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*Our Perspective on Issues Affecting Global Financial Markets*

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**KNOWLEDGE AND LEARNING IN THE 21ST CENTURY: AN OPTIMIST'S PERSPECTIVE**

Outrageous tuition costs. Mountainous student debt. Without help, higher education seems increasingly unattainable for many. Or is the future so dim? We contend that whether you are a farmer in Kenya, a dancer in Delhi or a software programmer in Berlin, learning something—anything—is cheaper, easier, faster, and more customized than ever before.

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# Knowledge and Learning in the 21st Century:

## An Optimist's perspective

Outrageous tuition costs. Mountainous student debt. Without help, higher education seems increasingly unattainable for many. The future looks dim—and along with it the future of the U.S. and global economy. A less educated workforce is a less productive one. Productivity—producing more with less—is at the root of prosperity and growth.

Or is the future so dim? We contend that whether you are a farmer in Kenya, a dancer in Delhi or a software programmer in Berlin, learning something—anything—is cheaper, easier, faster, more accessible and more customized than ever before. What's more, once created, knowledge is more durable and shareable. Collaboration on a massive scale is also more feasible than ever before in history.

The knowledge and information renaissance underway will bear fruit for decades to come. The lesson: while knowledge and learning are necessary to propel economic progress, such progress can still occur even given the high-priced constraint of traditional educational institutions.

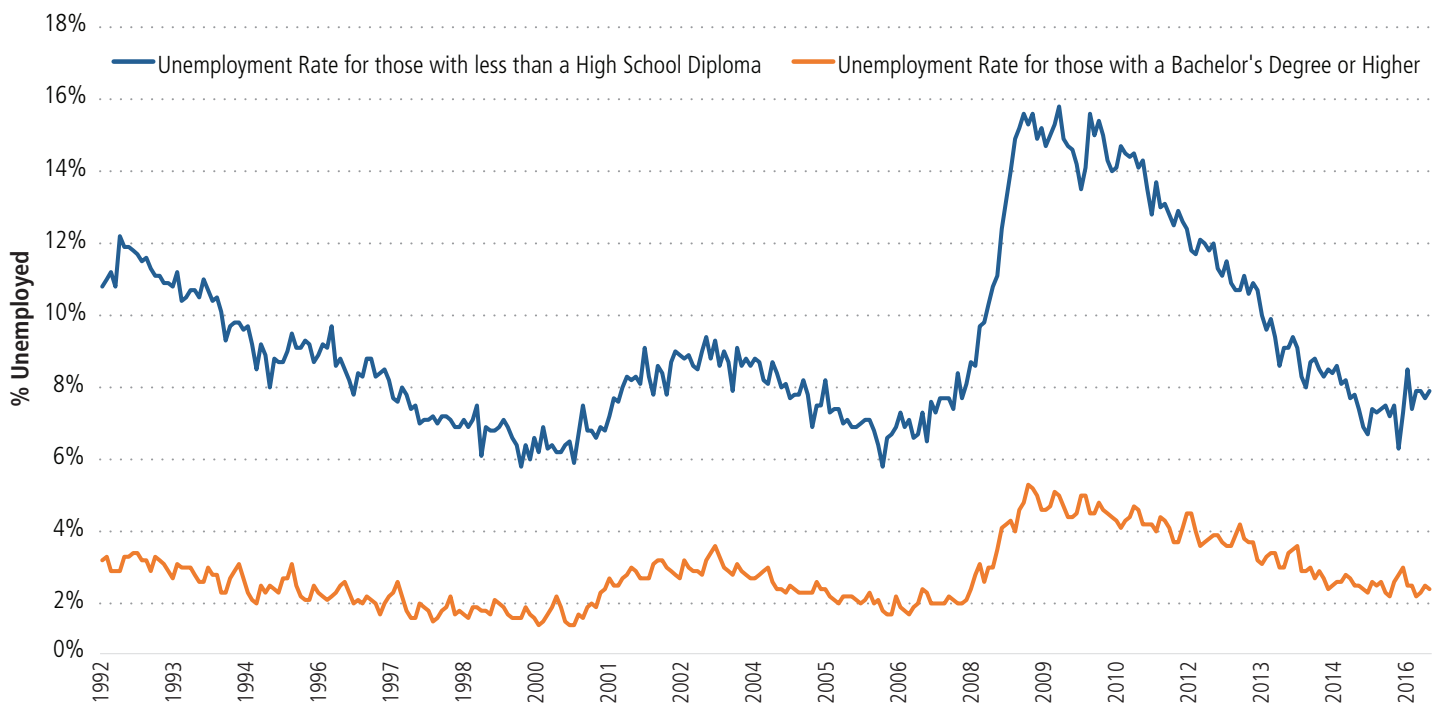
### INFLATED COSTS

In the words of Barack Obama, “The fact is, college has never been more necessary, but it’s also never been more expensive.”<sup>1</sup> In 1972, a public, four-year university tuition cost just \$428 per year. Add in room and board and you racked up a \$1,405 tab.<sup>2</sup>

In 2016, the same public, four-year degree costs a student \$20,092 per year, with room and board included. A private four-year institution carries an even more exorbitant price tag, fetching \$45,370 with room & board included—per year. Often the cost is divided up into the portion of paid by students and the portion financed by student aid or loans. We ignore such a distinction because, as economists, we know that regardless of how the bill is paid, real resources, either a lender with savings considering possible investment opportunities or a parent with hard-earned cash, must be devoted to the cause.

And it only looks set to get worse. Vanguard estimates that in 20 years the annual cost of a private college will exceed \$120,000 per annum,

fig. 1 GET SCHOOLED: THE GAP BETWEEN THE EDUCATIONAL "HAVES" AND "HAVE NOTS"



Source: Bureau of Labor Statistics

or roughly half a million dollars for a four-year degree.<sup>3</sup> Are you saving enough?

As former President Barack Obama aptly stressed, never has a degree been so important. Among those workers with a bachelor's degree, the unemployment rate was just 2.4% as of February 2017. But for workers with only a high school education, the unemployment rate was twice as high, at 5.0%. Worse still, for those who have not completed high school, the unemployment rate is not only higher but rising, registering 7.9% in February 2017 compared to 7.3% one year ago (See Figure 1).

The gap between the college-educated “haves” and the non-high school educated “have nots” is wide. In short, not only is the sticker price of education excruciatingly high, but the costs of not achieving a college degree are staggering. So what could possibly be the optimist's reply to such startling education facts? The internet, of course...but first some history.

«OPEN SOURCE HAS TAKEN  
OVER THE WORLD.»

## FROM ALEXANDRIA TO FLORENCE: ORGANIZING THE WORLD'S INFORMATION

For most of history, the production of knowledge and learning was fragile and sporadic. Even if a brilliant individual or group of individuals toiled away on new ideas, they did so in obscurity and ultimate futility. Ideas often died with their inventor.

Isolated projects to collect, curate, link and share the world's information were carried out but often fell short. The great library at Alexandria, built around 300 BCE boasted half a million scrolls on the shelves, roughly half of all books in existence at the time. The library went up in flames, whether by design or by accident, during the reign of Julius Caesar in 48 BCE.

Later the dream of education and enlightenment found few better friends than Lorenzo de Medici in Florence in the late 1400s. Lorenzo dispatched agents around the world to collect books and documents, make copies and share the volumes with scholars. As a result, Florence became a clearinghouse for ideas, both old and new, as well as the intellectual home of Galileo Galilei and Michelangelo.

As Joel Mokyr details in *Culture of Growth: The Origins of the Modern Economy*, “Nations and their economies grow in large part because they increase their collective knowledge toward productive ends.”<sup>4</sup> Most societies in history produced some limited technology but typically such achievements represent[ed] “one off” feats that “set-

tled down, and the growth [they] generated fizzled out.”<sup>5</sup> The brief, sporadic growth of shared knowledge goes a long way to explain the lack of economic progress exhibited prior to 1800.

Rather than growth, stagnation and lack of progress were far more common in history. As Mokyr summarized:

Stagnation occurs because the status quo can suppress further challenges to entrenched knowledge and blocks non-marginal advances using a range of means, from the threat to persecute heretics and the burning of their books, to subtle but effective mechanisms, such as meritocracies in which the key to personal success was the uncritical expertise in the existing body of knowledge inherited from the past.<sup>6</sup>

## UPENDING TRADITION

Where do we go from here? Today the world is different. Not only do institutions for the production and transmission of knowledge abound (albeit expensively), we have the internet, which infects and invigorates virtually every aspect of our lives. The message is that established, traditional institutions may not hold the keys to the future of knowledge and learning. We will provide examples in three areas where knowledge and education are flourishing: sharing, linking and collaborating.

## SHARING IS CARING

Instead of established media titans like ABC, CBS, NBC and the BBC, or even early internet pioneers like Yahoo and AOL, it was really you and I who revolutionized the web. What makes Twitter and YouTube wonderful is not the staff inside the building with “Twitter” emblazoned on it, but the users of the technology. User-generated content drives the web, with more than 60 trillion web pages residing on the internet.

UC Berkeley economists estimate that five years ago humanity stored “several hundred exabytes of information,” roughly equivalent to 80 “Library of Alexandrias,” for every person on the planet. Today, that figure has exploded to 320 “Library of Alexandrias” for each human being.

Included in that information bounty are sixty-five thousand user-created videos that appear on YouTube every day, which is roughly 400 new video hours every minute.<sup>7</sup> We, your faithful writers, tested the internet's chops on teaching. Applying snow chains to a vehicle before a trip into the mountains for a long weekend? A recipe for cooking a rib-eye steak in the oven? How to get in shape using just a pull-up bar? How to tie a bow-tie for special occasions (such as “Fed Day”<sup>8</sup> or your wedding)?

Sure, YouTube is not a traditional classroom, but on YouTube you can learn almost anything.

## LINKING: WIKI WACKY

But the web is more than just a treasure-trove of user-generated educational content, it's a global web of knowledge. Internet pioneer Ted Nelson was convinced that "every document in the world should be a footnote to some other document, and computers could make links between them visible and permanent."<sup>9</sup>

The links or connections matter most because, as technologist and co-founder of Wired magazine Kevin Kelly argues, it's not enough to have a collection of facts. "Science is on a long-term campaign to bring all knowledge in the world into one vast, interconnected, footnoted, peer-reviewed web of facts. Independent facts, even those that make sense in their own world, are of little value to science."<sup>10</sup>

Today the dream of a web of connected information has been realized in Wikipedia. Launched in 2001, at last count in 2017 it sported more than 40 million articles in 293 languages.<sup>11</sup> It has even been cited in some cases by the U.S. Supreme Court.

Prior to its discontinued print publication, the Encyclopedia Britannica set cost \$1,400 in 2015, a hefty price tag for the average household. Worse, for that price, you received a stale, soon-to-be-out-of-date collection of facts curated by editors. With Wikipedia, you get a living, breathing, changing, constantly-updated, rarely-wrong-but-quickly-corrected, durable encyclopedia of interconnected facts. Almost as many hyperlinks to additional references adorn each Wikipedia page as words. As a result, more information is available than ever before to the wondering mind and at bargain basement internet pricing: free.

## COLLABORATING: THE RISE OF OPEN SOURCE

Sharing and linking lead to our third example of the knowledge and information revolution underway: collaborating.

Bill Gates once labeled free software pioneers—that is, those people who created and gave away for free their software—as "new, modern-day sort of communists." But the reality is today many of the software programs you depend upon originated in the free software movement, or what is more commonly called today "open source." Open source means the original software is freely distributed and can be used and/or modified by anyone.

One example of successful open source software is the operating system debuted by software programmer Linus Torvald in 1991 called Linux (riffing off of the widely-used but centrally-controlled operating system called Unix at AT&T). Today, Linux powers 67% of all web servers. You can also find Linux in your smart TV, Nest thermo-

stat, Amazon's Kindle, drones, PlayStation 4, Google Home, Amazon Echo, Apple Watch, Apple TV, and even your Tesla, Ford, Honda or Toyota auto. Android, which is Google's mobile operating system based on Linux, accounts for 84% of the smartphone market as of 2016. Open source has taken over the world.

More fascinating than the ubiquity of open source software in our daily lives is the way it's produced. What "open source" means is that thousands of workers collaborate daily on projects all over the world. According to Black Duck Open Hub, more than 650,000 people contributed to a half a million projects worldwide last year. To put open source employment in perspective, that's twice the number of people employed at Amazon and 50% more employees than all of McDonald's stores combined.

This army of open sourcers isn't directed by top-down edicts of a CEO; instead, progress occurs bottom-up via online knowledge and learning. One popular bazaar for open source projects is GitHub. Created in 2008, the online hub connects nearly 2 million software programmers on thousands of projects. Anyone can "commit" to a project by submitting code (ideas) or "fork" an existing piece of software (meaning copy the existing file) and update/add/augment it as they see fit. Anonymous programmers anywhere in the world can contribute to projects—where contributions matter more than college degrees—and established companies themselves are tapping into Github as a way to produce new code.

## STICK A FORK IN ME


In a discussion on the difference between the books that adorned the library at Alexandria and books that still dot the shelves of the modern equivalent, Kevin Kelly remarked, "One quirk of networked books is that they are never done, or rather that they become streams of words rather than monuments."

So, too, with open source projects. At some point in the past it was necessary for an elite to collect information, preserve it, and share it with a precious few. Today, though, with the ever-growing array of information available, information has been liberated. Instead of the contents at Alexandria or in Florence being available only to the narrow elites, our current book of knowledge is available to any and all, for free. Every person on the planet will soon have access. Learning means self-directed inquiry. It can take place anytime, anyplace, whether in your living room or at the local coffee shop.

Knowledge is ever-changing and learning never ends—certainly not at university graduation. So earning a high-priced degree may still be required as a rite of passage to corporate America, but knowledge has never been more durable and widely available, nor learning easier.

Perhaps more importantly, viewing knowledge and learning this way shows that knowledge is more like an organism, growing and changing, rather than a fixed body of information to be doled out by our elders in bite-sized pieces over four years.

For the 21st century (and beyond), to focus on the traditional educational institutions as the key to learning and growth is to look in the wrong place. Instead, look to sharing, linking, and collaborating as the new foundations of knowledge and learning.

Such foundations provide bright futures for economic progress, says the optimist. 

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Emerging Markets Local Bond Fund

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### TAX-EXEMPT FIXED INCOME

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### US FIXED INCOME

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Cash Reserves Money Market Fund

Core Bond Fund

Corporate Bond Fund

Floating Rate Fund

GNMA Fund

High Income Fund

Limited Maturity Fund

Low Duration Fund

Strategic Income Fund

US Government Fund

## DUBLIN DOMICILED UCITS FUNDS

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World Equity Fund

### FIXED INCOME

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Global Emerging Markets Bond Fund

Global Emerging Markets Corporate Bond Fund

Global Government Bond Index Fund

Global High Yield Bond Fund

Global Inflation-Linked Bond Fund

Global Bond Fund

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