

N-Dimensional Market Maps

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ABSTRACT

This paper proposes that the law of value and demand better characterizes market activity than the law of supply and demand. The law of value and demand states that attributes determine value; value determines price; and that price determines demand. This mandates four-dimensional systems for all markets. The simultaneous analysis of four disparate markets reveals a statistically significant geometric system in 13 dimensions. This forms the framework for an n-dimensional model of the global economy, first revealed in this paper. The conclusion is that this law satisfactorily explains many economic phenomena that the law of supply and demand cannot.

INTRODUCTION

There is a famous joke in mathematics. While there are several variations, it often goes like this: *A mathematician and his best friend, an engineer, attend a public lecture on geometry in thirteen-dimensional space. "How did you like it?" the mathematician wants to know after the talk. "My head's spinning," the engineer confesses. "How can you develop any intuition for thirteen-dimensional space?" "Well, it's not even difficult. All I do is visualize the situation in n-dimensional space and then set $n = 13$."*¹

A real thigh-slapper, that.

There is a perceptual problem, here, though.

Laughing at the 13 dimensional space hurts its feelings.

That is because, for markets, a 13 dimensional space is not a joke. It is merely a subset of a much larger, n-dimensional set describing all markets. In its economic

cartography, it is as real as the markets it describes. Furthermore, we need not characterize such spaces solely through some form of undocumented intuition. Instead, a market-driven analytic geometry explains n dimensions of the economy at the same time. Importantly, a driving force behind this geometry is you. That is to say, as you move through the world you buy goods and services. So does everyone else. Your behavior, in conjunction with everyone else's on the planet, moves the economy in statistically predictable ways. Once we reduce these influences to mathematically reliable relationships that derive from the market maps that describe its various sectors, we have the tools to enable us to see the economy for what it is: a series of interconnected markets that respond in predictable ways to producer offerings. Maps of these markets are important for optimal new product placement by producers.

This paper introduces n-dimensional market maps as they apply to commercial aircraft, automobiles, bicycles and beef.

METHODOLOGY

This paper uses several open data sources and some that require subscriptions. The open sources include the CIA World Fact Book^{2,3} and several suppliers' websites. The subscription services include The Teal Group⁴ and Forecast International.⁵ Tecolote Research's COSTAT⁶ software provided the framework in which to perform multiple stepwise regression analysis. Tecplot 10⁷ displays the multidimensional graphs.

A BRIEF AND PARTIAL HISTORY OF GEOGRAPHIC MAPPING

Credit for the invention of first map of the entire known world goes to Anaximander of Miletus, around 570 BCE.⁸ Anaximander envisioned the world as cylindrical and drum-shaped, and, as viewed from above, it consisted of Europe, Libya and Asia surrounded by a circular ocean.⁹ The idea that a ring of ocean encircled the known dry land dates back to Homer, though he never recorded it.¹⁰



Anaximander's Map of the World

Figure 1: Anaximander's Map c. 570 BCE

This map, shown in Figure 1, while crude by modern standards, offered its users some information that they never had before in a single document: a worldview that offered physical relationships between landmasses and seas and oceans, thus highlighting physical borders for all to see. It spelled out the relative positions of Europe, the Black Sea, Asia and the Nile River, and gave some indication of the perceived sizes of all its components. It of course lacks many of the features we have come to expect in modern maps. It has poorly defined coastlines; its proportions are inaccurate; the map shows rivers running from one sea to another. Moreover, of course, the earth is more sphere than drum-shaped.

Importantly, though, it offers a vision of the world. Just because it is not 100% as accurate in its view as what we now call modern maps does not mean it was not extremely important in its time. For as the biologist Richard Dawkins points out, "Vision that is 5 per cent as good as yours or mine is very much worth having in comparison with no vision at all. So is 1 per cent vision better than total blindness. And 6 per cent is better than 5, 7 per cent better than 6 and so on up the gradual continuous series."¹¹

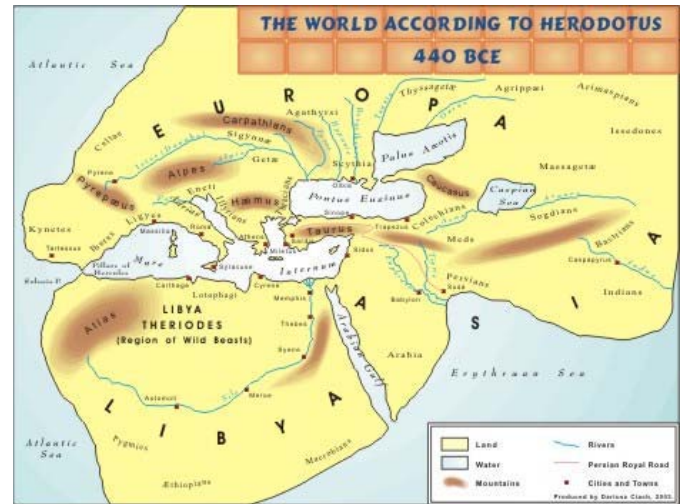


Figure 2: Herodotus's Map of the World, c. 440 BCE

With time and concerted effort, better maps were on the way. With his effort displayed in Figure 2, Herodotus managed to better define the Mediterranean coastline, and recognized that rivers flow from high ground to lakes, oceans or seas and show mountain ranges on his maps.¹²

Roughly two centuries later, Eratosthenes (275-195 BCE), in addition to being the first person to use the word "geography," invented meridians, or north to south lines, and "parallels," imaginary east to west lines, which divided the earth into sectors.¹³

With Ptolemy's world map, as reconstructed well over a millennium later in Figure 3, grid lines combined with projections to form representations of a spherical earth. His work suggested precise ways to fix position using a coordinate system with meridians of longitude and parallels of latitude.¹⁴ Even with such improvements, however, Ptolemy's then-new maps did not offer all of the precision that, say, Christopher Columbus might have liked. Ptolemy thought that Eurasia covered 180° of the globe, which convinced the explorer to look for a short cut to India by heading west [History of Cartography].¹⁵ Discovering America, of course, was only the happy luck that came to Columbus with the vast miscalculation.

Such slips in economics are often fraught with more peril.

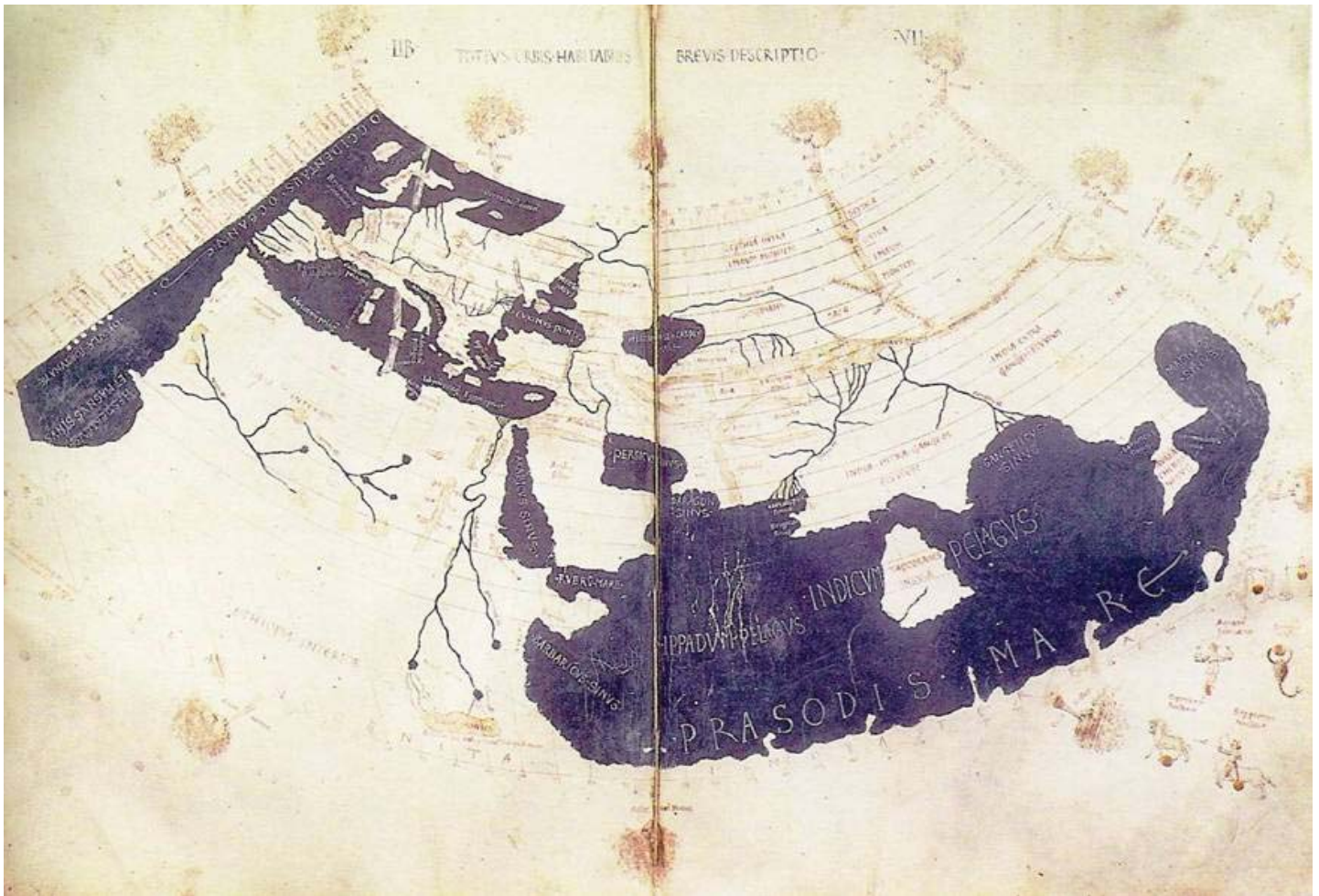


Figure 3: A 15th Century copy of Ptolemy's World c. 150

ECONOMIC MAPS

The concept of an economic map, has, to date, largely meant the tracking of market activity as imposed upon a geographic map. Such maps might track, say, the rank of the countries of the world as they relate to the production of grain, or crude oil or precious metals. Many other related forms of these maps show the entire economic activity of a region, such as Europe, as shown in Figure 4.¹⁶ This map is particularly helpful as it adds a third dimension to the mix, as it shows the level of activity as a height, much like a mountain on a geographic map. Maps of this sort show where the potential suppliers may find plentiful buyers, and how just how much money is available.

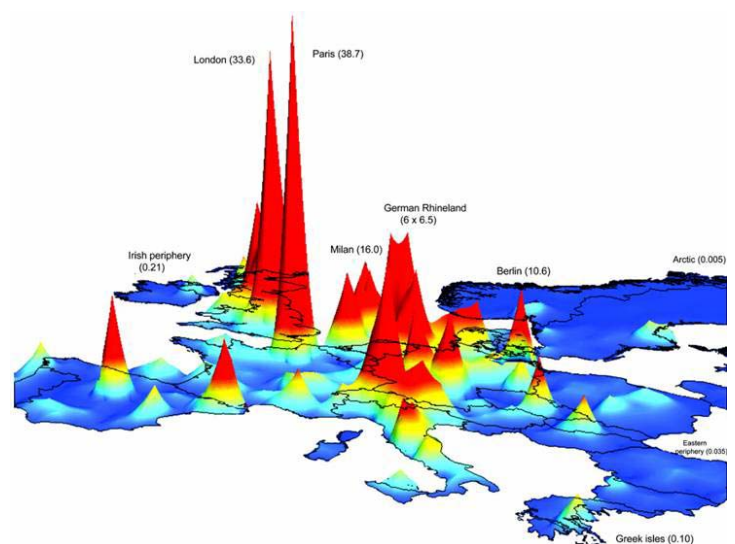


Figure 4: Economic Activity Map of Europe

Some important questions about how the markets separate themselves from one another are raised.

these investigations. Such analyses, by design, also do not address the matters of what the consumers buy, how much money they have for purchases and how they come to their buying decisions. Since such maps do not address these issues, one might ask if they are addressable by some other cartographic forms. Perhaps they would not contain countries and continents, but would still have boundaries, positions and coordinates

If we decide that we need to plot position, perhaps the best place to start is with the Cartesian coordinate system. We find 3-dimensional version of it in Figure 5.

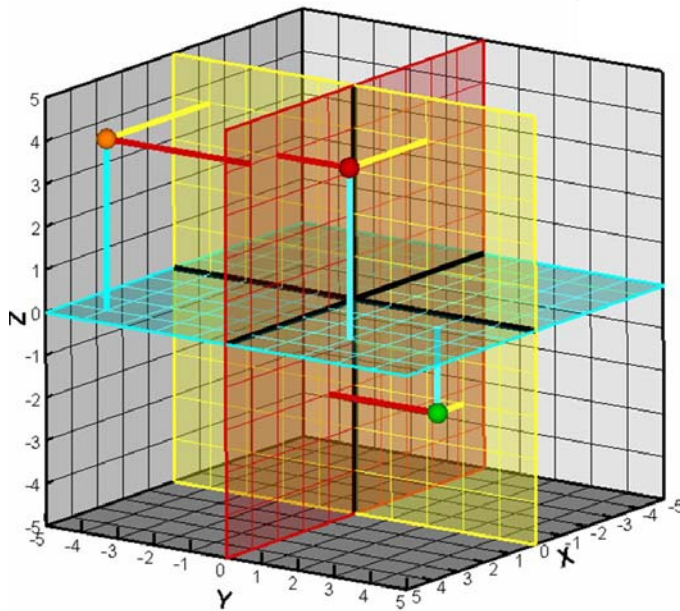


Figure 5: 3-Dimensional Cartesian coordinate system

The three dimensional system Descartes derived permits plotting of ordered triples in eight regions arranged about an origin denoted 0,0,0. As shown above, the leftmost point denotes $X = 4$, $Y = -4$, and $Z = 4$, or, in ordered triple terminology, 4, -4, 4, while the bottommost point is 1, 3, -2. The topmost point is in the only region where all values are positive, and its value is 3, 2, 4. Interestingly, of those eight sectors in this system, seven of them entertain negative numbers. While the concept of negative numbers moved mathematics considerably forward, one wonders if market analysis is best served by such a system. Put another way, is there a coordinate system consisting entirely of positive numbers that might offer enhanced analysis for economics?

We do not have to go far to find useful systems consisting entirely of positive coordinates. The latitude and longitude system used for plotting position on the earth has nothing but such values, and it does just fine. Going west means moving in a fashion that, west of the prime meridian, longitude increases to 180° west longitude, at which point it gradually decreases to 90°

east longitude, and, upon return to the prime meridian, 0° longitude. If this system serves global positioning issues well, what can it do for market issues?

For new perspective on this question, we need to begin by considering a different view of a common structure, the house. Specifically, we can start with a common two-room house. Just to make the problem more concrete, we can begin with a very specific house, the birthplace of Elvis Presley, as shown in Figure 6.¹⁷



Figure 6: Elvis Presley birthplace, Tupelo, Mississippi

Elvis was born in this house in 1948. Now, Elvis was not Rene Descartes, but even baby Elvis knew some things about position not easily handled by the Cartesian coordinate system. If he were to go the point where the common wall between the rooms met the far wall, if he thought about it, he would observe that where that common wall met the far wall, there was a line, or axis, running vertically marking their intersection. If the diaper-clad lad were in that front room and crawled along the common wall, he would be going at right angles to the far wall. If he instead wiggled his way along the far wall toward the front of the house, he would be going at right angles to the common wall. Descartes, if he were still alive, might say that baby Elvis, as he moved about the front room of his house, resided in a three-dimensional work explained by the sector of his coordinate system in which all values are positive. In such a view, the point at which the floor, common wall and far wall amounts to the origin, which, in Cartesian 3D lingo, is 0,0,0.

However, baby Elvis surely would not be content to reside solely in the front room of this structure. At a certain point, he likely found himself in the other room. If we were to draw this house and strip off its roof, we might have found him in the back room, or Room 2 as shown in Figure 7.

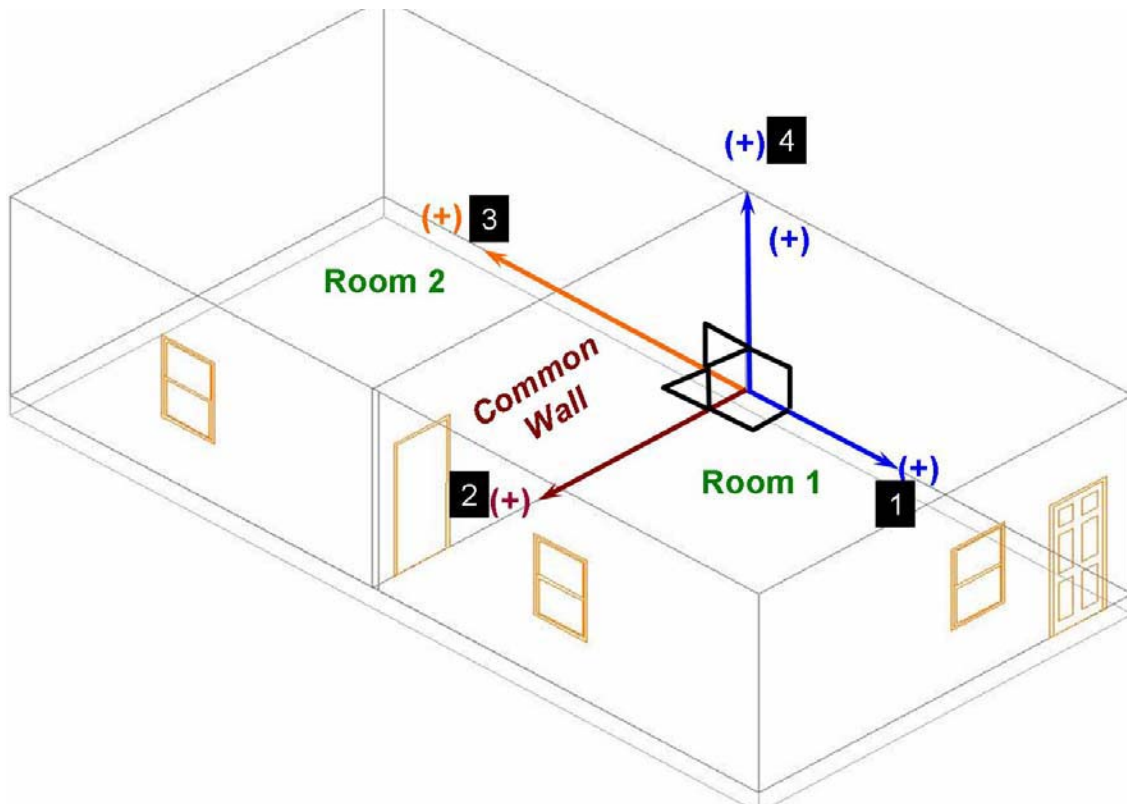


Figure 7: A 2 Room Structure has 4 Dimensions

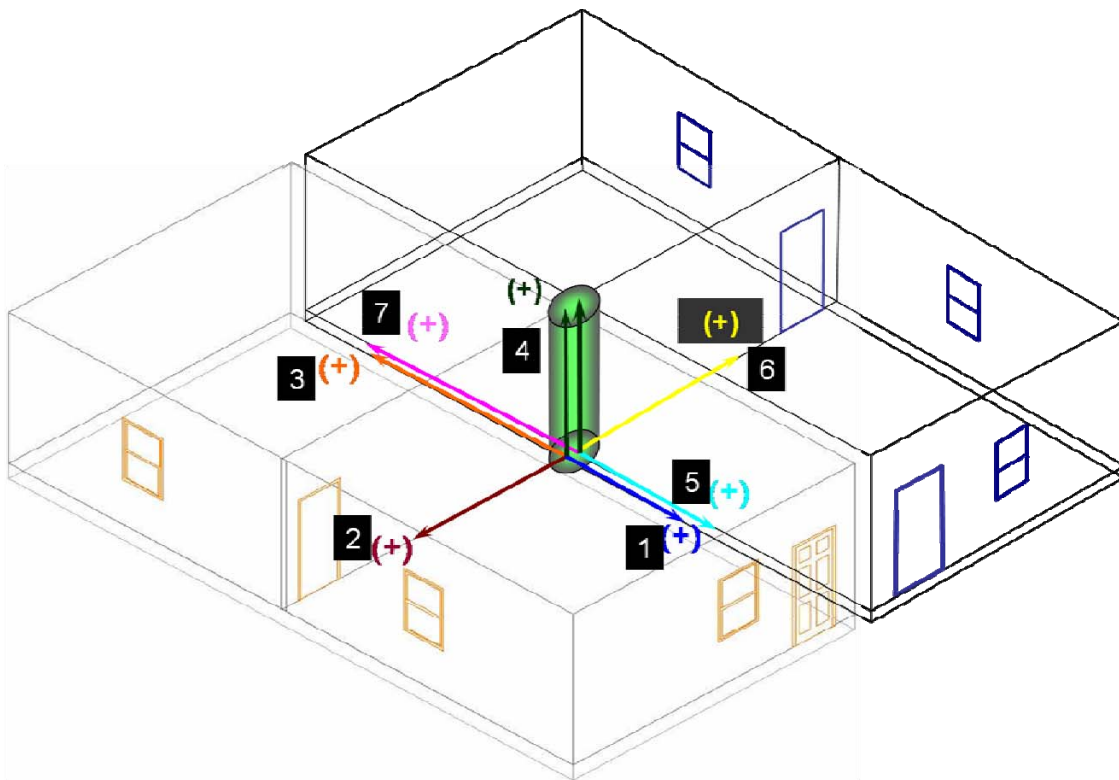


Figure 8: A 4 Room Structure has 7 Dimensions

If Elvis drew himself to where the far wall, common wall and floor intersected, he would once again be in a region in which three dimensions faced him: up, where the common and far walls intersect, along the common wall at right angles to the far wall, and along the far wall at right angles to the common wall. But, if he looked to the back of house, to the back wall, he would be looking in a direction opposite that toward the front of the house. And, very importantly, in a sense similar to that used for global positioning, the distance from his new position to the back of the house is not negative, but is instead positive. Positive space in the back room is not negative space in the front room. Both rooms contain a space and relate to one another in that they share a common *vertical* axis. If little Elvis were to move toward the back of the structure along the far wall, he would be moving along an entirely different axis, in this view, the one labeled "3" in Figure 7. This, contrary to the Cartesian way of thinking, is not negative direction in terms of axis 1, but is instead positive direction along axis 3. Moving forward along axis 3 toward the back wall is movement away from the origin, 0,0,0,0, in the same way that forward movement along axis 1 from the origin to the front wall is. If we do not resort to a Cartesian system, we are not beholden to any notion of negative direction. In addition, if we need not limit ourselves to three dimensions, we can entertain others as they suit our needs.

Such conditions might have haunted our young Elvis, had his father had an inkling to expand his house.

Suppose, for a moment, that Elvis's dad had decided to build a roughly duplicative, but not exactly identical, partially detached version of his house in Tupelo immediately adjacent to the original. This new structure has separately constructed walls, but shares a common pillar with the original, as shown in Figure 8. Since both structures use the same center post, that dimension, which we denoted as dimension 4, is the same for both. However, if little Elvis were to wander through the front door of this new structure, he would find two entirely new dimensions, those numbered 5 and 6.

Dimension 5 runs from the center post toward the front wall of this new structure and is, in this case, parallel to, but is not necessarily the same length as dimension 4. The front room of this newer structure, while shown as roughly the same length as dimension 4, could be inches, feet, or miles shorter or longer than the separate dimension that it parallels. Dimension 6, which appears to run in the opposite direction from dimension 2, is the direction little Elvis might move if he were to wander from the center post along the common wall in the new structure. Moreover, as with the original structure, if Elvis were to go into the back room where the common wall meets the center post and move toward the rear of the house, he would be going in still another direction, here along axis 7.

Given that Figure 8 represents a new coordinate system, the obvious question that comes from it is this: Are there more coordinate systems that might be of use to us? Perhaps some seemingly mundane objects offer clues into other useful ways to plot position. We find such a device in Figure 9. This is a scissors-lift, used to take workers and materials up and down (and, in this case, to take them over terrain).¹⁸ Using a series of hinges and actuators, it can move from a totally collapsed arrangement (B), to a partially extended position A and fully extended situation C. If we consider the hinge points as ordered pairs, while they move in space, only the distance between opposing hinge points changes, while the distance between linked points remains the same. This, then, is the basis for a simple, yet useful, addition to our ability to plot location.

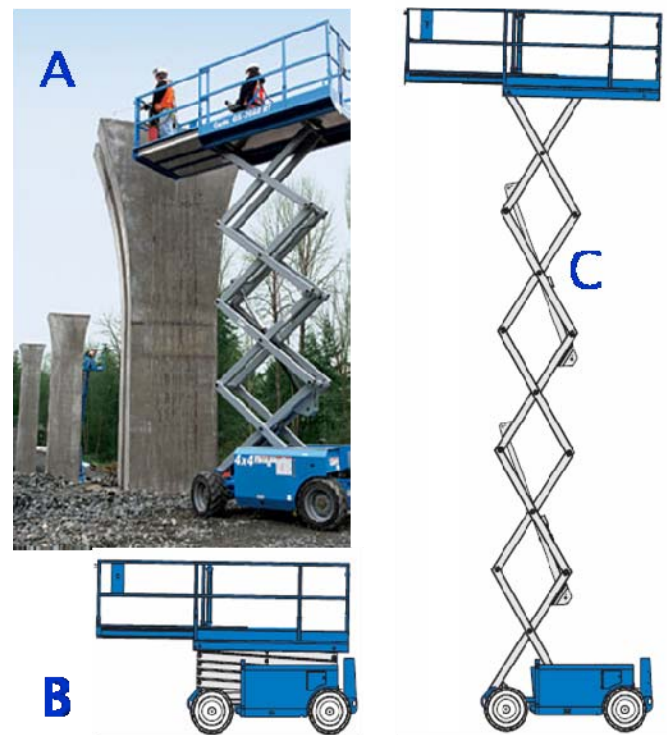


Figure 9: Movable Coordinates on Scissors-lift

As shown in the left hand side of Figure 10, standard Cartesian coordinate plotting makes use of right angle plotting. All "x" values are relative to a parallel Y-axis; all "y" values are relative to a parallel X-axis, where the X and Y-axes are at right angles to one another. If we consider the ten ordered pairs highlighted there $\{(0,1), (1,0), (0, 1), (1,1), (2, 1), (1, 2), (2, 2), (3, 2), (2, 3), (3, 3)\}$, we notice that they form 3 squares, much like the shapes formed by the scissors-lift arms in Figure 9A.

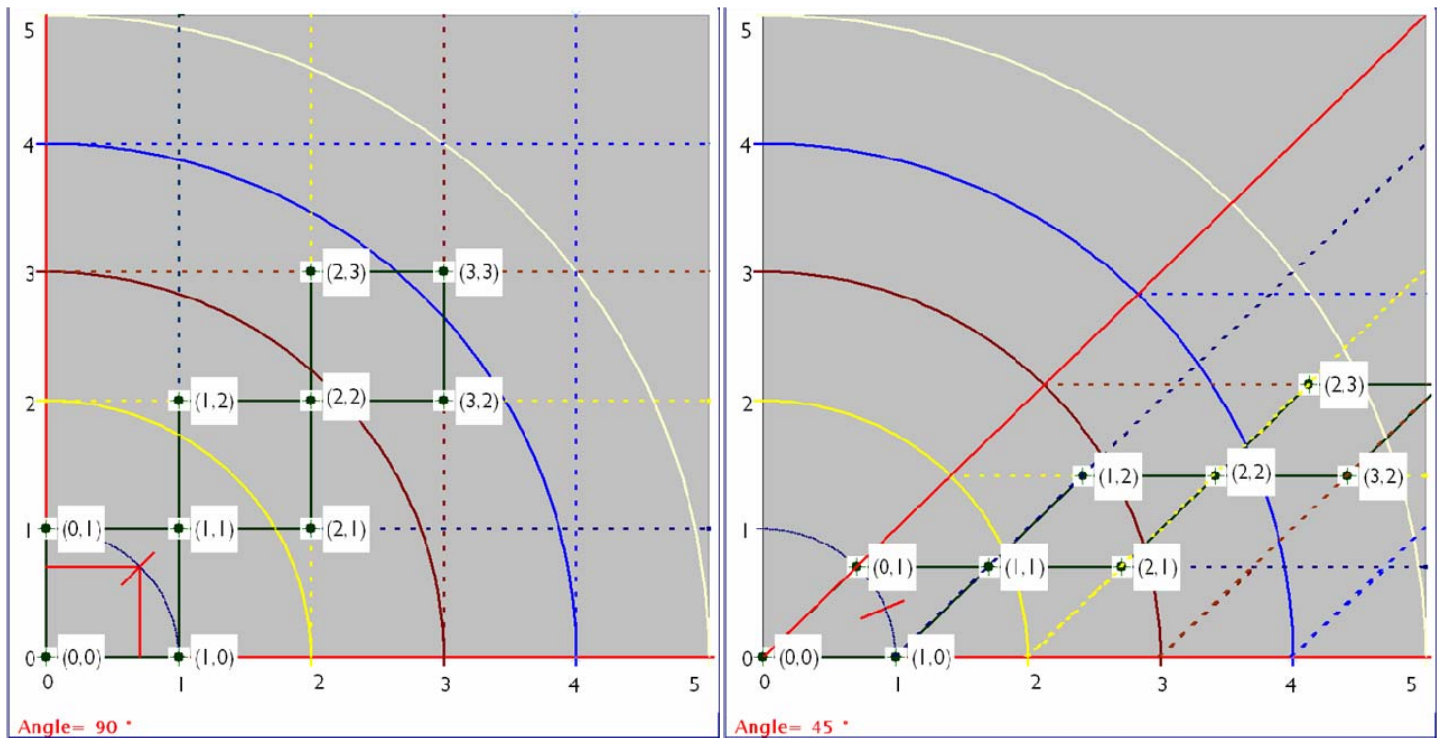


Figure 10: Cartesian/Right Angle plots (left) vs. Non-right Angle (Polar) plots (right)

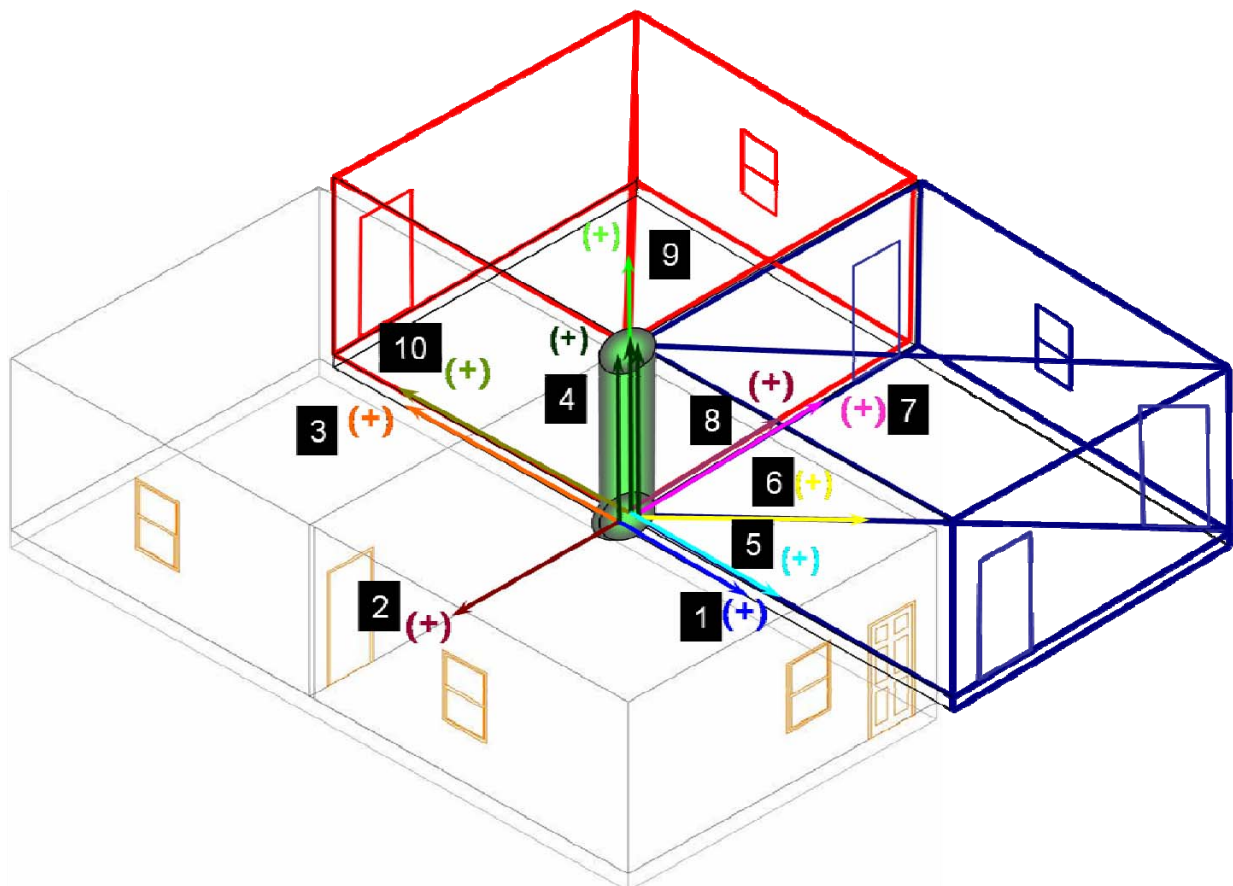


Figure 11: A 6 Room Structure has 10 Dimensions

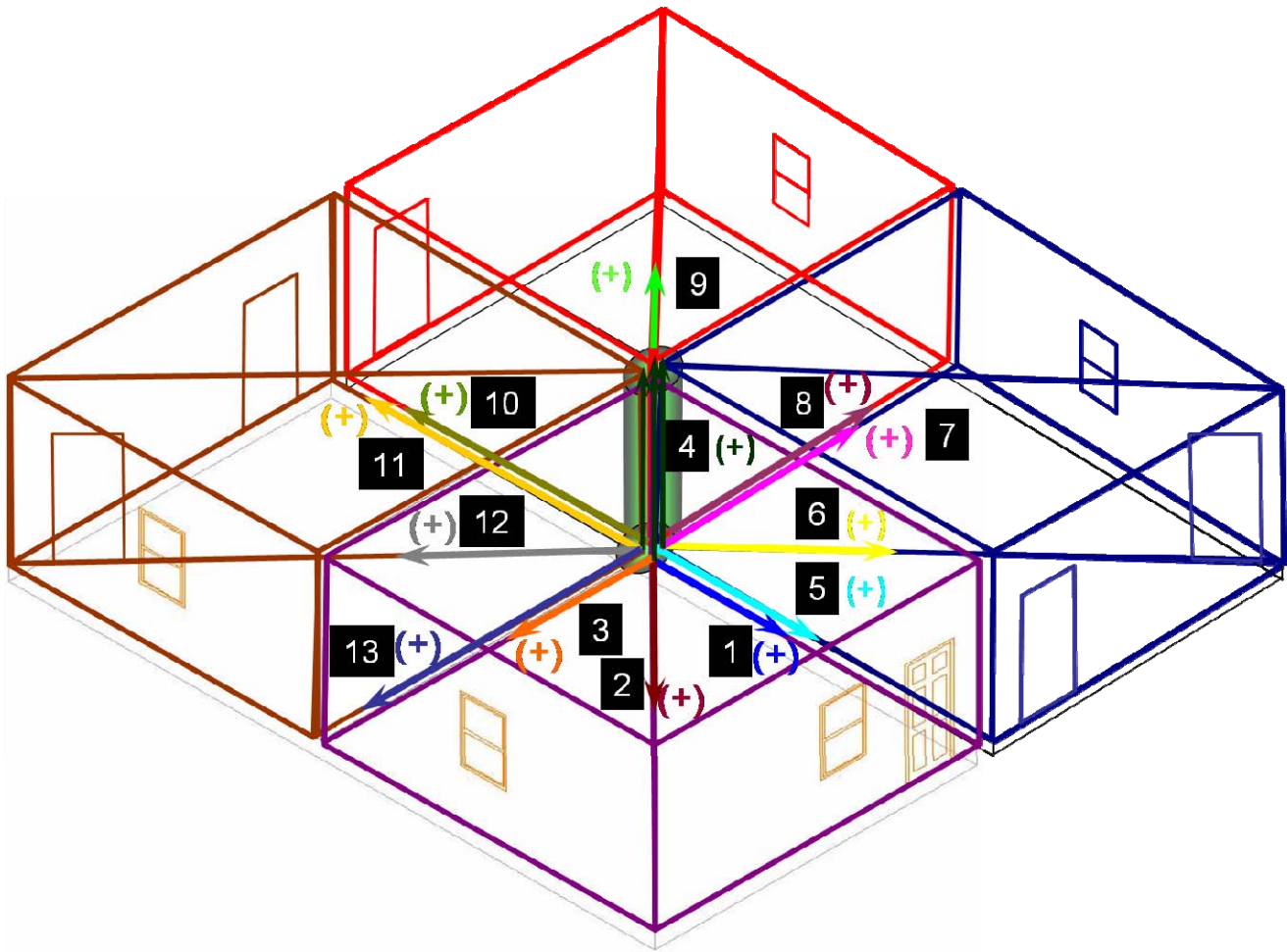


Figure 12: An 8 Room Structure has 13 Dimensions

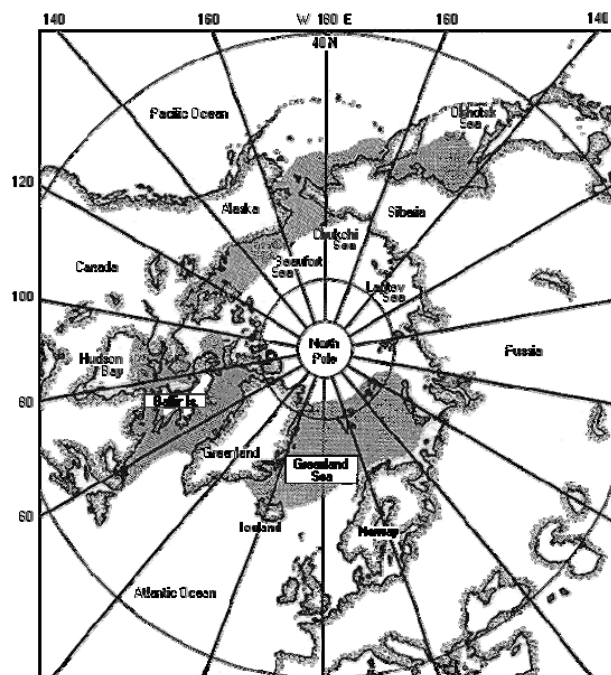


Figure 13: The North Pole is a central point about which latitudes and longitudes emanate

Now, suppose for a moment that we abide by the notion that, in a slightly varied coordinate system, we retain the requirement for “x” values to be parallel to the “Y-axis” and that “y” values must parallel the “X-axis,” but drop the requirement that the X and Y axes be at right angles to one another. Instead, we place the axes at oblique or acute angles to one another. As shown in the right hand side of Figure 10, we can account for position in cases in which the axes are not at right angles to one another. The ordered pairs we examined on the left hand side of Figure 10, which once formed squares, now form rhombi. This shape of this system, in this instance, is roughly akin to that shown by the scissors lift in Figure 9C, though it clearly could take any rhomboidal shape.

That we observe that we can maintain accountancy for position in non-right angle systems seems as if could be of benefit to us. If we return to the example of Elvis house, we are now emboldened to expand our potential applications.

Presume that we decided not to broaden the size of the structure, but reorder it. Specifically, assume that we split the new addition of two rooms into four rooms. For each of the recently added rooms we will put up a wall through the diagonal of the room, thus dividing it into two, as shown in Figure 11. Dimension 5, as previously indicated in Figure 8, remains where it was. We move dimension 6, though, to the diagonal running from the central core to the far right corner of the building. We must move dimension 7 as well, and it now occupies the back wall of the right most pair of rooms. In the rear most pair of rooms, we find dimensions 8, 9 and 10 mirroring what dimensions 5, 6 and 7 do for the front room. Note that the each of the rooms shares the same central core, which we call dimension 4. Furthermore, given what we found out through our examination of Figure 10, we know that, if necessary, we could plot our position in any of these wedge shaped rooms.

Not only can we plot our position in such structures, we can also continue to expand them in the same way we have been doing all along. For example, we could split the original two-room house into four rooms by running diagonal walls through each of the previously existing rooms as shown in Figure 12. If we do this, we now have that elusive 13-dimensional system to which our mathematician alluded early in our discussion of multi-dimensional constructs. Our problem now lies in how to use and properly populate it. We have found that we can describe sectors as they relate to physical structures. One wonders if the analysis extends to market analysis. It is to that issue that we now turn.

The notion of sectors in geography dates back as far as the 3rd century, where the Chinese in the Han Dynasty drew marked sectors on maps.¹⁹ You will note that in

several places we have used the notion of a “central core,” for a representation of a physical structure, which allowed us to delineate and measure structure sectors, which we hope to carry over into an economic structure. Central points exist in geography as well. The North and South Poles represent points from which all latitudes and longitudes originate. In the case of modern mapping, lines of latitude and longitude must necessarily be roughly circular, as they ring the globe as they mark position. Latitude lines are parallel to one another, but lines of longitude never are. As shown in Figure 13, the ring around the North Pole is similar in structure to the central core we studied in Figures 8, 11 and 12. That we see a central core in both physical and geographic structures is interesting, but not useful for economics. What we need is an analogy that works for markets.

We can get that from the United States’ Central Intelligence Agency (CIA). The CIA puts the world’s total output, or Gross Domestic Product (GDP) at around \$78.4 trillion in 2008, and split that amount into three components, as indicated in Figure 14.²⁰

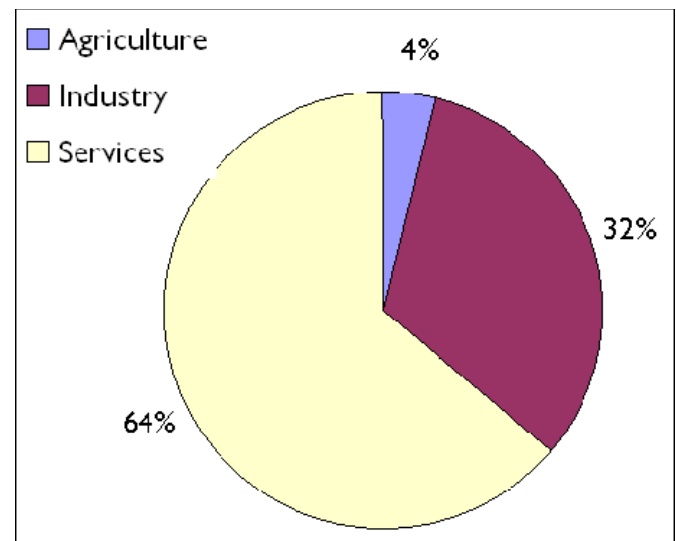


Figure 14: World GDP 2008 Split according to CIA

They determined that of that amount, 4% came from agriculture, 32% from industry, and the balance of 64% from services. Equally important for our purposes, we note that Figure 14’s pie chart has a central point of origin. In this, it is in a sense like the North Pole, a point from which all others are measured. Additionally, if we consider the entire pie chart, from the center of it to its outer ring, it is similar in construction to a “top-down” or “plan” view of the central core we used for Figures 8, 11 and 12.

In fact, if we assume that we have a cylinder with a radius of 1, with an eye to make the volume of that cylinder equal to the volume of 2008 U.S. dollars