

Executive Summary
The Global Economic Impacts Associated with Virtual and Augmented Reality

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Our study estimates the projected global economic impacts associated with the spread of virtual and augmented reality (“VR/AR”) technology over the next five years. VR describes a three-dimensional, computer-generated environment in which a person can become immersed, while AR is a real-world environment combined with computer-generated sensory input such as sound, video, and graphics, and is designed to enhance a person’s perception of reality by overlaying the real world with additional information. While both VR and AR are expected to have applications in gaming and entertainment, other anticipated uses include education, medicine, retail, military and industrial applications.

At the time a new innovation is introduced, its success is difficult to predict as it is unclear in which areas it will be used, the extent of its adoption, and the technologies and related ecosystems that will be developed that build upon it. To address this challenge in the case of VR/AR, we utilize a range of potential adoption scenarios and approaches to characterize the inherent uncertainty in any economic predictions.

Using three different potential adoption scenarios, we consider two approaches to measure the impact of VR/AR on GDP: a “conservative approach” that estimates economic impact only in the form of revenues from VR/AR headset sales, and a more optimistic “comparable approach” that infers additional economic impacts that could be realized as a result of VR/AR adoption. The conservative approach’s focus only on VR/AR headset revenues is conservative in that it does not account for the associated ecosystem that could develop around VR/AR, such as accessories and VR/AR applications, or the innovations that build on VR/AR and that cannot be easily predicted today. Under this scenario, we estimate global VR/AR revenues for 2016 to 2020 will total approximately \$2.8 billion in the low adoption scenario, \$10.3 billion in the medium adoption scenario, or \$24.0 billion if high adoption of VR/AR is realized.

For the comparable approach, we measure the effect of the ecosystem by looking at the size of the ecosystem that developed around smartphones and tablets. We view smartphones and tablets as sufficiently similar technologies to VR/AR to allow us to use an estimate of their economic impacts to infer the potential economic effects associated with VR/AR because, for example, like with smartphones and tablets, VR/AR is likely to also be used (1) for entertainment, such as gaming, as well as viewing television programs and movies, (2) for communication with co-workers, friends, and family, and (3) by professionals, in, for example, the education, healthcare, and retail sectors. Moreover, similar to smartphones and tablets, VR/AR is also expected to emerge as a platform for a myriad of applications, advertising, and commercial opportunities.

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Under the comparable approach, we develop an econometric model to estimate the relationship between GDP levels and smartphone and tablet sales. Using this estimated relationship, we then estimate the ecosystem multiplier associated with the average cost to a consumer of acquiring and using a smartphone or tablet over its life, relative to the average impact of a smartphone or tablet on GDP. This multiplier captures the additional GDP impact of smartphones and tablets over and above what consumers spend to own those devices. We find that the impact of an additional smartphone or tablet on GDP represents a multiplier of approximately 4.3 times the cost to the consumer of owning the device. In other words, for every \$100 spent on a device, an additional \$430 of total GDP benefit is generated. We then apply the economic impact from the multiplier to projected VR/AR headset revenues for 2016-2020; this yields an additional estimated global economic impact of VR/AR of \$11.8 billion, \$43.7 billion, and \$102.0 billion for the low, medium, and high adoption scenarios, respectively, in the 2016-2020 time period.

Thus, we estimate the total economic potential of VR/AR technology over the next five years could be \$14.6 billion for low adoption, representing the addition of \$2.8 billion in headset revenues and \$11.8 billion in additional multiplier effects. This total economic potential could reach \$54.0 billion for medium adoption or could be up to \$126.0 billion for high adoption. Our results are summarized below in Table 1.

Table 1
Estimated Economic Impact of VR/AR Technology (\$B)
2016 – 2020

	Low Adoption	Medium Adoption	High Adoption
[1] Conservative Approach (\$B)	\$2.8	\$10.3	\$24.0
[2] Comparable Approach (\$B)	\$11.8	\$43.7	\$102.0
[3] Estimated Total Economic Impact (\$B)	\$14.6	\$54.0	\$126.0

It is important to note that we have estimated the effect of VR/AR on the economy, as measured by GDP. However the impact of VR will extend beyond the economy, with experts predicting a range of social benefits. Some of these social impacts will have economic consequences, which may be accounted for in our estimates. However, there are also benefits to individuals and society that are not accounted for in our models, both tangible and intangible. We leave the estimation of these effects to future research.