# American Economic Growth and the Voyage of Columbus

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"Life, as we know it, does not exist."
*Swami Mhakhaphi*

Since the imaginative, pathbreaking, inventive analysis of Robert Fogel (1962), the counterfactual analysis has intrigued and scintillated a generation of economists. Fogel considered the state of the American economy in 1890, had the railroads never been invented. He found that less than 10 percent of the American output could be attributed to the single innovation of railroads, thus demonstrating irrevocably that the loss of trains would not derail the American economic juggernaut. However, no stationary equilibria exist. Indeed, Fogel's analysis showed that the American economy was resilient in ways not previously considered. Furthermore, Fogel's article had greater impact. After all, if the railroads did not exist in 1890, they probably do not exist now, for there is no record of them being invented in the last ninety-two years.[1] Nonexistent railroads are unsafe to use (L. M. Mijhak, 1835).

Since Fogel's analysis, the counterfactual has been successfully employed in a variety of other areas. A. Gibbons and O. Ho (1966) considered what would have transpired had the transatlantic railroad not been constructed at the turn of the century. They found that, with the necessarily higher costs of transportation, lighter than air vehicles would have been developed. Their conclusion was disputed by S. S. Vicente (1967) who proved conclusively that lighter than air vehicles are not possible, for no construction

materials having sufficient rigidity are lighter than air. Nevertheless, X. O. Warbly (1968) analyzed the state of the world if "aeroplanes" were possible, and found they would not have been used anyway. Errors in Warbly's procedure were found by Muon (1970), who reevaluated the counterfactual using the Multiple Augmented Data Construction Assistance Package. Muon arrived at the same conclusion as Warbly, although the difference in cost and value of aeroplanes is reduced. In a clever twist, Shatter and Filth (1975) consider "what if Fogel had never written his article," and projected that economic historians would have turned to cocaine use instead of counterfactuals. Finally, Dromedary (1976) hypothesized that if Fogel were conceived on a train, he would have utilized more traditional methods in economic history.

The problem all of these articles share is that, by the time rail transportation is introduced, the U.S. economy had already produced the entrepreneurial class that paved the way for capital accumulation and growth. As a popular slogan of the 1890's asserted, "you can't keep a good robber baron down." Fogel demonstrates that railroads were not fundamental to the American economy, but does not consider deeper issues. In retrospect, it is obvious that Fogel was on the wrong track, for without railroads, entrepreneurs would have found other ways to bilk the government out of millions of square acres[2] of land. Thus, in demonstrating the invincibility of the American economic juggernaut, Fogel created a straw man.[3]

In order to perform a valid test of the invincibility of the American economic cornucopia, the counterfactual must predate

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[1] There is one undocumented report of the steam locomotive being invented in the USSR in 1927, by Igor Antonvich. No report of rails being employed there surfaces, however, until 1949.

[2] There is some evidence that bilking the government out of round acres is sufficiently difficult that bilking would be reduced to $\pi/4$ of levels otherwise attained. This assumes no overlapping properties, however, and scale economies in honest graft.

[3] This is generally regarded as a despised type, except among Iowa children.

the development of the celebrated entrepreneur and the waves of immigrants whose sweat was an important input into the production process. Consequently, it is hypothesized that, rather than stumble upon the two American continents, Columbus fell off the edge of the earth. Certainly this is a valid test, for if America were to be virtually unchanged, despite not being discovered, certainly the "American century" was inevitable. I choose the year 2000 as a target date, and compare America as it will be in the year 2000 to the way it would have been then, had Columbus fallen off the edge.

The paper proceeds in three parts. First, I construct a model of the earth, in which implications of Columbus falling off the edge can be tested. A new analytic procedure, the highly touted Fractured Reconstructive Autoerotic Projection Package with Econometrization (FRAPPE), from my 1983 study is used to detail the properties of the counterfactual world. These results are summarized in the third section. The fourth section offers conclusions and some proposals for further research.

Before formulating the model, a few possible objections may be laid to rest. Dribble (1980) has argued that America was not discovered by Columbus, but by another Italian with the same name. In a later paper, Dribble (1981) alleges that Isabella did not finance Columbus,[4] but that Ferdinand, dressed like the Queen of Spain, did. Readers should note that Dribble now drives a milk truck in Cleveland.

A more substantive issue was raised by Occam, who states (reprinted without permission):

> If the world were flat, Columbus would certainly not have observed masts rising over the horizon as ships came in. As a result, he would have not believed the earth to be round, and would never have sailed. Hence he could not have fallen off the edge.          [1983, p. 17]

Fikus (1980) is less ambiguous on this point, stating that, in the presence of rational ex-

pectations, Columbus would have sailed only if he would reach India.[5] Milcfed (1981) counters that Columbus should sail if and only if he will discover something worthwhile, and thus it is sufficient for Columbus to sail if he feels it is worthwhile to find out what it feels like to fall off the edge. Occam (1985) will agree to this point, ecstatic over the elegance of the approach.

This shows that it is not contradictory to presume Columbus sailed away and fell off the earth. Certain topographical facts are implied by this statement, which form the core of the model developed in the next section.

## I. The Model

Let $\mathfrak{X}$ be a subset of an uncountable cross product of the complex space, with the subset product topology generated from the lexicographic topology on complex space. Let $B$ represent the Borel sets on $\mathfrak{X}$ generated from this topology, and $\mu$ a nonnegative measure on $B$. If $\mathfrak{X}$ is compact, let $\mathfrak{X}* = \mathfrak{X}$, otherwise let $\mathfrak{X}*$ be the one point compactification of $\mathfrak{X}$ with induced metric $\mu*$. Extend $\mu*$ to the nonstandard reals, and denote this extended metric $*\mu*$, over $*\mathfrak{X}*$, the nonstandard extension of $\mathfrak{X}*$.

Choose a point $s \in *\mathfrak{X}*$.[6] A *path* from $s$ to $x$ is a continuously differentiable mapping $p:[0,1] \to *\mathfrak{X}*$ such that $p(0) = s$ and $p(1) = x$. Such a path is a *catastrophe in* $\mathfrak{X}$ if $(\exists t)(0 < t < 1$ and $p(t) \in *\mathfrak{X}* \setminus \mathfrak{X})$. A catastrophe is a path leaving $\mathfrak{X}$. Thus, if $\mathfrak{X}$ is the earth's surface, a catastrophe is the event of leaving the earth's surface. In the context of this model, we may state the counterfactual hypothesis as follows:

$$(1) \qquad (\exists s \in \mathfrak{X})(\exists x \in *\mathfrak{X}*)$$

($p$ is a path from $s$ to $x \Rightarrow p$ has a catastrophe). It follows that (1) implies $*\mathfrak{X}*$ is disconnected. Let $\mathfrak{Y}$ be the largest con-

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[4] Which Columbus is meant is not clear.

[5] In point of fact, Columbus did sail, did not reach India, and the earth is not round anyway but ellipsoidal. Fikus correctly notes that the facts are irrelevant to a counterfactual argument.

[6] Chosen as it represents Spain.

nected subset of $\mathscr{X}$ containing $s$ in the discrete topology, and $*\mathscr{Y}*$ the one point compactification of the nonstandard extension of $\mathscr{Y}$.

Define an individual's state by his position in $*\mathscr{Y}*$ (location), his consumption rate $z \in \mathscr{Z}$, and a vector of attributes $v \in \mathscr{V}$.[7] Thus an individual is an element of $*\mathscr{Y}* \times \mathscr{Z} \times \mathscr{V}$. The state of the world is given by a vector of individual types, that is, an element in $\hat{W} \equiv \times_{\alpha \in \Gamma}(*\mathscr{V}* \times \mathscr{Z} \times \mathscr{V})$, where $\Gamma$ indexes all things.

The evolution of the earth can be given by a function $\Psi : \Re \times \hat{W} \to [0,1]$, where $\Psi(t,W)$ is the probability of $W$ at time $t$. There is some uncertainty in the function determining $W$ at the subatomic level, and thus statements concerning the actual world state have some variance.

Define $U$ to be the projection of $W$ onto the United States. Let $W_0$ be the actual state of the world in the year 2000, and $U_0$ the projection of $W_0$ on $U$. Let $\Phi(W) = \Psi(2000, W)$, given (1),[8] and define

$$W_1 = \int_{\hat{W}} W\Phi(W)\,d*\mu*.$$

That is, $W_1$ is the expected world state given the counterfactual (1). Then we have, if $U_1$ is the projection of $W_1$ onto $U$:

THEOREM: *In the coarse topology pseudometric,*[9] $\rho$, $\rho(U_0, U_1) = 0$.

PROOF:
  For proof, send \$8.99 to Proof, Box 666, London, Canada. (Canadians add \$6.)

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[7] There need not be finitely many attributes, although this saves on computational costs.

[8] The necessity of deriving the nonstandard complex measure space $*\mu*$ is obvious.

[9] A pseudometric on a space $S$ is a function $p : S \times S \to \Re$ satisfying:

(a)   $(\forall x \in S)(\forall y \in S)(p(x,y) = p(y,x) \geqslant 0)$;

(b)      $(\forall x \in S)(\forall y \in S)(\forall z \in S)(p(x,z)$
$$\leqslant p(x,y) + p(y,z)).$$

A psuedometric maps leather into those cheesy shoes that look like vinyl.

This shows that, despite Columbus falling off the edge, the United States is on average substantially unchanged, relative to the actuality. To get a grip on the real implications of the counterfactual, the most likely world state was generated, given the counterfactual, using FRAPPE, an artificial intelligence procedure that simulates the development of the world, given an initial state. Some of the results we found for this hypothetical world are listed in the next section. A full explanation of the FRAPPE technique can be found in my 1983 study.

## II. Results of the FRAPPE

The FRAPPE is a maximum-likelihood forecast procedure that takes as an input the initial state of the world and the stochastic differential equations governing state transformation. From this, FRAPPE constructs the most likely subsequent state. This is used as an input, and the process repeated. To find the state of the world on January 1, 1490, FRAPPE is used in reverse, calculating the most likely predecessor to the current state. Thus, to calculate the state of the world $W_0$ in 1490, everything about the world is inputted as a vector $W_2$ with dimension corresponding to the cardinality of the reals. Anti-FRAPPE is operated until the most likely initial state in 1490 is found. At this point, the initial state is altered so that the counterfactual hypothesis holds. FRAPPE is then used to find the world state on January 1, 2000. Simulations reveal that FRAPPE conclusions are insensitive to subatomic stochastic fluctuations for periods up to 500 years.[10] Thus, FRAPPE is valid for the objective of this paper, but not useful for testing the Big Bang Theory.

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[10] In particular, FRAPPE is useful in forecasting human events, weather, and the stock market for the next several hundred years. For the last reason, FRAPPE's mechanics must remain a trade secret. However, the details will be published in my 2010 study posthumously. Unfortunately, the common knowledge of FRAPPE would destroy FRAPPE's analytical ability, for the same reason undecidability crops up in the theory of algorithms, and thus FRAPPE will not be exploitable when generally known.

To summarize the FRAPPE results, I present a rough chronology of the events following Columbus' demise. While America is virtually unchanged in 2000 A.D., the rest of the world is drastically different.

After Columbus disappeared, rumors ran rampant that a Nirvana lay across the sea. Hundreds of ships were launched from Spain and Portugal to this Paradise, and with each ship, the promise of returning exacted. None returned, and Spain's power as a nation diminished with this burden on the treasury, and the Moors recaptured Spain in 1511.

Meanwhile, the industrial revolution gathered strength in the British Isles and Northern Europe. Fed by trade with India and China across the land, Italy, Palestine, and the Moslem countries prospered. An Englishman, F. Drake, experimented with a hot air balloon developed by a friend; the first channel crossing occurred in 1604. Without the Americas as an avenue of exploration, hardy types substituted balloon travel. Frustrated at the number of middlemen between Europe and China, France and England captured large portions of the Middle East in the "Great Balloon War" of 1712. This was followed by the "Second Balloon War" of 1731, in which the first motorized dirigible was used. The leader of the British forces, Margaret Attila "the Hen," was defeated at Qum in 1735, and the Europeans sued for peace.

Frustrated in eastward expansion, and intrigued by the studies of A. Monrovia concerning plate tectonics and "floating continents," the English turned their eyes toward newly discovered Australia. In a daring exploit, a team of Welsh divers unfastened Australia from the Pacific rim and, in dead of night, sneaked it past Indian and African shipping, to fasten it near the edge of the earth roughly 1,000 miles off Brittany.[11]

The new "continent of America," named for an aborigine phrase meaning "what?," was first used as a penal colony to house former British Lords and French royalty.

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[11] Travelling around the Cape, Australia was accidently inverted. Thus, the shape of the United States was not significantly altered.

These individuals eventually revolted, and the rest is history.

The rest of the world is perturbed in the FRAPPE analysis. For instance, individuals of the Indian subcontinent and native Americans were never given the same name, and certain confusions avoided. Moreover, the former did not acquire the statistical preeminence they are noted for, instead becoming the world's foremost proctologists. Japanese technical prowess was diverted away from electronics, automobiles, and processed seaweed toward military exports and grain, the latter grown hydroponically in 75-story farms.

Certain differences in the United States cropped up as well. California, placed next to the edge of the world, still had its earthquakes and flakes. However, Baltimore became an exciting city and a "den of iniquity," instead of the dreary middleclass drudge it is today.

### III. Conclusions and Research Proposals

This paper demonstrates that, whether or not Columbus discovered America, the United States would have been relatively unchanged. Thus, America is invincible to tinkering with history to a degree heretofore unsuspected.

It would be interesting to know if this is true in general. That is, is it the case that, for all $\varepsilon > 0$, a $\delta > 0$ exists so that, if history is perturbed by less than $\delta$, then America is perturbed by less than $\varepsilon$? In this case, America would be continuous, and hence integrable. One might then wonder if the United States converges in probability to what it will be, as time diverges.

Several related topics emerged during this analysis. Suppose Ponce de Leon (1513) had discovered the Fountain of Youth in Florida. Would the South have won the Civil War? What would have happened to the sales of grits and carpetbags in Boston?

If the earth had more than one moon, it is likely the space race would have turned out differently. Indeed, a general solution to the $m$ nation $n$ moon problem would shed light on certain general equilibrium welfare issues raised by Errow (1981). Errow demonstrated

that if preferences are homothetic and moons are triangular, one should add them up.

Other industrial questions concern us. What would have transpired if one size didn't fit all? If your mileage didn't vary depending on how you drive? And if contents did not settle during shippage, would cardboard be elastic?

Two interesting counterfactual analyses are given by Deviant (1970) and Vildeside (1975). Deviant considers the effects on scholastic aptitude and economic growth if torture had become an accepted way of teaching undergraduates. Vildeside considers, in a partial equilibrium framework, necessary alterations in search theory if the searcher's physical attributes are endogenous, in the "putty-clay" sense.

Critics of counterfactuals have charged[12] that, given the inability to forecast the U.S. economy even months in advance, and the dearth of all but the most coarse data on historical events, it is absurd to expect to reconstruct how the economy would have been if it were different. There are three avenues of response to this, two theoretical and one practical. First, the inability to forecast in the modern economy is irrelevant, for the economy was simpler in the old days. Second, if the data are coarse, one can use the coarse topology[13] to analyze them. Thus, no theoretical impediments exist to applying counterfactuals, although it is interesting to suppose they did.

Finally, if there are countably many events, there are continuum-many subsets of events that can be negated and studied via the counterfactual argument. This produces a wealth of avenues of inquiry not seen in any other discipline.[14] Moreover, counterfactuals fall in the grand tradition of "assuming it away."

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[12] Several such charges were made in a made-for-TV movie that aired last year. I cannot remember the film's name but it concerned teenage pregnancy.

[13] If $S$ is a space, the coarse topology is the set $\{\emptyset, S\}$. This topology is generated by the pseudometric that everywhere vanishes.

[14] For instance, there are merely countably many possible mathematical theorems in a countable language such as English.

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