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A Wall Street Rocket Scientist in King Arthur's Court

What if Hank Morgan had been a quant?

In 1889, Mark Twain published one of the first stories involving time travel, *A Connecticut Yankee in King Arthur's Court*, beating H. G. Wells and his *Time Machine* by six years. It was the fourth-best-selling of his novels, after *Huckleberry Finn*, *Tom Sawyer* and *The Prince and the Pauper*.

Like the last book, it is usually considered a fine children's adventure story, mixed with a little history, comedy and American common sense.

In fact, it is a deeply bitter book, the blackest of Twain's brilliant comedies. Hank Morgan, a cheerful and energetic factory foreman from 19th century Connecticut, wakes up in sixth century England during the reign of King Arthur. Twain did not strive for historical accuracy (just as well since the modern legend of Arthur combines several historical and fictional aspects stretching over nearly a millennium). The preface states, "It is not pretended that these laws and customs existed in England in the sixth century; no, it is only pretended that inasmuch as they existed in the English and other civilizations of far later times, it is safe to consider that it is no libel upon the sixth century to suppose them to have been in practice in that day also. One is quite justified in inferring that whatever one of these laws or customs was lacking in that remote time, its place was competently filled by a worse one."

Fortunately, in 1889 and since, everyone has ignored the unpleasant stuff and concentrated on the thought experiment of what modern ideas would be useful in past eras. Twain's book created a subgenre of fiction, which includes several of



It looked as if the plan to introduce simple options in the Dark Ages was off to a bad start ...

the most popular *Star Trek* episodes. Scientists, soldiers, historians, artists, musicians and ordinary people have been thrown back in time by science, magic, imagination, travel to a lost place or new planet or unspecified means. They have traveled to every historical era including many, like King Arthur's court, that never existed. Some changed their adopted times, some assimilated and some returned home. All, as far as I can tell, and including Hank Morgan, fell in love.

King Arthur on Wall Street

A couple of years ago, I happened to be reading some contemporary reviews of *Connecticut Yankee*. In the January 13, 1890 issue of the

London Telegraph, an unsigned review commented, "Were King ARTHUR to descend in New York to-morrow he would make for Wall-street." This seems to be suggesting a variant of the going back in time story, there are also many stories of people from the past being transported to modern times, by the means above plus being frozen. What would the King do on Wall Street? Corporate raider? Trader? Hedge fund manager?

Fascinating as those questions are, I am more interested in the forward (or is it backward) version: what would happen to a modern financial quant, transported back in time to King Arthur's court? This is a serious question. Do we know anything in quantitative finance that is useful

or interesting on its own? Or does everything we do represent a small and arbitrary cog in a large machine? Have we addressed basic human questions of interest to the ages? Or are our skills specific to our era, about as useful in the sixth century as knowing the keystrokes to use Windows without a mouse or the names of all the Academy Award winners for costume design?

There are rules to this game. Our Morgan cannot take anything with him, including specific knowledge of historical events. We won't give him exceptional extra-financial knowledge, like how to make a workable cannon with his bare hands from common forest materials. We cannot assume common sense is so scarce in the sixth century that simple tricks convince everyone that Morgan is a God. We cannot simply rebuild all of 21st century society, or urge everyone to move faster on the development path that was taken anyway.

Suppose, for example, that you knew how to make radios from raw materials. I don't know that it is possible to do it efficiently without a large industrial infrastructure, but it might be. You'd have to know how to make glass vacuum tubes, and precision calibration equipment, and electrical generators, and lots of other stuff; but it's conceivable to me that you could teach a group of sixth-century workers to do it. It's also conceivable that if you knew how to do it, you could persuade people to help you with demonstrations of simpler appliances or principles.

If you did, people would use it, and it could have profound effects on society. Development might take an entirely new direction. Ideas would spread faster than conquest. Efficient centralized administration would be possible. You might not need transportation like railroads to carry the coal and iron to giant factories to make steel for more railroads. You might be able to leapfrog the industrial revolution with a more dispersed and human-scale economy. Or not. But it's a reasonable speculation.

Dark Age finance

Do we have anything in modern quantitative finance as useful as a radio? In Twain's version of King Arthur, there are no traces of Roman institutions left in England. The economy is organ-

ized around self-sufficient villas, manors, monasteries and villages. There is temporary internal and external peace due to a strong King who has won many battles. But there are no large-scale institutions to preserve either peace should the King falter or die. In particular, there is no system for succession.

To develop, people need to specialize, making the most of their comparative advantages. They must trade the surplus of their specialized production for necessities and luxuries produced by others. This requires trade which is facilitated by the development of towns, markets (the physical kind), transportation networks, communication and commercial law. The growth in exchange is nurtured by high-quality money (as store of value, medium of exchange and numeraire), bills of exchange, trade financing, insurance and other financial tools.

None of this requires modern quantitative finance. It was well-known to Adam Smith, or at least David Ricardo, over 200 years ago. In outline, if not in analytic detail, it was probably known to sixth-century merchants, not to mention Romans and other ancient peoples. In any case, it can't help us with our game because it amounts to explaining the next thousand years of economic development in Europe and urging people to do it faster. Finally, it's hard to see how anyone except a hypnotist could talk someone into opening a bank or insurance company in the Dark Ages. There were plenty of simpler, time-tested opportunities for profitable businesses.

To leapfrog medieval market towns and renaissance banks, we would have to introduce modern portfolio theory. The obvious place to try would be the international ports. We know that these continued to operate after Roman times, English merchant goods have been found throughout the Mediterranean region. I have faith that in such places people understood the basic statistics of finance. Some ships come back, some don't. Some of the ones that come back are loaded with exotic and valuable cargo, some are not. The more ships you invest in, the more predictable the fraction that are profitable.

The idea that it is important to keep track of successes and failures is straightforward. It would take a lot of late night conversations over

ale to explain standard deviation, but I think it could be done. The pitch is that it is thousands of times more profitable to package risk and sell it to investors than to bet your own money. Our Morgan would start by persuading merchants to gather accurate statistics on ship successes and failures, and to issue securities representing fractional interests in voyages.

The history of finance is the history of sales. There are lots of great ideas, it's not until someone pays enough to attract aggressive sales people that the ideas bear fruit. We're going to use gamblers for our salespeople. We know there were lots of them in England at the time. They would have a practical appreciation for the statistics necessary to understand Modern Portfolio Theory. More important, we know they can travel around carrying things of value and persuade people to risk their money. If they can talk people into playing games at poor odds, they should have no trouble selling securities with high expected returns. While we don't have much information about the risk and return of sixth-century international trade, using data from earlier and later periods suggests that expected log returns of 30 per cent with 100 per cent standard deviation are reasonable for a single voyage. You don't need to combine many voyages to make that more attractive than any available alternative.

Development Unique in History

We now start a virtuous circle. Investors want shares in ships, so they produce trade goods or ship-building and provisioning supplies. Gamblers exchange the goods for securities, and take them to the ports. It's easy to get a ship, provisions and cargo by selling securities in the return cargo. Ships go out and come back with foreign goods. The newly wealthy investors purchase the goods. People begin to devote more and more of their economic effort to trade goods, because it is so much more profitable than consumption goods.

As things develop, we need to teach people about the Capital Asset Pricing Model. Having mastered Modern Portfolio Theory, the math is easy. People need to start considering whether to buy ship securities, or to invest in physical capi-



tal assets like mills and roads. More important, people need to consider human capital investments. Without the Capital Asset Pricing Model to guide them, people will tend to underdiversify, picking low-volatility, high return projects. There will not be enough risk in the economy and it will be too concentrated. The result is likely to be an economic disaster.

Our new economy is developing without government or any strong central institution. Because it is trade-based, the ideas should spread throughout the world. The financial rewards are distributed widely, creating a financially-secure middle class. There is a ready market for constructive use of all kinds of talent and energy. It's not unreasonable to hope that such a world would be peaceful, just, tolerant and prosperous.

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Since our entire economy is securitized, there will soon be demand for advanced financial engineering, Black-Scholes and beyond. By this time, there should be enough advances in education to have a class of people with the training to understand and apply these ideas.

Could this really happen? Could we use modern quantitative ideas to make the Dark Ages financially secure without technological progress or force of arms or great political ideas? I think it's possible. I don't underestimate the practical problems. I would give long odds against any individual succeeding. But I think the ideas have real power, and could be explained to people in the sixth century. I think people who did understand them would find them attractive. It would be hard to find enough people to listen and act on the ideas, and there

are many forces that could derail the process. But I do think it is possible.

I have ignored the superstition, illiteracy, innumeracy, religious beliefs or political and social conservatism of the past because I have a strong personal faith that merchants and gamblers haven't changed much throughout history. They thrive in every era. I also have faith that material comfort and financial security are strongly attractive to the great majority of people in any times.

Twain's Version

It does give me pause that Twain's Hank Morgan was similarly optimistic. He is appalled by the ignorance, superstition, backwardness and despotism of the times; so he uses his showmanship and technical knowledge to introduce public

education, industrialization, freedom and democracy. But the reactionary forces are strong. The church and the nobility lead a counterrevolution. The peasantry throws away Morgan's 19th century advantages to march uncomplainingly into concentration camps.

With only his faithful sidekick and 52 schoolboys, Morgan blows up all the modern factories. He begins to rant like a 20th century fascist. "[K]nights can be killed, but they cannot be conquered. We know what is before us. While one of these men remains alive, our task is not finished, the war is not ended. We will kill them all." Thirty thousand knights die in the mechanized traps Morgan sets. But their corpses spawn disease that kills his band, and the Dark Ages settle back over the world, erasing all traces of 19th century progress.

The horrors of the final scene must have been suggested by the US Civil War, but in retrospect seem to be accurate predictions of the terrible wars and political struggles of the 20th century. The knights dying on the wire recall the first World War, and the wholesale destruction, concentration camps and desire to exterminate the enemy fit right into the second. The idea of a society turning upon itself, neighbors killing each other in unspeakable barbarity was repeated in the Spanish Civil War, the killing fields of Cambodia and depressingly many other places.

The English reviews of the book were uniformly and spectacularly bad (which did not stop it from enjoying robust sales among non-critics in the UK). They ranged from ponderous pomposity, "In his last book Mr. Clemens fails to make us laugh by any method, even the worst. He is not only dull when he is offensive, but perhaps even more dull when he is didactic," [*Speaker*, 1890, unsigned] to airy pomposity "One may be pardoned for confessing that the task [of reading the book] has proved too severe. [This review is based on a] trial of several chapters taken at random," [*Athenaeum*, February 15, 1890, unsigned] to outraged pomposity "Will this shrine in human souls be destroyed because a Yankee scribe chooses to fling pellets of mud upon the high altar?" [*London Telegraph*, January 13, 1890, unsigned]. It makes you hope some of these critics lived to see *Monty Python and the Holy Grail*.

Only one American publication took a similar tone, "A buffoon, like the hero of this tale, playing his contemptible tricks where Sir Thomas Malory has trod with a noble teaching of knightly courtesy, and uttering his witless jokes where Tennyson has drawn so many a high moral of true gentleness, is a sorry spectacle." [*Boston Literary World*, February 15, 1890, unsigned] Most likely this was due to the aspects of the book that were seen as anti-Catholic at the time (1890 was the peak of the second major wave of US anti-Catholicism, and Twain has been accused of participating in the sentiment) rather than any reverence for Art.