there will be sufficient Datacentre CPU sales which are not associated with Datacentre FPGA sales to prevent foreclosure. Accordingly, the CMA believes that the Merger does not give rise to a realistic prospect of an SLC in the supply of Datacentre CPUs as a result of conglomerate effects.

Potential foreclosure of rival suppliers of embedded CPUs

39. The CMA also considered whether the Merged Entity could leverage Xilinx's position in the supply of FPGAs for embedded applications to foreclose rival embedded CPU suppliers through a bundling/tying strategy. Xilinx's shares of supply of FPGAs for embedded applications are broadly comparable to its substantial position in Datacentre FPGAs.³⁵ However, the CMA does not believe the Merged Entity would have the ability or incentive to engage in such a strategy. Following the same reasoning set out above in the context of datacentre applications, the evidence indicates that embedded CPUs are infrequently used with FPGAs for embedded applications. AMD's presence in the supply of embedded CPUs is also very small.³⁶ The CMA therefore believes there will be sufficient embedded CPU sales which are not associated with sales of FPGAs for embedded applications to prevent foreclosure of embedded CPU rivals. In addition, Intel has a larger presence in embedded CPUs and, as a supplier of FPGAs for embedded applications, could also offer a competing bundle in the event of the Merged Entity engaging in such a foreclosure strategy.³⁷ The CMA also did not see any

³³ [REDACTED] (FPGA customer questionnaire, question 10): there are multiple available competitors to AMD and Xilinx; [REDACTED] (CPU customer, question 11) described the market as 'competitive' with other legitimate suppliers for both Datacentre CPUs and Datacentre FPGAs.

³⁴ The Parties estimated Intel had estimated shares of supply of [90-100]% (MN, Annex 23).

³⁵ The Parties estimated Xilinx's share in the supply of FPGAs for embedded applications globally was [40-50]% in 2020 (MN, Annex 21).

³⁶ As noted above (footnote 14), AMD has consistently had a share of <[0-5]% in the supply of embedded CPUs between 2018 and 2020 (MN, Annex 23), according to the Parties' estimates, and the CMA has received no evidence indicating this share will grow materially in the future.

³⁷ The Parties estimated Intel's share of embedded CPUs to be approximately [10-20]% in 2020 (MN, Annex 23).

evidence of a business strategy to foreclose rival suppliers of embedded CPUs post-Merger in the Parties' internal documents.

40. As such, the CMA believes the Merged Entity would have neither the ability nor incentive to leverage its position in FPGAs for embedded applications to foreclose suppliers of embedded CPUs.
41. Accordingly, the CMA believes that the Merger does not give rise to a realistic prospect of an SLC in the supply of embedded CPUs as a result of conglomerate effects.

Third party views

42. The CMA contacted customers and competitors of the Parties. The large majority of third parties that responded to the CMA's merger investigation did not express concerns regarding the Merger and some suggested that the Merger would be pro-competitive. Third party comments have been taken into account where appropriate in the competitive assessment above.
43. One third party raised concerns that the Merged Entity could, by leveraging its position in the supply of Datacentre CPUs, foreclose rival suppliers of SmartNICs through offering a combination of Datacentre FPGAs and Datacentre CPUs to customers that the third party suggested might otherwise combine a Datacentre CPU with a SmartNIC.³⁸ However, as noted above, the CMA does not believe the Merged Entity would have the ability or incentive to use its Datacentre CPU position to foreclose Datacentre FPGA suppliers given its small position in the supply of Datacentre CPUs.³⁹ The CMA therefore does not believe that the Merged Entity would have the ability or incentive to use its Datacentre CPU position to foreclose SmartNIC suppliers.
44. Another third party raised concerns that the Merged Entity would have an ability to bundle Datacentre CPUs, GPUs for datacentres and SmartNICs. However, the Merged Entity has a limited position in the supply of Datacentre CPUs and also GPUs for datacentres and SmartNICs.⁴⁰ Accordingly, the CMA does not believe the Merged Entity would have the ability or incentive to

³⁸ The CMA understands that SmartNICs can be used in datacentres to offload specific processing tasks that a system's CPU would normally handle. The third party's concern was based on their view that for certain critical functions, customers may choose between an FPGA and a SmartNIC, but typically would not use both ([~~38~~], CPU competitor questionnaire, question 4).

³⁹ As set out in greater detail in footnote 26 above.

⁴⁰ The Parties estimated that AMD's share of GPUs for datacentres was [0-5]% in 2020 (MN, Annex 23), down from [5-10]% in 2018. The Parties estimated that Xilinx's share of SmartNICs was [10-20]% in 2020 (RFI3 response) but stated that this was a 'highly conservative' estimate because the denominator for this calculation only includes ready-built SmartNICs, while the numerator includes both (i) Xilinx's ready-built SmartNICs and (ii) FPGAs which Xilinx understands were purchased to be integrated into SmartNICs by the customer. The Parties estimated that on a less conservative basis, using only third party data (rather than a combination of the Parties' own revenues and third party data), Xilinx's share of SmartNICs was [0-5]% (RFI3 response).

harm rival suppliers of any of these product types as a result of a bundling strategy.

Decision

45. Consequently, the CMA does not believe that it is or may be the case that the Merger may be expected to result in an SLC within a market or markets in the United Kingdom.
46. The Merger will therefore **not be referred** under section 33(1) of the Act.

Naomi Burgoyne
Director
Competition and Markets Authority
29 June 2021