From The Cretaceous To Nagasaki: How Path Dependence Shapes Cities

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Our story begins during the Cretaceous Period, when dinosaurs walked the foothills of Appalachia and south Georgia was submerged beneath a shallow sea. As best we can piece together, during that time the landmass that would become North America looked like the map below, with a massive interior sea cutting through the Plains states, and much of the southeastern United States underwater.

Fast forward about sixty-five million years later, when Europeans began colonizing North America. By that time, the sea level had dropped significantly, and the Atlantic Ocean met the continent about 150 miles further south. But as settlers started moving further inland, they encountered traces of that ancient coastline. Keen-eyed geography fans will note that the Cretaceous coast tracks pretty closely to the dividing line between the current-day Coastal Plains and the Georgia Piedmont.

Now it's important to note that, before the invention of the railroad, transporting goods overland was *hard*. Roads were shoddy and/or non-existent, terrain was rugged, and the most powerful machine we had to pull a cart clocked in at precisely 1 horsepower. By some estimates, it cost just as much to transport a pound of goods *across the Atlantic Ocean* from Europe to America as it did to transport it 30 miles overland once it got here (Glaeser 2014). So up until the early 19th-century, the shipment of goods through the US interior was conducted almost exclusively on rivers (and eventually, canals).[1]

The problem was that, no matter what river European settlers started traveling down – the Savannah, the Chattahoochee, the Congaree, the James, the Potomac – they eventually reached a point where the river was no longer navigable, and they had to deal with rapids and waterfalls. They called this point the Fall Line, and it lies exactly where the flat plains of that old Creataceous sea meet the higher-altitude inland.

The Fall Line was bad for business, because back before we dug canals to avoid river rapids, anyone wanting to transport goods from above the Fall Line to the sea had to physically get out of the boat, pick it up, and walk it down below the falls. This is called **portage**, and settlements started popping up at the Fall Line of each major river to help traders who wanted to get their boats from one side to the other (Bleakley and Lin 2012). Eventually, these portage sites also became mill towns, because all the fast-flowing water made it profitable to operate a water mill. The combination of river traffic and mills made these towns important centers of commerce. They included:

- Augusta (on the Savannah River)
- Macon (on the Ocmulgee)
- Columbus (on the Chattahoochee)
- Milledgeville (on the Oconee)
- Columbia, SC (on the Congaree)
- Richmond, VA (on the James)
- Washington, DC / Alexandria, VA (on the Potomac)
- Baltimore, MD (on the Patapsco and Gwynn's Falls)
- Philadelphia (on the Schuylkill)

In the 19th century, steam replaced water for powering mills, and railroads replaced riverboats for transporting goods. And all the old portage towns listed above, stripped of their reason for being, slowly faded into obscurity, which is of course why you've never heard of them…

[1] When you want to move from one place to another, friction is the enemy. And water is one of the most frictionless surfaces we have.

Kidding, obviously. The image above plots present-day economic activity (as measured by night-time lights from satellite imagery), along with rivers (dotted lines) and the Fall Line (solid line). Remarkably, even today there is a city at nearly every intersection of a river with the Fall Line, despite the fact that river transportation carries a much smaller proportion of goods, and canals made portage obsolete. In addition to the cities listed above, other important cities cropped up along the Fall Line as the country expanded west, including San Antonio, Austin, Dallas, and Little Rock.

The persistence of these cities illustrates a concept called **path dependence**. In essence, history matters, and the sequence of choices that we make in the past strongly shapes and constrains the choices that we make today. Once you create a city, that city doesn't disappear even when its original purpose is fulfilled.

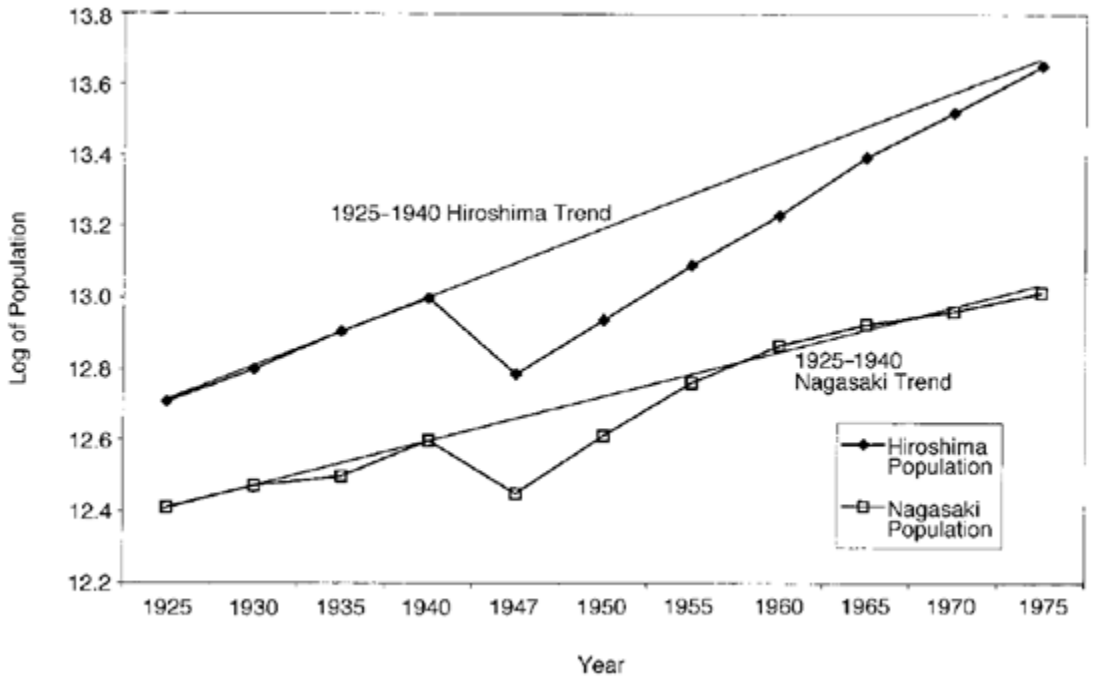
Now you might be thinking, "but Professor Ornstein that's really obvious. Sure, Augusta isn't literally in the business of picking up boats and walking them to the bottom of a waterfall anymore, but that doesn't mean it should *disappear*. I mean, all the buildings and houses are still there. It makes sense that it would just transition into some other industry." If that's what you were thinking, congratulations! It's a really good point!

Here's the counterpoint.

Hiroshima and Nagasaki

In the final years of World War II, the Allied powers launched an unprecedented strategic bombing campaign against Japanese cities. The US military estimated that these bombing campaigns killed roughly 300,000 Japanese citizens and destroyed almost 2.2 million buildings in 66 cities. This culminated on August 6th and 9th, 1945, with the detonation of two nuclear weapons over Hiroshima and Nagasaki, the 8th and 12th largest cities in Japan.

Given the enormous death toll (roughly 8.5% of Nagasaki's population and 20.8% of Hiroshima's population), destruction of the cities' infrastructure, and subsequent fears of radiation poisoning, one might have expected these cities to decline or even disappear. But here's what happened after the war:



Both cities returned to their pre-war population *within ten years*. And they returned to their pre-war growth trend (i.e. what you would have expected to see if there had been no war at all) within 15-30 years (Davis and Weinstein 2002). This is all the more remarkable because this V-shaped population recovery was not due – as in other Japanese cities – to the exodus of refugees followed by their return once housing was rebuilt. The number of people that died in Hiroshima and Nagasaki in the immediate blasts and from subsequent radiation poisoning was so large that the post-war growth of those cities had to have been due in large part to *new people* moving in. The strong bounce back in population growth provides strong (albeit horrific) evidence that, once a city becomes established, it is extraordinarily difficult to remove it from the map, even if you temporarily remove all its people and physical infrastructure.

Ooh, Also Pirates!

I almost forgot about this example, but it came to my mind as I was writing the essay. It's another great illustration of how city locations become "sticky"[2] once they get established.

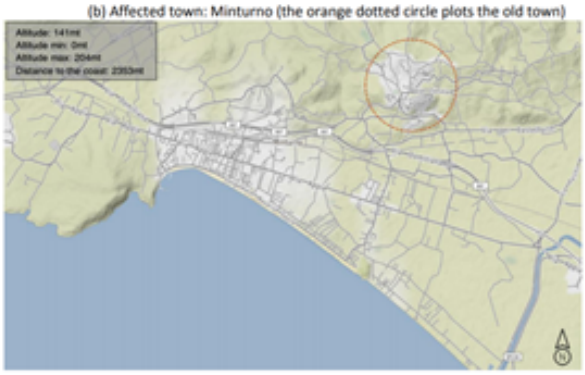
From the 16th century up until the early 19th century, the northern coast of Africa was occupied by a group of Ottoman vassal states that made a habit of attacking European ships and towns, and/or extorting European ships and towns to pay them tribute in exchange for not attacking them. You may remember them from history class as the Barbary Pirates. The early United States paid them tribute for a while[3], until Thomas Jefferson decided that paying pirates not to rob you was a bad idea. He teamed up with Sweden and fought a couple of wars with them starting in 1801.

Anyway, one of the Barbary Pirates' favorite targets for plunder was Italy, because it was an easy sail for corsairs based in Tunisia. Here's a map of all the Italian cities and towns they attacked from 1516 to 1798.

[2] A real economics term.
[3] Tribute payments to the Barbary States made up roughly *one-fifth* of the US federal budget in 1800 (Taylor, 2021).

One of the interesting things this map shows is that the western and southern coasts of Italy were *much* more likely to be targeted by pirate raids than cities on the eastern (Adriatic) side of Italy. Sailing around the boot heel of Italy was apparently too much for pirates in search of a quick score.

Italy at the time was divided into a bunch of independent city-states, so it could never mount a concerted military response to the pirates. Instead, Italian residents mostly solved the problem themselves by moving their homes to more defensible locations, slightly inland from the sea and high up on cliffs.



Comparing the map of Minturno (western Italy) with San Benedetto del Tronto (eastern Italy) gives you a sense of how these cities adapted. Even today – 200 years after pirates stopped attacking them – cities on the western coast of Italy are located in less economically productive land, their population centers a few hundred meters up and away from the beautiful Mediterranean coast.

Although this was a useful way to ward off pirates, it is actively *detrimental* today. By moving to inland, mountainous areas, the economic development of those cities on the west coast of Italy was constrained. They could not grow as large as they might have grown in the non-rugged, coastal plains, and their city centers are more difficult to access from ports. These cities are "stuck in the wrong places," a mislocation that some economists estimate has taken a substantial toll on long-run Italian economic growth (Accetturo, Cascarano, and de Blasio 2020).

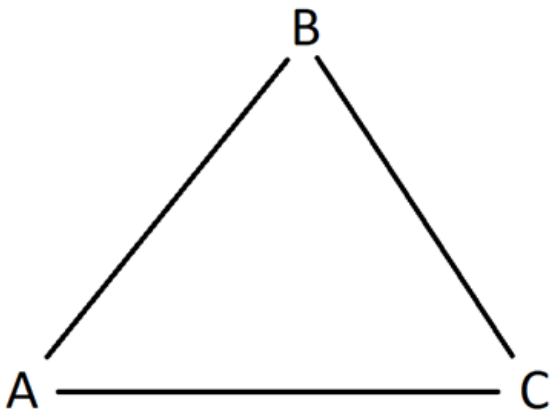
Some Theory: Why Scale Economies -> Path Dependence

Why is the location of cities path dependent? It turns out that there is an important link between path dependence and the concept we discussed in the last essay: **increasing returns to scale**. *Any time a system exhibits increasing returns to scale, you can expect some path dependence in long run outcomes.*

One of the most famous examples of path dependence is the QWERTY keyboard. Do you know this story? Why the top row of your keyboard spells out "qwertyuiop?" (Out of all the 26 factorial – roughly four trillion-trillion-trillion – possible combinations of keys?) Because back in the 1870s, typewriters had the unfortunate habit of jamming whenever you struck the keys too quickly. So the designer of the keyboard layout on the original Remington typewriter deliberately placed all the most common letters far apart from one another, so typists would be forced to slow down a bit while typing (David 1985). Yes, the keyboard I'm typing this paper on today was deliberately designed 150 years ago to slow me down.

Even after mechanical typewriters were replaced by electronic keyboards, and faster keyboard layouts were invented, QWERTY persisted. Once it became the industry standard, it proved impossible to displace. The impediment is increasing returns to scale: it is more profitable to operate in a big market (the existing QWERTY market) than to strike out on your own and adopt a new standard. Typists who learned QWERTY in school don't want to buy a new keyboard that requires them to learn typing all over again. And computer manufacturers don't want to produce a keyboard layout for which there is no demand! We're stuck in a suboptimal equilibrium.

This logic applies to the location of cities as well. To see why, consider the Krugman Model from the previous essay:



Villages A, B, and C are all equidistant from one another, so none of them has any particular advantage in manufacturing textiles. Any place is just as good as another. But increasing returns to scale means that, once transportation costs decrease enough to spur agglomeration, only one of those villages will attract the new manufacturing industry.

This is in stark contrast to other economic theories of trade that emphasize comparative advantage (i.e. some places are relatively better at producing a good, and others are relatively better at producing something else). None of the villages in our model has a comparative advantage over any of the others. But village A (or B, or C) gets all of the industry anyway!

And once industry agglomerates in City A, increasing returns to scale will tend to keep it there. No worker has an incentive to move to village B or C, because the factory jobs aren't there. And

no factory has an incentive to move to village B or C, because all the factory workers live in City A. Just like the typists and the computer manufacturers working with QWERTY keyboards, no individual party has an incentive to deviate from the equilibrium.

Even if the textile industry moves to another country, and its original reason for forming disappears, City A is likely to persist. All of the labor and physical infrastructure is there, so a new industry is more likely to locate there than in Village B or C. Patterns of human settlement that occurred in the distant past are difficult to erase, even when you take away the thing that caused those settlement patterns in the first place.

How Dalton Became the "Carpet Capital Of The World"

To illustrate that last point, consider Dalton, GA, a town of just over 30,000 residents off I-75 between Atlanta and Chattanooga. By the most recent estimates I could find, 85% of carpets sold in the United States, and 45% of the carpets sold *worldwide* are made within 65 miles of Dalton. How did such a small town so far from the coast end up as the "Carpet Capital of the World?"

The story goes like this. Back in 1895, a fifteen year old Dalton resident named Catherine Evans Whitener made a tufted bedspread as a gift for her brother's wedding. Her tufting technique was so unique that within years, word had spread about these awesome bedspreads that a girl in Dalton was making, and she was inundated with orders from around the country. To keep up with demand, she taught her neighbors to tuft, and when that wasn't enough, people moved there from out of town to learn her technique. By 1920, there were 10,000 tufters working from their homes in Dalton making bedspreads.

After WWII, the tufted bedspread craze died down a bit, but there was fresh demand for new homes covered in wall-to-wall carpet. And the skills that Daltonians had learned for tufting bedspreads turned out to be well-suited for mass producing carpet. The dyeing and finishing companies that had originally located in Dalton to produce bedspreads pivoted to making carpet, and the rest is history. Unlike other manufacturing industries that have moved abroad in search of cheap labor, carpet-making remains in Dalton today, because the production process requires workers to have some skill in tufting (Krugman 1991).[4]

History is full of these kinds of origin stories, in which the industries that come to define cities get their start as a happy accident. Bill Hewlett and David Packard started a company in 1939 out of their one-car garage in Palo Alto and got a lucky break selling the electronic equipment to Disney to produce *Fantasia*. Henry Ford, Ransom Olds, David Buick, and the Dodge Brothers all started tinkering with automobiles in early-1900s Detroit, bankrolled by Michigan lumber barons who wanted to supply the wood for these "horseless carriages" (Glaeser 2014). Some places get a head start, and once they do it starts a virtuous cycle where forward and backward linkages jostle to locate in the same place.

[4] Goodness, that's the most I've ever typed the word "tufting." You can find all you could possibly want to know about the history of the US carpet industry here.

Conclusions

Some people argue that path dependence implies that city governments should play an active role in industrial policy, subsidizing companies to relocate. If you can lure a new factory to your town, the reasoning goes, then you might kick off that virtuous cycle where workers and capital agglomerate, building up an industry and paying off your original investment many times over. Though there is some logic to this argument, the research suggests that for every industrial subsidy success story, there are many more that fritter away public money for benefits that never materialize (Jensen and Malesky 2018). More on this in a few weeks.

I think these stories should humble us about our ability to make good predictions. No government agency could have guessed in 1900 that the way to build a booming carpet industry would be to attract a group of skilled bedspread tufters to your town. No one could have predicted in 1939 that the best way to build a high-tech agglomeration – one that would eventually invent the semiconductor and the personal computer – would be to host a garage in which two random engineers build electronic oscillators for a feature length film about a cartoon wizard mouse.

The world is weird, and history casts a long shadow. The best we can do (in my personal view) is to make our cities safe, healthy, attractive places to live. The innovations and the industries will follow.

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