Institutions and Economic Growth:

How Institutional Change Triggers Divergence, Convergence, and Non-Zero Sums

by

Scott Edouard Auriat

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Department of Economics
University of Alberta

Abstract

The thesis explores the effect of institutional change on economic output. Chapters 1 and 2 are empirical and examine historical events. Chapter 1 makes the case that the Mongol Empire played a prominent role in the Industrial Revolution emerging in Western Europe. Western Europe developed democratic institutions that better supported economic growth because it was never successfully invaded by the Mongols. Chapter 2 uses the collapse of the USSR as a natural experiment and shows that the countries born from the collapse of the USSR that opted to join the European Union did better than the countries that did not. The paper makes the case that this was due to the market-focused institutions of the EU. Chapter 3 is a theoretical paper that develops a model elucidating the primary causes of the sudden jump in growth rates concurrent with the Industrial Revolution using game theory. The idea is that good institutions shift the payoffs to engaging in cooperative endeavors such as trade.

Dedication

In memory of my father, Aime; thank you dad

Acknowledgments

I sincerely thank my committee, Rick Szostak, Malik Shukayev, and Ashantha Ranasinghe; this paper would be impossible without your support. Furthermore, thanks to everyone at the University of Alberta Economics department for the thoughtful discussion and help over the years.

Thank you to my family. Every one of you has been so supportive of me over the years. Mom, you are always there for me; without you and dad, none of this would be possible; you guys provided the foundations for us all to thrive. Thanks to my siblings Trent, Lia, Kaille, Tristan, and Damon, I couldn't ask for a better family!

Thank you to my partner Matthea. You were a rock for me during the stress of school, not to mention a pandemic, and I couldn't have done this without you. The thought of our future together was a massive motivation for me to keep pushing forward.

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Introduction

Economists have long endeavored to explain economic growth. Indeed, what many consider the start of economics, Adam Smith's publication of the Wealth of Nations was just this; see (Smith, 1950). Smith attempted to explain growth with a significant emphasis on what we would currently call institutions. Consider his famous quote: "Little else is requisite to carry a state to the highest degree of opulence from the lowest barbarism, but peace, easy taxes, and a tolerable administration of justice" (Smith, 1755); see (Irwin, 2014). The elements Smith proposes as causes of growth, that carries a state from barbarism to opulence, are institutional. Institutions are persistent rules that shape, limit, and channel human behavior and, consequently, structure economic activity; see (Fukuyama, 2014) (North and Thomas, 1973). Peace, easy taxes, and justice emanate from a given institutional structure; they are products of people persistently following a specific set of rules, or "humanly devised constraints", over time.

When modeling economic behavior, institutions are often taken as given. Consider the problem of the consumer. When economists solve for x by maximizing u(x) subject to a budget constraint, they assume certain institutions are present. The model assumes the agent owns some endowment that they can trade with minimal transaction costs in a market. Thus, the model takes as given, among other things, the presence of property rights, contract enforcement, and markets; all very complex institutions.

In a developed country the existence and quality of the institutions just noted can be taken as given and, in a sense, can be taken for granted. However, historically, the presence of these institutions is anything but given. In fact, they are historically scarce. The critical point being while endeavoring to understand patterns of economic growth over long periods, institutions should not be thought of as given. Instead, the evolution and adoption of different sets of institutions by different societies should be considered as a potential cause of the diverse economic outcomes we see across countries today.

The common thread connecting the chapters is that institutions are critical when explaining why some countries are rich and others poor. While the thesis does not propose institutions are the only factor essential to growth, the suggestion is they should take a front seat. The first two chapters look at historical factors that generated a break in institutional trajectories. History is a complex chain of events that shapes and is shaped by culture and geography. Every link in this chain is required to stretch from the past to the present. Yet, it is a common understanding that certain links are more important than others. That certain historical events push the chain in drastically different directions. In chapters 1 and 2, I nominated two events.

Mongol invasions beginning in the early 13th century were events that drastically altered and reshaped Eurasian geopolitics. The Mongols formed the largest contiguous empire in human history and were a massive exogenous shock in the most literal terms. No one outside the Eurasian Steppe anticipated such an incredible force sweeping down on vast swaths of humanity. I suggest the invasions shook the institutional fabric of Eurasia by encouraging more autocratic forms of government; this happened to such a degree we still see the effects on economic output today.

The second event was the collapse of the USSR. The spread of communism and the Cold War shaped the world for nearly a hundred years. Most considered the presence of the USSR on the world stage as an immutable feature of the geopolitical landscape; thus, the collapse of the USSR in the late 90s was a global shock. The institutional paths of the countries born from the collapse were suddenly set free of the heavy-handed influence of the USSR. Amid this new freedom, I look at the different paths taken and propose that those able to adopt better institutions quickly should have witnessed better subsequent economic performances; indeed, this is what I find.

In Chapter 3, I propose a game-theoretic model attempting to capture prominent features driving the jump in growth rates concurrent with the Industrial Revolution. The idea is relatively simple; institutions shape cooperation between people and groups. Thus, we can model growth as an evolution of institutional dynamics that shifts the incentives to cooperate. Groups are inherently better off cooperating in the long run, but there are short run incentives to compete – this is a dynamic prisoner dilemma. I propose certain institutions are the key to escaping the competitive equilibrium and moving to a cooperative one.

Chapter 1

The Origins of Liberal Democracy and the Economic Legacy of the Mongol Empire

1.1 Motivation

1.1.1 Why Europe First?

Why did the Industrial Revolution start in Britain and quickly spread to Western Europe and its offshoots? What are the origins of Liberal Democracy? Why does it take root and flourish in certain countries but not others? What is unique about Western Europe that allowed its emergence? Is there a connection between liberal democracy and economic growth? These are some of the most captivating questions in economics, and all have proven difficult to answer. The above questions are all related to a broad question, that question being, what is the fundamental cause of growth? Many disciplines have employed numerous methods to address and shed light on the question. One approach economists promote is examining history to uncover natural experiments or instrumental variables (IVs).

The IV/natural experiment approach is perhaps most famously demonstrated in (Acemoglu et al., 2001) (I will refer to this paper as AJR).[1] This paper, in many respects, complements the AJR paper quite well. It complements AJR in that I use the same methodology, but more importantly, it builds on the story

[1] for Acemoglu, Johnson, and Robinson, the three authors

AJR tell. The AJR paper explains variations in GDP/capita across borders by the adoption of inclusive vs. extractive institutions in a given colony during the colonial era. One can think of inclusive institutions as early forms of liberal democracy. AJR suggests that disease prevalence was the main determinant of which institutions were adopted in a given colony; where settlers could live, they set up inclusive institutions, where they could not live, they set up extractive institutions. But, what the paper does not explain is why European colonizers had access to these inclusive institutions? Why is it that European colonizers could, if they wanted to, copy and paste their mother country's institutions to a new colony? Where did these institutions come from in the first place? [2]

I go further back into history to find an exogenous shock, or IV, that pushed Western Europe down the path to liberal democracy while forcing other countries off this path. The paper considers exposure to the Mongols as an IV and shows robust results in a two-stage least squares (2SLS) regression. The suggestion is, Mongol invasion forced countries to adopt more autocratic institutions, which impeded growth. Given the Mongols did not invade Western Europe, the region developed comparatively more liberal institutions facilitating development. The results are robust to different model specifications and spatial correlation. Additionally, I will make the case that the only realistic violation of the exclusion restriction would bias the results downward, suggesting the findings are conservative.

The paper stands in contrast to many other theories as to why Western Europe initially ascended to prosperity. For example, the paper's findings do not support theories founded on geographic determinism, religion, human capital, or trade. In the broadest context, the paper's main contribution suggests the emergence of Liberal Democracy in Western Europe was primarily caused by the area's relative isolation from a war. Eurasia was destined to produce two highly incompatible worlds, an agrarian city-state world and a nomadic one, a war for dominance between them shaped the modern world. Luckily for Western Europe, they spent the most time watching from the sidelines.

1.1.2 Empirical Motivation

> *For the specific context of Acemoglu, Johnson, and Robinson's work, the finding that mortality rates are correlated with growth differences is itself*

[2] For similar work see(Rodrik et al., 2004, Miguel et al., 2004, Hall and Jones, 1999, Casey and Klemp, 2018). A vital contribution to this type of research was made by (Heckman, 1997), who showed that natural experiments are a type of IV estimation.

a data pattern of interest and one that theory ought to address.

— (Durlauf, 2009)

I will straight away address a concern that will be on many people's minds. How can I plausibly make a case that something that happened hundreds of years ago affects economic output today? I will regress contemporaneous variables on a variable that represents events that occurred hundreds of years ago. How can I make a causal case? The reality is causality is almost impossible to prove in papers like this. The critical question is: what is the alternative?

The above quote relates to a critique of growth regression made by Steven Durlauf. Durlauf makes both a very technical point and a rather obvious one. The technical issue is that growth regression suffers from what he labels *model uncertainty*, meaning there is no way to know from theory which variables are or aren't exogenous. This leads to the rather obvious point, all growth regressions potentially suffer from endogeneity. So how do you proceed to uncover which variables are causal if growth regression can't shed light on causality? Well, as Durlauf alludes to, one method is to look at history to uncover data patterns, or correlations, to shed light on potential causal variables.

I have already talked about the Acemoglu, Johnson, and Robinson (AJR) paper above. Essentially Durlauf is critiquing critiques of the AJR paper. Durlauf is essentially pointing out that while the AJR paper is hard to prove, it is at least trying to find the answer in the right place. This is similar to the famous story of the person who loses their keys in the dark but looks for them in the light. While the AJR paper uses suspect data, historical anecdotes, and small sample size, there is hope to find the keys.

I go into detail with regards to this criticism because I will do something similar to AJR. I will give the reader a correlation between history and growth differences and then offer a causal mechanism. [3]

1.1.3 Empirical Methodology

At the most basic level, the paper's goal is to estimate the effect of institutional quality on output. Essentially find β in the following equation.

[3] (Sala-i Martin, 1997) make a similar case. Their famous paper runs a million growth regressions to point out the problem Durlauf alludes to.

$$(GDP/Capita)^i_{today} \;=\; \gamma \;+\; \beta(\textit{Institutional Quality})^i_{today} \;+\; e_i$$

However, this is a classic example of endogeneity, and thus β is not accurate. Many techniques, some quite elaborate, have been utilized to address the problem. The approach I will employ is to add exogenous geographic controls and instrument for institutional quality. Like the AJR paper I want to find a geographic variable such that the following is true:

$$\text{Geographic Variable} \Rightarrow \text{Institutional Development}$$
$$\text{Output Today} \not\Rightarrow \text{Geographic Variable}$$

That is, the geographic variable has an effect on institutional development, but output today could not plausibly affect this variable. This structure allows us to isolate the direct impact of institutions on growth and not pick up the backward causality. Recall in the AJR paper the geographic variable was the prevalence of certain diseases that affected only Western Europeans. My thesis then becomes the following:

$$\text{Eurasian Steppe} \Rightarrow \text{Mongols (IV)} \Rightarrow \text{Institutional Development}$$

Essentially the unique geography of the Eurasian Steppe created the Mongols. The Mongols then were a shock to institutional development, and clearly, output today would not affect the Eurasian Steppe or where the Mongols invaded. Econometrically I will obtain something like the following:

$$(GDP/Capita)^i_{today} \;=\; \gamma \;+\; \beta\widehat{IQ}^{\,i} \;+\; \alpha\boldsymbol{G}_i \;+\; e_i$$

Where:

- $\boldsymbol{G}$ – Geographic controls
- $\widehat{IQ}$ – is the predicted/instrumented institutional quality

More precise equations will be presented in section 3.2. The critical point here is to connect the history to be discussed to the assumptions required for accurate

estimation. Thus while the history to be presented can be detailed, it is important to keep in mind how it connects to the methodology and vise versa.

A brief road map of the paper is as follows. Section 2.1 discusses why looking at Eurasia offers an suitable control for geography. In section 2.2 – 2.3, I discuss the Eurasian Steppe in general and the Mongols in specific to build a suitable instrumental variable and discuss the mechanism by which institutions were shocked and, importantly, only institutions were shocked, discussed in section 3.4 – 3.5. Following empirical analysis in sections 3.1 – 3.3, I will turn to section 4 to discuss history to elaborate how this institutional shock has persisted until the present day.

1.2 Historical Context

1.2.1 Why Eurasia First?

To answer the why Europe first question, one must first answer the 'why Eurasia first' question. Many archaeologists, anthropologists, and historians, along with social scientists in general, have noted that pre-industrial revolution Eurasia was more prosperous than the rest of the world. Why is this so? In short, the answer offered by most is that Eurasia had a geographic advantage over the rest of the world. The idea has been espoused by many but is most famously attributed to Jared Diamond; see (Diamond, 1999). Diamond pointed out Eurasia had access to more domesticatable plants and animals, a temperate climate, access to the ocean, and a long east to west axis. These factors allowed for the development of agriculture and the diffusion of agricultural technologies.

I will focus on the long east-west axis more so than other components (see figure 1.1 showing each continent's longest axis). The benefit of a long east-west axis is relatively straightforward. Climates tend to change much slower from east to west than north to south. Thus Eurasia had an extensive scope for the exchange of technologies. A technology invented in China might be adaptable to similar climates in far off Europe and vise versa. Importantly, this isn't just theoretical; we have many historical accounts and archaeological evidence of the diffusion of technologies across Eurasia to a much greater extent than any other continent.

Looking at historical empires gives strength to Diamond's hypothesis. Con-

Figure 1.1: Eurasia's Long East-West Axis

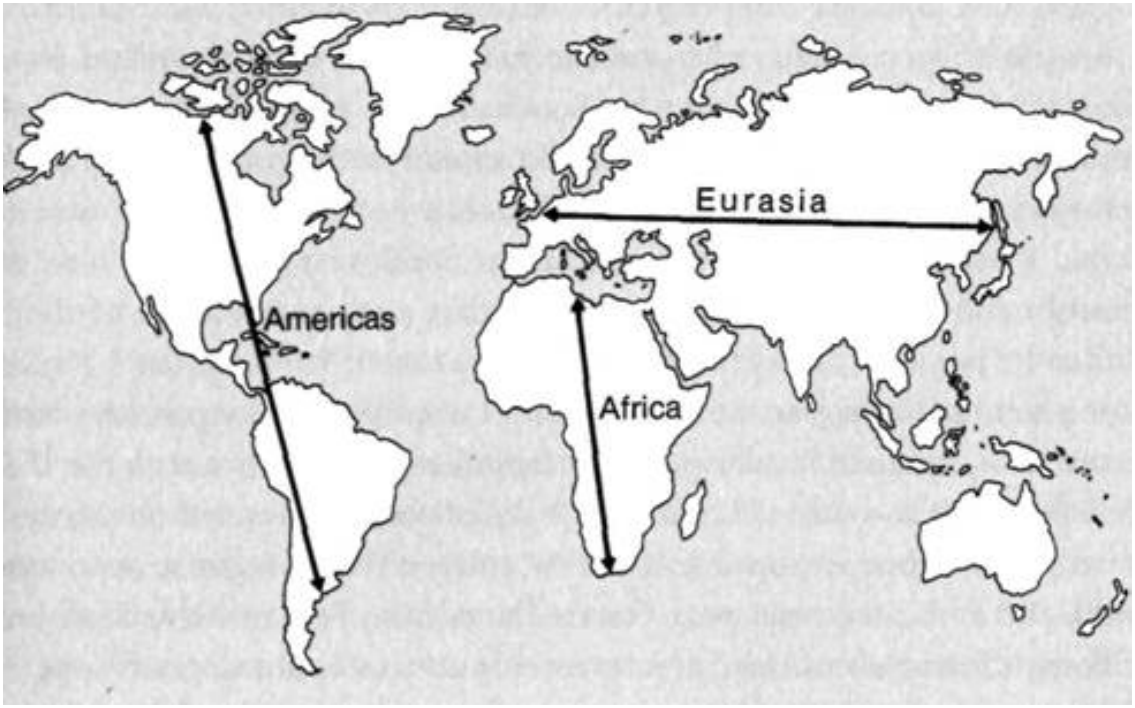
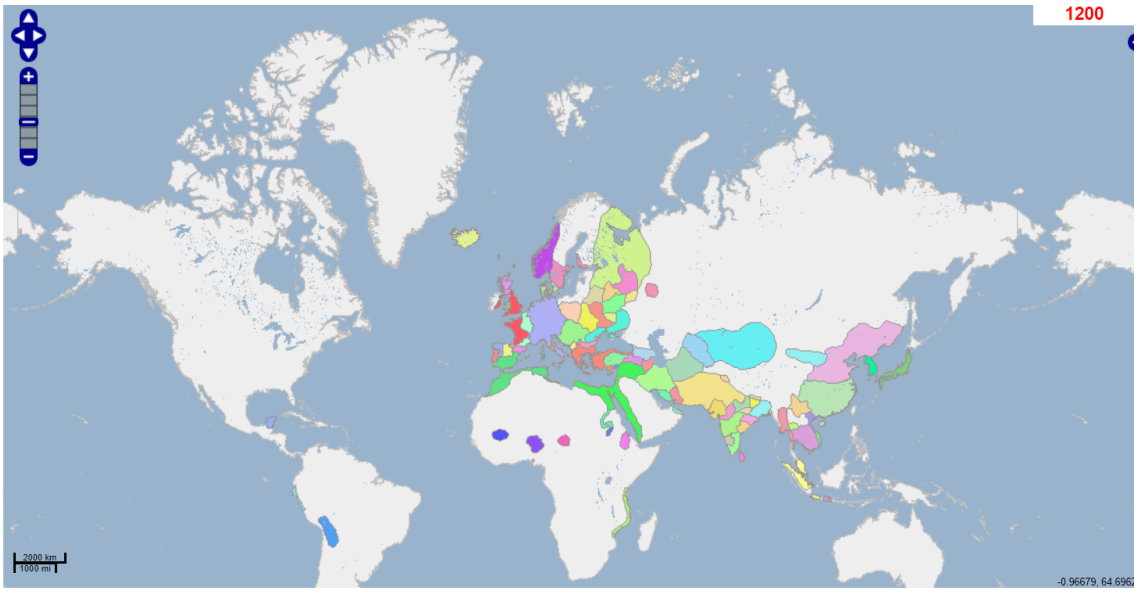


Figure 1.2: World Empires in 1200 CE

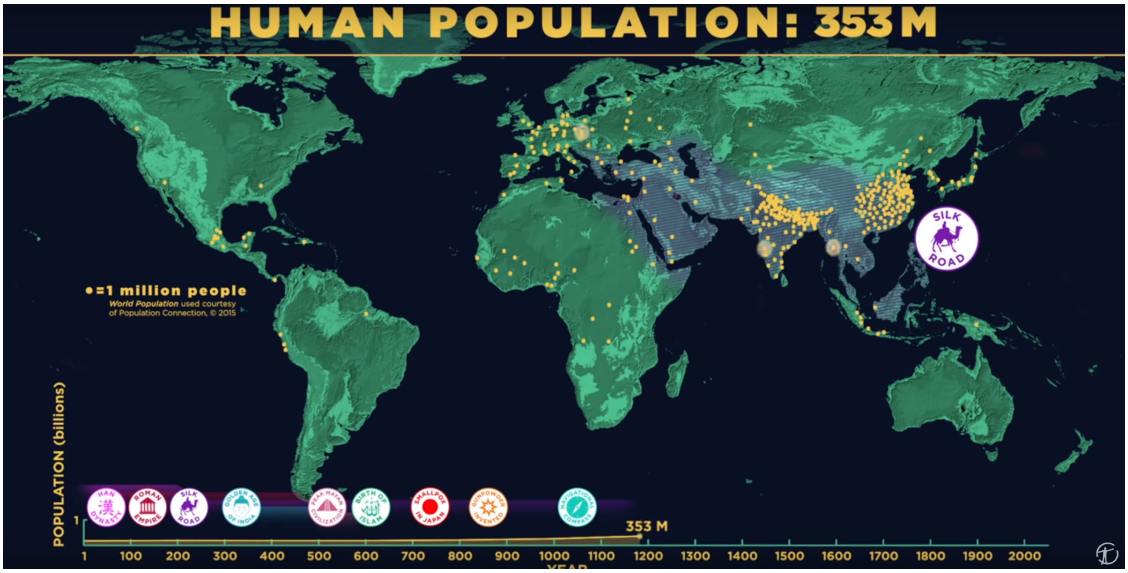


sider the map of world empires in the year 1200 CE (see figure 1.2). [4] The first thing to notice is that empires primarily existed in Eurasia. Given the first thing required for an empire is agricultural productivity, as food abundance allows people to leave farming to become soldiers, it seems clear, merely looking at this map, that Diamond's claim appears accurate. If empires imply an agricultural surplus, and

[4]The image is from a website that depicts the expansion and contraction of empires through time; see (GeaCron).

being close to the East-West axis implies an agricultural surplus, we would expect to see empires span out along the East-West axis. Indeed this is just what we see. Note: from here on, I will refer to the Eurasian east to west axis depicted in Figure 1 as the East-West axis.

Figure 1.3: World population in 1200 CE



This claim can be further backed by looking at the location of world population in the year 1200 (see figure 1.3). If the East-West axis implies agricultural surplus, and high levels of population imply an agricultural surplus, then we would expect to see a dense population along the East-West Axis. Indeed this is what we see.

Along with Agricultural surplus and subsequent population density comes the parallel development of complex institutions. Thus, the Eurasian geographic advantage allowed for the initial conditions required for the emergence of something akin to liberal democracy, which was a conduit for the Industrial Revolution. The next step is to look at an institutional shock that set Western Europe down the path of liberal democracy while knocking other regions of that path.

1.2.2 The Mongol Empire

2.2.1 The Story of the Steppe

The overriding story I will tell is one of a geographic characteristic affecting institutional development. At heart, the story revolves around the Eurasian Steppe (see figure 1.4). The Steppe is a 8,000 KM plain spanning from Hungary to China. While much of Eurasia is very hospitable to agriculture, the Steppe was not. The Steppe is said to have two seasons, an eight-month harsh winter followed by a blazing hot summer. The Steppe's distance from any significant body of water creates vast swings in temperature and unreliable precipitation.

Figure 1.4: The Extent of the Eurasian Steppes

The Steppe, for most human history, until recent centuries, has been inhabited by nomadic people. While much of Eurasia saw the emergence of agriculture and city-states, the Steppe, until recently, remained nomadic. With domestication of the horse by nomadic people, the Steppe began to rise as a military threat. Horse domestication took centuries, but it's believed humans began to ride horses around 3500 BCE.

Eurasia can be historically characterized as having two worlds, a nomadic one and a sedentary one. The worlds have often not coexisted peacefully. When the worlds meet, they "rub up against each other like sandpaper" (Carlin, 2010). There are many reasons to believe that peaceful coexistence between the two groups would always be at odds, if not impossible. The most economic theory in nature as to why this is the case suggests common climate conditions generate shared food shocks. Poor agricultural yields happened as nomadic peoples experienced shortages of game to hunt. Thus, when the nomadic people desired to trade the most, prices for what they desired would be the highest. Therefore, the temptation to pillage and raid a sedentary society in tough times was inevitable. Furthermore, as the population grew, agricultural societies constantly desired more territory, which saw them encroach upon valuable nomadic hunting territory. Though there were extended periods of peace, the two sides' interests were "fundamentally irreconcilable, and confrontation between them was unavoidable" (Khodarkovsky, 2002).

It is vital to note that while the Eurasian Steppe, and the nomadic tribes that inhabited them, do not play a significant geopolitical role in today's world, they played a central role in the past. Given nomadic lifestyles are very rare in the modern world, it is hard for us to imagine that in Eurasia, the nomadic world would have competed with, and at times dominated, the agrarian city-state world. Yet, this indeed happened. And I suggest it had a significant impact on institutional and subsequent economic development. Yet, given we do not see this today, we are biased to understate the effect the interaction of these worlds has had on the modern world.

To this point, there is no justification to only focus on one tribe of the Steppe. However, it is clear that historically one tribe had a much more dramatic impact on the world than the others, that tribe being the Mongols. [5] Furthermore, the Mongols had a unique history in that for somewhat random reasons, they, unlike other nomadic tribes, never made it to Western Europe (to be discussed in section 2.2.f). Thus, unlike when the Roman Empire, for example, had to deal with the Huns, Vandals, or other Steppe tribes, Western Europe was spared from having to deal with the greatest and most feared of all Steppe tribes.

It is worth noting that recent evidence supports the claim that climate shocks influenced relations between the Mongols/Steppe and sedentary society. A recent paper suggests an extreme drought before Mongol invasions, and then as invasions began, there was a period of intense rainfall. In essence, the Mongols

[5]Note: it is more accurate to call the Mongols a collection, or confederation, of many tribes unified as one).

had perfect conditions for their rise as drought caused the desire to unite and raid. Extreme rainfall then allowed for very healthy horses and soldiers, "Genghis was literally able to ride that wave" (Pederson et al., 2014). With that said, there are many other reasons for Mongol success, which I discuss in detail in section 2.2.e.

It is worth a quick disclaimer that I do not intend this paper to say something negative regarding nomadic people in general. The reality is a sedentary life vs. a nomadic life will create the need for different sets of institutions and cultures. Unfortunately, these institutions and cultures seemed to conflict with each other. As with much of history, it is a tragedy a peaceful solution didn't emerge. The important point here is not to compare lifestyles. Instead, I want to make the case that for liberal democracy to emerge, sedentary societies needed to stay clear of the path towards autocracy. Interactions with nomadic tribes, and the Mongols in particular, tended them down this path.

2.2.2 Empires and Military Power

It is important to structure our thoughts regarding empires before focusing on the Mongols. By definition, an empire is: "an extensive group of states or countries under a single supreme authority" (Oxford Dictionary). While some grow very large and have long lives, like, for example, the British, the Roman, and the Mongol Empires, others are small and short-lived. So why do some empires grow vast and last for long periods while others remain small and quickly die out?

The answer, in short, is differences in military power. While there are historical examples of empires joining together peacefully, the reality is that almost all empires are formed through military invasions. Empires expanded as military power allowed them to. They got conquered when their military power faltered in the face of invasion. In short, the study of a great empire is the study of a powerful military. So what determines military power?

A shortlist of determinants of military power would include agricultural productivity, military technology, and authoritarian or autocratic control. I will focus on the last item in the list. Autocracy is crucial for military efficiency. Simply militaries operate the best with one leader and a strict hierarchy of command beneath the leader. Alexander the Great once pointed out "a military of sheep led by a lion" is much more formidable than a "military of lions led by a sheep" (Tarn, 2003). Strong tactical leadership and compliant and obedient soldiers make a military formidable. Note there is a very similar quote attributed to Genghis Khan.

This fact leads to a critical trade-off. A given country could maximize military power by giving supreme authority to one leader, but they will sacrifice individual liberties by necessity. Maximize military power, and you minimize personal freedom and vise versa. Every society must, in some form or another, make this trade-off. Why countries mitigate this trade-off differently and progress in different directions is a critical theme of the paper.

2.2.3 The Incredible Death Toll of the Mongols

In a recent book, historian Matthew White documents the 100 most deadly events in human history; see (White, 2011). White is well known as someone who studiously records historical death tolls; most consider him an unbiased and reliable source, noting, of course, there is always room for questioning such historical estimates. White puts Genghis Khan's conquests as the second deadliest episode in human history, with a death toll of 40 million ranked second only to World War Two (WW II).

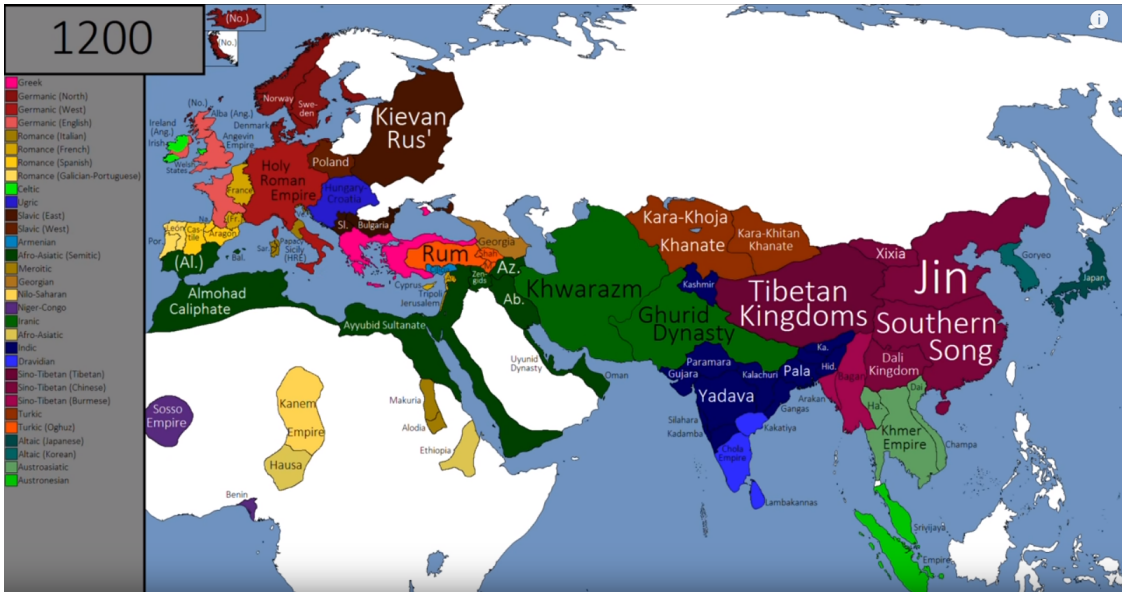
If correct, this is a remarkable death toll. Consider the population of the world in 1200 CE, roughly when the conquests started, was about 5% of what it is today; this means that the conquests of Genghis Khan killed approximately 10% of the world's population. While not the first empire to be responsible for such cruelty, the sheer death tolls make the Mongol Empire distinctly different than anything the world had previously seen.

To add to this, many consider Timur's conquest as an extension of Genghis Khan's. Timur, or Tamerlane, who began his conquests in roughly 1360 CE, thought himself a descendant of Genghis and felt it was his divine mission to unite the Mongol Empire under one leader once again. Timur carried out conquests in much the same way as did Genghis, with extreme force and brutality (Morgan, 2007). Timur's conquests are ranked ninth on White's list with a death toll of 17 million. Adding both death tolls together, as many historians do, gives us a toll very close to WW II. However, while roughly 2.5% of the world's population died in WW II, about 15% of the world's population died at Genghis and Timur's hands. These numbers are extraordinarily high and contemporaneously unprecedented. Note: this isn't even the end of death tolls attributed to the Mongol's, this is just deaths attributed to the two most deadly rulers.

2.2.4 The Largest Contiguous Land Empire in History

The paper's thesis suggests the geographic expansion of the Mongols was a shock to institutions in the lands they invaded. The Mongol Empire was dynamic and changed from year to year, but it is worth looking at a few key snapshots to demonstrate the empire's geographic expanse; note the Mongol Empire is considered the largest contiguous empire in human history. Figure 1.5 shows Eurasian empires in 1200. [6] Figure 1.6 shows the world just 27 years later, the year Genghis Khan dies. Note the incredible advance of the Mongol Empire under Genghis Khan.

Figure 1.5: World Empires in 1200 CE – Just Before Mongol Invasions Begin



Genghis spent much time contemplating the continuation of his empire after his death. Given this, he established legal codes for governance, called the Yasa, and strict rules for choosing a successor. He demanded that the Mongol Empire stay unified under one leader. He named his third son Ogedei to be his successor. If we look at figure 1.7, we see the Mongol Empire in 1241, the year Ogedei dies. Ogedei expanded the empire further into China, Russia, and Eastern Europe.

While Genghis did an excellent job naming his successor and ensuring everyone would remain consolidated under said person, Ogedei failed. Ogedei died unexpectedly and named his grandson to be his successor. However, at the time, his grandson was too young, only eight years old, to become great Khan. Ogedei's unexpected death marks a crucial turning point in our story, to be revisited in

[6] Figure 5–9 and 15–16 taken from (History of the World)

Figure 1.6: World Empires in 1227 CE – The Year Genghis Dies

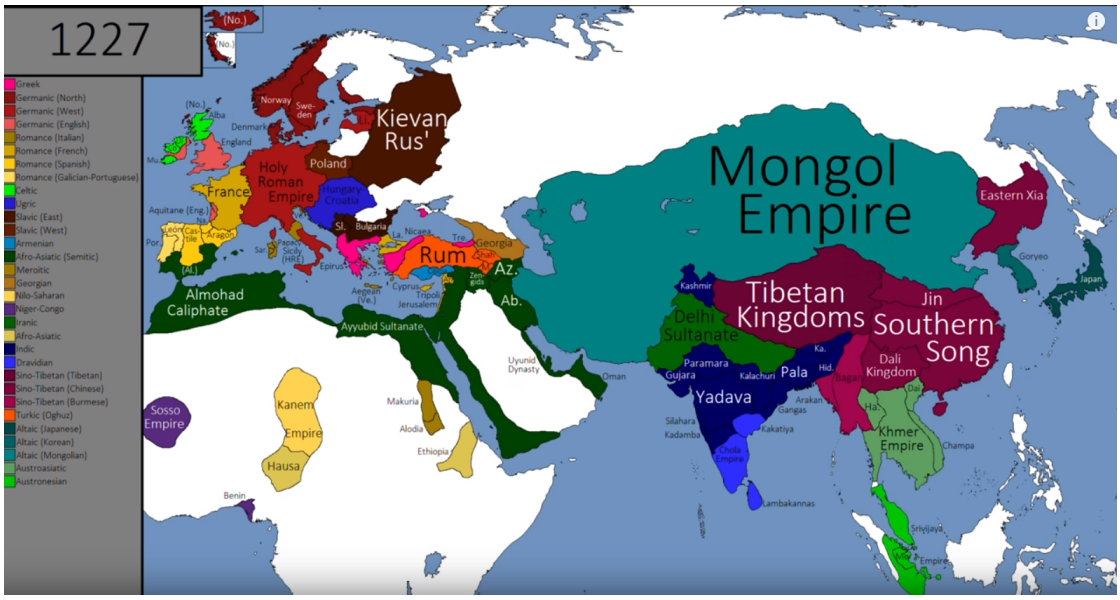
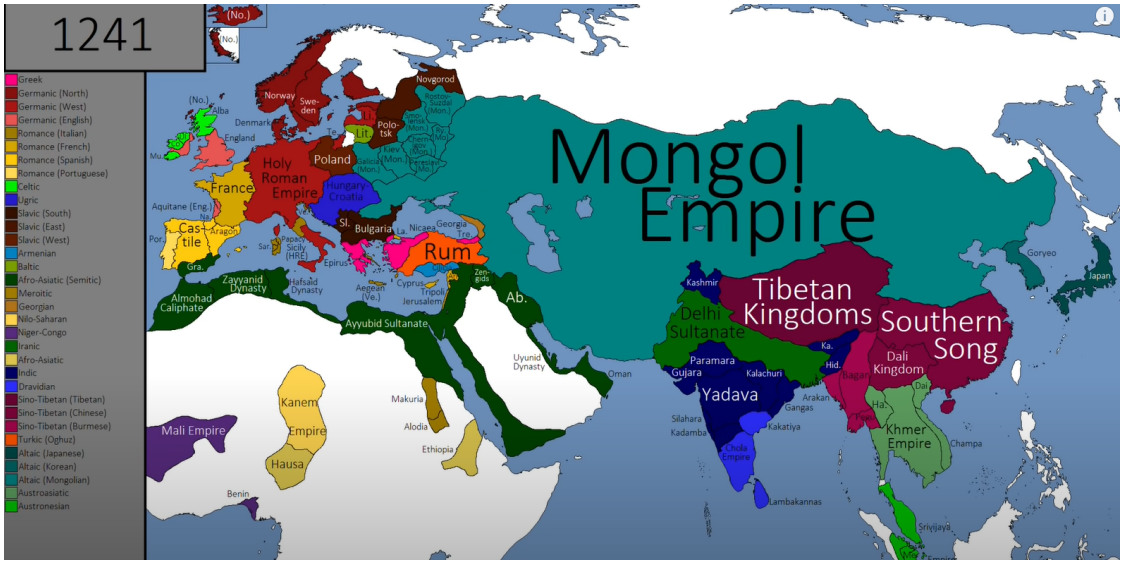


Figure 1.7: World Empires in 1241 CE – The Year Ogedei Dies

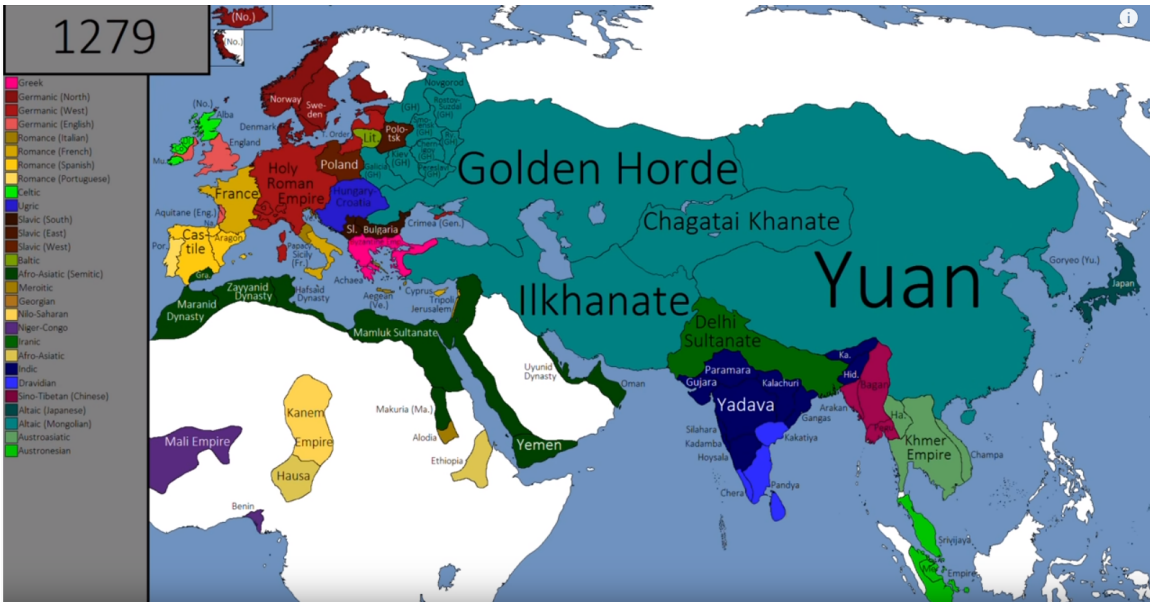


section 2.2.6

Figure 1.8 shows the Mongol Empire at its greatest extent in 1279. At this point, it had fractured into four parts in light green; The Golden Horde, Chagatai, Ilkhanate, and Yuan. The four pieces were divided among Genghis's four sons: Jochi, Chagatai, Ogedei (the successor to Genghis), and Tolui. While Genghis wished the empire to remain consolidated, this did not happen. The various houses, aligned to each of these four sons, started to fight with each other, and the empire was never again unified.

About 80 years later Timur enters the story. If we look at figure 1.9, we see

Figure 1.8: World Empires in 1279 CE – Geographic Height of the Mongol Empire



the Timur Empire at its greatest extent in 1425. It is worth quickly pointing out that if one looks at the East-West axis (roughly from Paris to Northern Japan) in this map, it cuts right through the heart of the empires in Eurasia, again substantiating Diamond's claim. It is also worth zooming out, to see most of the world's empires are still in Eurasia.

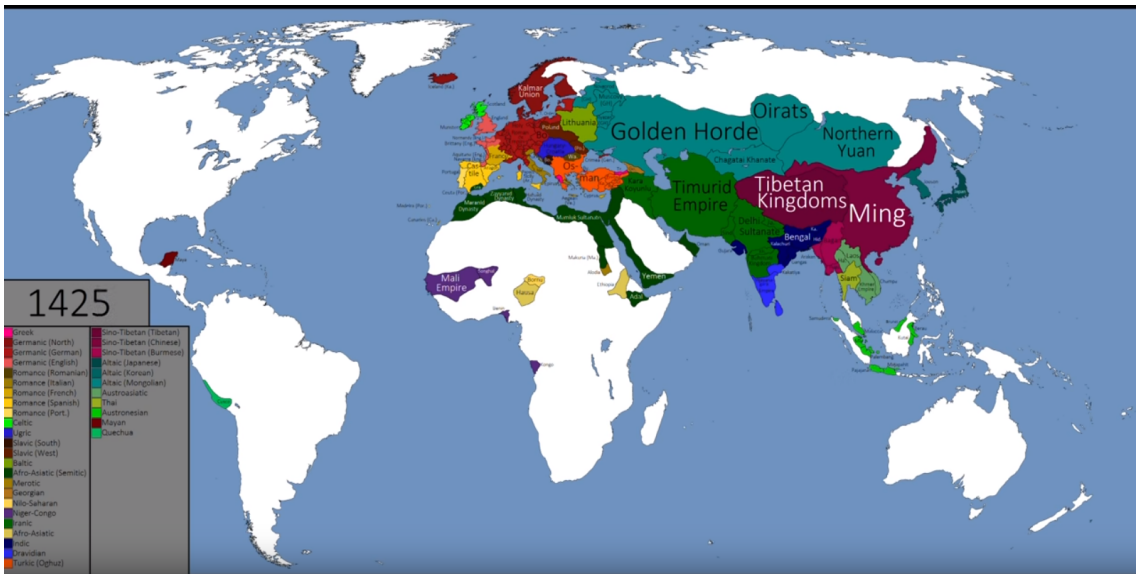
Timur's big success that other Mongol rulers were unable to accomplish was his conquests in India. Timur's goal, as mentioned, was to reunite the empire under one ruler as it had been under Genghis, but he failed to do so. Notably, Timur's grandson Babur set up the Mughal Empire in northern India, which remained in power until 1857. Mughal is an altered spelling of the word Mongol. Note that Mongol rule did not disappear from the world until the 20th century; the last known descendant of Genghis to rule, ruled a part of modern-day Uzbekistan until 1920; (Ringmar).

2.2.5 What Explains the Mongol's Success?

Suppose one thinks of the Steppe as a military development program, a weapon systems advancement tool, combining the horse with the bow and rider to evolve into increasingly dangerous armies. Then the Mongols were the culmination, the nuclear bomb.

Concerning military technology, the Mongols perfected horse riding and

Figure 1.9: The Timurid or Timur Empire in 1425 CE



arrow shooting as a method of attack. Their composite bow allowed their horsemen to pierce through armor from hundreds of meters away. They invented a type of stirrup that allowed the rider to shoot while standing up and turning in different directions (see figure 1.10); see (Inglis-Arkell). Mongols archers were incredibly accurate; it's been noted they could shoot birds out of the sky while riding a horse in full stride.

Figure 1.10: Mongol Bow and Stirrup

Tactically the Mongols had very advanced strategies of attack. Marco Polo

describes how the Mongols never maintained one position but instead attacked by "perpetually riding around and shooting into the enemy". A famous scholar of military strategy points out that the German's borrowed many tactics from the Mongols during World War II. The German generals felt they needed to return to more mobile forms of attack to prevent trench warfare seen in World War I. The concept of Blitzkrieg came from generals who studied the Mongols. The idea being you should surprise, encircle, and cut of opposing armies before they can form a well-defended perimeter; see (Gabriel, 2006).

A key Mongol tactic was to keep the enemy from a strong defensive position while drawing them out into open areas where they could leverage their superior cavalry. As a testament to their military power, (Gabriel, 2006) suggests the unified Mongol army was so advanced that a European army wouldn't have won a decisive victory against them until the mid to late 19th century holding Mongol technology constant at a mid-13th-century level.

With the above noted, the most significant advantage the Mongols had was not technological or strategic but institutional. Before Genghis, the area in and around Mongolia, referred to as the Eastern Steppe, was fragmented into many small nomadic tribes. Genghis unified the peoples of this region to a remarkable degree. Great strategy and technology are useless without a strict hierarchy of command to implement them; that is a lion to lead the sheep. Genghis entrenched the necessary components for highly autocratic, and militarily efficient, governance.

Genghis Khan is considered by many to be the greatest military strategist in history. Great military strategy and unity form a dangerous feedback loop. The better the strategy, the more troops will unify under the leader. The more soldiers a leader has, the better they can implement a strategy, and so forth. Genghis played this feedback loop as good as, if not better than, any person in history.

Given the above-noted supremacy of the Mongol armies in open battlefields opposing armies would almost certainly retreat into a city. Cities at the time usually had large walls surrounding them to prevent invasion. Thus, the Mongols spent much of their time laying siege to cities. While nomadic armies of the past often failed in breaching the fortification, the Mongols were much more advanced. During their initial invasions, they learned from the Chinese and developed cannons and other types of equipment that were quite advanced and able to breach defensive fortifications.

While the Mongols employed many highly effective military strategies, the most effective and deadly tactic was a rule – if you don't immediately surrender,

you die. The vast majority of the deaths at the Mongols' hands resulted from mass killing in cities that did not surrender. For example, during the Mongol conquest of Baghdad, as many as 1.5 million people were killed in a matter of days, see (Frazier); I will revisit this story in section 4.2.d. While it was not the first time this tactic had been used, the Mongols utilized it on an unprecedented scale. Comparing them to a nuclear bomb, in practice, is quite apt. Given the credible commitment that not surrendering was met with death, cities began to submit with time. The Mongols began to win battles before they arrived.

2.2.6 Why didn't the Mongols Invade Western Europe?

This question is of vital importance, and it serves as a bridge to empirical analysis. I suggest the Mongols were a shock to institutional development in the areas they invaded/conquered, but, importantly, they never made it to Western Europe. Thus it is essential to establish this difference in exposure to the Mongols was primarily due to a historically lucky break for Western Europe and not some other confounding factor.

Notably, the reason the Mongols didn't venture into Western Europe was not that they felt Western Europe was too powerful or difficult to conquer. The Mongols were ready to invade Western Europe after they invaded Poland and Hungary in 1241 but turned back, given they needed to return to Mongolia for the election of another great Khan. As mentioned, this is the year Ogodei unexpectedly dies. Consider the following quote: "At that point, Bela–and Europe–were saved by a stroke of great fortune: Ogodei, the Great Khan, suddenly died. To high-ranking Mongols, it was vital to be present" (Hansen, 2012).

The flip side to being unified under one leader is when that leader unexpectedly dies, what does the army do? Who do they take orders from? The answer is no one; they shut down and wait. The Mongol army was incredibly powerful at this point but had no choice but to turn itself off. As it happened, it did not start back up again for a decade.

It took years to name a successor to Ogedei. When they finally elected Guyuk, Ogedei's son, in 1246, he unexpectedly dies just two years later. Ogedei did a lousy job of naming a successor, and Guyuk did an even worse job. The lack of clarity as to who should be the legitimate khan, and more importantly, who should get to choose, led to infighting, a problem that was never resolved. The Mongol Empire was never unified again. Amidst all the infighting Monke, son of Tolui was

named the next khan in 1251. However, Monke's immediate focus was on the Middle East rather than Western Europe.

While Ogedei was focused on the immediate conquest of Western Europe, Monke was not. Mongol sentiment post-Ogedei was that "there were fatter and better target elsewhere" (Hansen, 2012) or "put simply, Europe was not the best prize on offer" (Frankopan, 2015). They were " disappointed with the general poverty of the area compared with the Chinese and Muslim countries, turned away and did not bother to conquer the cities, loot the countries, or incorporate them into the expanding empire" (Weatherford, 2005). Even though Western Europe was not their most pressing concern, if the Mongols remained united, they eventually would have returned to Western Europe, and there is little doubt they would have conquered the region. However, after Ogedei's death, too many resources got tied up fighting each other. Mongol power began to fade.

It is essential to note the Mongols defeated themselves more so than any outside force. The first significant victory against the Mongols that pushed them territorially backward is considered 'the battle of Ain Jalut' in 1260 against a force known as the Mamluks (essentially modern-day Egypt); see (Amitai-Preiss, 2004). It is important to mention that the army that lost in this battle was only a fraction of the unified Mongol army that just recently sacked Baghdad in 1258. In the years following 1258 Mongol forces began to rapidly get absorbed into internal battles. Most historians agree a unified Mongol army would have won the battle of Ain Jalut easily. The Mongols greatest enemy came from within.

The unexpected death of Ogedei constitutes one of the great what-ifs in human history. Before invading Europe, Mongol leaders estimated it would take about ten years to capture all of Europe. In 1241, after the conquests of Poland and Hungary, the Mongols were ahead of schedule. Western Europe was saved from untold death and destruction by a stroke of good luck. One can only imagine how much history would have changed had Ogedei lived ten more years!

1.2.3 The Suffocation of Democracy/Liberalism

In an in-depth book about the history of democracy, David Stasavage argues that we often falsely celebrate democracy as uniquely European; see (Stasavage, 2020). Stasavage argues against the simplistic yet standard view that democracy emerged with Greek thinkers and took early forms in ancient Greece and Rome. While disappearing for a while in the dark ages, it reemerged in Europe later on during

the renascence. And the rest is history. Counter to this, Stasavage suggests that early forms of democracy could be found all over the world. That there is nothing inherently European about democracy, and for that matter, liberalism. Instead, Stasavage argues, democracy emerges when the state is sufficiently week. Thus, the question becomes not why democracy is distinctly European; instead, why are weak states distinctly European?

The suggestion here is that a significant historical event, Mongol invasions, pushed areas they invaded to accept more extensive, authoritarian, and powerful states. The road to autocracy was paved with external threats. Europe, and more precisely Western Europe, enjoyed relative security and peace compared with their Eurasian neighbors.

While the Mongol Empire had a very complicated and lengthy set of rules for governance, the following quotes sum up the core of their ideology "resistance would be meet with death, loyalty with security" (Weatherford, 2005); or take a similar quote "peaceful submission was rewarded; resistance was punished brutally" (Hansen, 2012). Economist Deirdre McCloskey makes a simple yet powerful suggestion "when you have a war for survival you can't be liberal" (Trevor Burrus and McCloskey). Societies fighting the Mongols could not be liberal when to survive, you are forced to submit to complete subjugation to your conquerors. Individual freedom becomes secondary to survival.

Many note that under the Mongols, certain individual liberties thrived. The Mongol Empire was a vast region where trade was protected and flourished. Furthermore, the Mongols tended to support religious freedom.[7] However, even though some elements of freedom and individual liberty were present, one needs to ask: how could a genuinely liberal society enshrined in individual rights, ever come from a place where resistance is met with death? The Mongols saw death and destruction as completely necessary if it destroyed individual identity. The only identity that was permissible was one that was first and foremost wholly loyal to the Mongols. Thus, while some liberties thrived under the Mongols, the foundation for a genuinely liberal society was eroded entirely.

[7] to be more precise, they supported religious freedom in the early era of the empire, but as many converted to Buddhism and Islam, they became less tolerant.

1.3 Empirical Analysis

1.3.1 Data Description

3.1.1 The IV

Let's first define a variable: M^i will represent the degree to which a modern country, indexed by i, was affected by the Mongol Empire. There is no single clear choice of M^i, but a logical option would be:

- $M^i_{\%,t}$ - a measure of time spent invaded by the Mongols and the percentage of the country invaded. I construct the variable using the (GeaCron) website. I mark the year the Mongol's entered and exited the territory of a modern-day country. I record the number of years the Mongol's occupied the region. I then multiply this number by the percentage of the country invaded. I then normalized it to be between 0 and 1. *Example: The Mongols entered Ukraine in 1242, exited in 1442, and conquered* 75% *of the country. So we get a value of (1442 - 1242)*$\times .75 = 150$*. I then divide this number by the maximum value; which is Pakistan = 438. Thus,* $M^{Ukraine}_{\%,t} = 150 \div 438 = 0.34$

I will use this variable as my main instrument with additional instruments in robustness checks. To see how $M^i_{\%,t}$ was constructed, along with other instruments to be used, see the Appendix. See Figure 11 for a visual representation of the geographic distribution.

3.1.2 Geographic Controls

Additionally, I will include a measure of geographic quality. My story suggests that many parts of Eurasia had a roughly equal likelihood of having an industrial revolution. The emergence of different institutional structures resulted in Western Europe winning the race. However, while I suggest Eurasia had a geographic advantage over other continents, we should not consider this to be the same across Eurasia. Eurasia is a vast landmass that varies widely in terms of geographic quality.

The key variable I will include aims to capture the advantages of being on the Eurasian East-West Axis. Economic research often promotes either institutions

or geography as the cause of long-run differences in GDP/capita across countries; I suggest both play a role.[8]

The issue with promoting geography as the fundamental cause of growth is that geographic variables are often endogenous to growth. While in a broad sense geography is exogenous, the earth was in place before modern growth, many measures of geographic quality are not exogenous. Instead, they are deceptively endogenous to other factors, such as institutions. As an example, consider disease prevalence. Many have argued that high disease prevalence in some countries demonstrates a fixed geographic disadvantage, which has caused lower growth rates. However, one can reason that disease prevalence is largely endogenous to institutions, the suggestion being that a high incidence of diseases is caused by inadequate incentives to cure them. Thus countries are not necessarily naturally endowed with more diseases, but rather, lack good institutions. The task then is to find a purely exogenous measure of geographic quality.

To construct an exogenous measure, what is essential to consider is the relative advantage a given country had with regards to its ability to share technologies (see section 2.1). The critical geographic variable I will use is a measure of the distance the center of a given country is from the East-West axis (roughly the 48th parallel). Let me define:

- East-West Axis Proximity – a variable between 0 and 1 that is increasing the closer you get to the East-West axis. For example, if a country is on the equator it would get a value of 0 while a country right on the axis would get a value of 1 (see appendix for a detailed description)

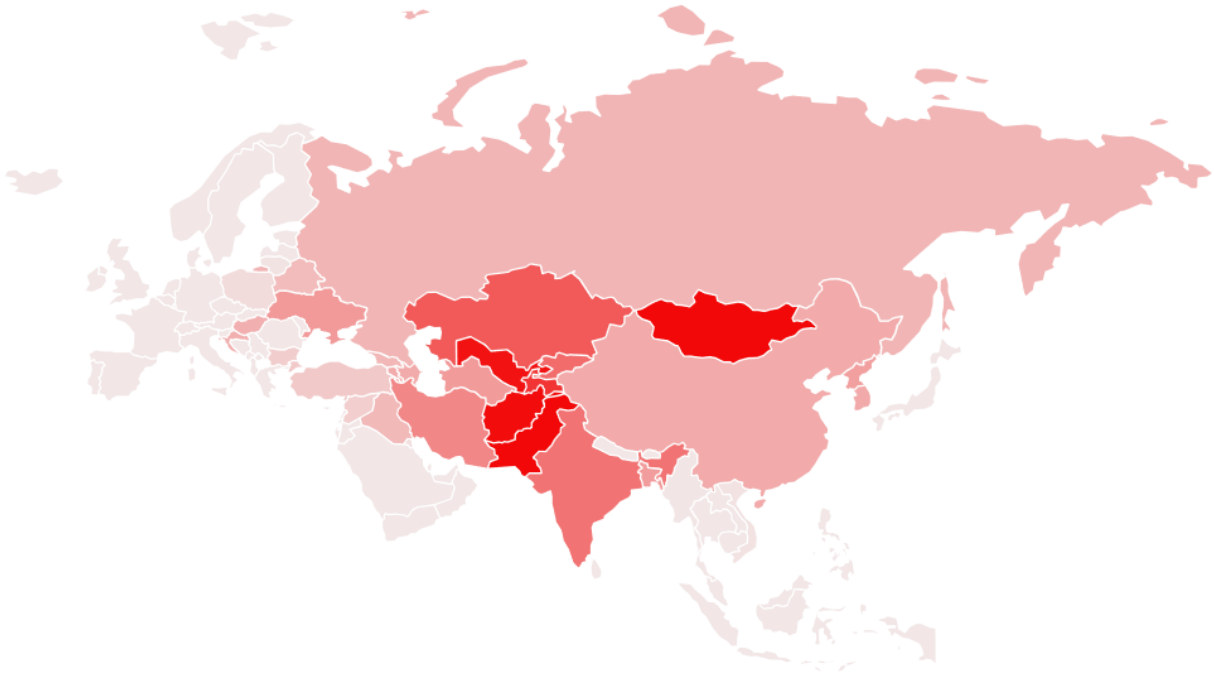
East-West Axis Proximity can be considered an exogenous measure of geographic quality. The measure emanates from the good fortune of some to end up where agriculture had significant advantages via a temperate climate and a broad scope for the diffusion of technologies. Thus, while instrumenting for institutional quality with $M^i_{\%,t}$, the East-West Axis Proximity variable does not require such treatment and can be viewed in terms of its direct effect.

Finally, in the primary regression, I will include a dummy variable that is 1 if landlocked and 0 otherwise. The argument for including this in the primary regression is straightforward. The Mongols were a land empire; perhaps all they did was conquer countries destined to be poor due to being landlocked. At the time

[8]For work supporting geography as the fundamental cause of growth see (Diamond, 1999, Gallup et al., 1999, Sachs and Warner, 2001).

of Mongol invasions, arguably the world's most important trade route was a land route, the Silk Road. However, with time trade began to be dominated by sea-going vessels. The dummy variable does a good job of taking care of this potential confounding factor. I will also consider other geographic variables in section 3.4.

Figure 1.11: Map of $M^i_{\%,t}$



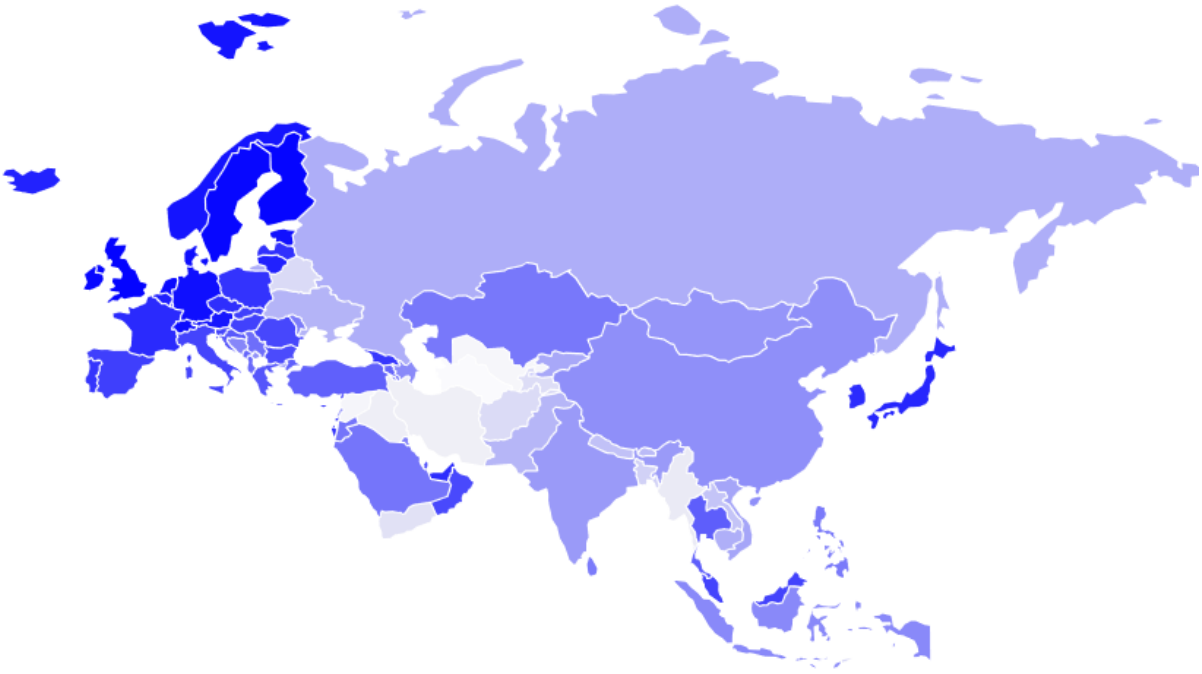
The darker the red the greater the effect of the Mongols. The countries with the lightest shade (see Western Europe) were not invaded at all

3.1.3 Dependent Variables

For the dependent variable in the first stage, I will use a measure of institutional quality called "Civil Liberties" published by Freedom House; see (House). I will label it *CL* for short. According to Freedom House, Civil Liberties captures "Individual freedoms–ranging from the right to vote to freedom of expression and equality before the law". While there are many potential institutional quality measures, 'Civil Liberties' emphasizes democracy and individual freedom. Autocratic governance implies no adequate checks on the state's power and low levels of civil liberties, which impedes the development of institutions such as property rights vital for growth.

Looking at figure 1.11 and 1.12 one can visually see a clear negative correlation between $M^i_{\%,t}$ and *CL*, ρ = -.4 (Note: the variable is measured from 0-60 and is increasing in institutional quality).

Figure 1.12: Map of Institutional Quality (CL)



The Darker the blue the higher percentile rank, i.e. the darker the better the institutional quality

Finally, I will use GDP/capita as taken in the year 2016 as the second stage dependent variable; taken from the World Bank.

1.3.2 Estimation Equations

The following equations summarize the first and second stage of the 2SLS analysis.

First Stage

$$CL^{i}_{2016} = \gamma + \theta M^{i}_{\%,t} + \boldsymbol{\omega G}_i + e_i \tag{1.1}$$

- Where:
  - γ: a constant
  - CL: Civil Liberties
  - $M_{\%,t}$: Measure of how much a given country was effected by the Mongols
  - $\boldsymbol{G}$: A vector of Geographic Controls
    - East-West Axis Proximity
    - Landlocked Dummy – 1 if country is landlocked, 0 otherwise

Second Stage

$$log(GDP/Capita)^i_{2016} \;=\; \widehat{\Gamma} \;+\; \Theta\widehat{CL}^{\,i} \;+\; \boldsymbol{\Omega G}_i \;+\; u_i \tag{1.2}$$

- Where:
  - $\widehat{\Gamma}$: the predicted intercept from the first stage
  - $\boldsymbol{G}$: the same as in the first stage
  - $\widehat{CL}$: is the predicted institutional quality from the first stage

See table 1.1 below for summary statistics. Note the average of $M^i_{\%,t}$ = .1 seems very low, but if weighted by population (to be discussed) it is quite a bit higher, equal to .3.

Table 1.1: Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Max
$(GDP/capita)_{2016}$	91	24,462.530	32,753.800	571.074	193,745.600
CL_{2016}	91	34.971	18.261	2.000	60.000
$M^i_{\%,t}$	91	0.117	0.231	0.000	1.000
East-West Axis Proximity	91	0.706	0.266	0.011	1.000
Land Locked Dummy	91	0.275	0.449	0	1

The exclusion restriction implied by the IV estimation is that conditional on controlling for the variables in the regression, Mongol invasion did not affect GDP/capita today other than through a shock to institutional development. The regression will include all the countries in Eurasia (N=91); see appendix for full list of countries and summary statistics.

1.3.3 Regression Results

In the first stage we must verify that there is a statistically significant negative correlation between CL and where the Mongols invaded. We can see this is indeed the case (see table 1.2 below). Note with a F-statistic of 24.496 in (1), 24.133 in (2) and 19.871 in (3), the instrument is suitably strong.

Regression (1) uses no weights, while regression (3) shows results weighting by population. Weighting by population is logical as I suggest that the Mongols largely determine a country's population. The logic being, countries invaded would end up geographically bigger and thus likely more populated (see further discussion

in section 4). Furthermore, there is a natural logic to weighting by population as we care about people, not per se a country. With that said, the reality of doing so means China, India, and Indonesia, to a significant extent, determine the results; this is a problem not in theory but practice. The best solution is to show that we get the same statistical significance with no weights and population weights. Thus, it would be true for any weights in between. Regression (2) shows weights by the log of population. There is no clear candidate for in-between, but natural log makes intuitive sense. Regardless, the log population results show that some in-between weights also result in statistical significance.

Table 1.2: First Stage Least Squares

	Dependent variable:		
	CL_{2016}		
	(1)	(2)	(3)
$M_{\%,t}$	-40.400^{***}	-40.118^{***}	-50.042^{***}
	(6.570)	(6.505)	(6.500)
Land Locked	-2.961	-3.051	7.758
	(3.604)	(3.677)	(6.054)
East-West Axis Proximity	38.906^{***}	38.434^{***}	16.485^{***}
	(5.828)	(5.835)	(5.689)
Weights	None	Log(Population)	Population
Observations	91	91	91
R^2	0.458	0.454	0.407
F Statistic (df = 3; 87)	24.496^{***}	24.133^{***}	19.871^{***}
Note:			*p<0.1; **p<0.05; ***p<0.01

In the second stage results are as expected with regards to $\widehat{CL}$; see table 1.3. The coefficient is positive and highly statistically significant both with no weights and with population weights. Landlocked is statistically significant in the population weighted case. East-West Axis Proximity is only statistically significant when weighting by population. The sign is positive as predicted. Figure 1.13 depicts the second stage of the regression. Note the coefficients on CL changes very little when adding East-West Axis Proximity. East-West Axis Proximity and $M^i_{\%,t}$ are almost orthogonal when regressed on each other; see table 1.4.

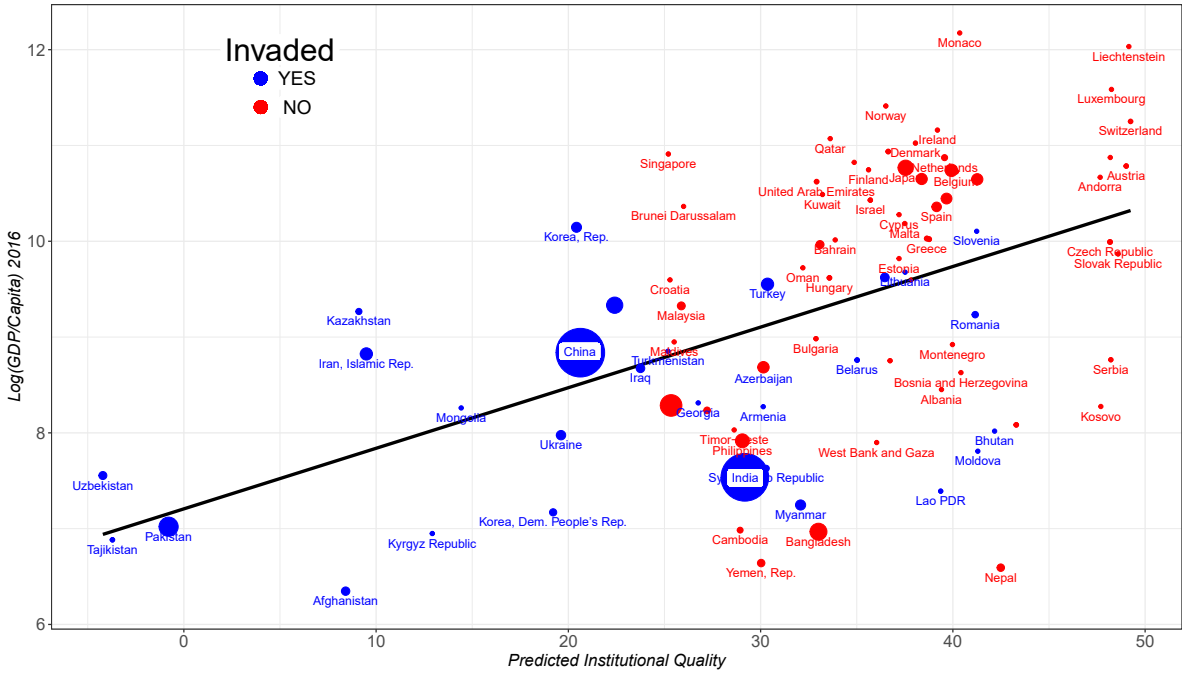
Table 1.3: Second Stage Least Squares

	Dependent variable:		
	log(GDP/Capita) in 2016		
	(1)	(2)	(3)
$\widehat{CL_{2016}}$	0.072***	0.070***	0.045***
	(0.014)	(0.013)	(0.010)
Land Locked	−0.126	−0.186	−0.996**
	(0.316)	(0.319)	(0.461)
East-West Axis Proximity	−0.582	−0.378	2.854***
	(0.669)	(0.652)	(0.397)
Weights	None	Log(Population)	Population
Observations	91	91	91
R^2	0.367	0.370	0.386
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 1.4: Instrument on Geographic Quality

	Dependent variable: $M^i_{\%,t}$	
	(1)	(2)
East-West Axis Proximity	0.140	−0.032
	(0.091)	(0.112)
Weights	None	Population
Observations	91	91
R^2	0.026	0.001
Note:	*p<0.1; **p<0.05; ***p<0.01	

Figure 1.13: Log(GDP/Capita) against predicted/instrumented institutional quality



1.3.4 Validity of the Exclusion Restriction

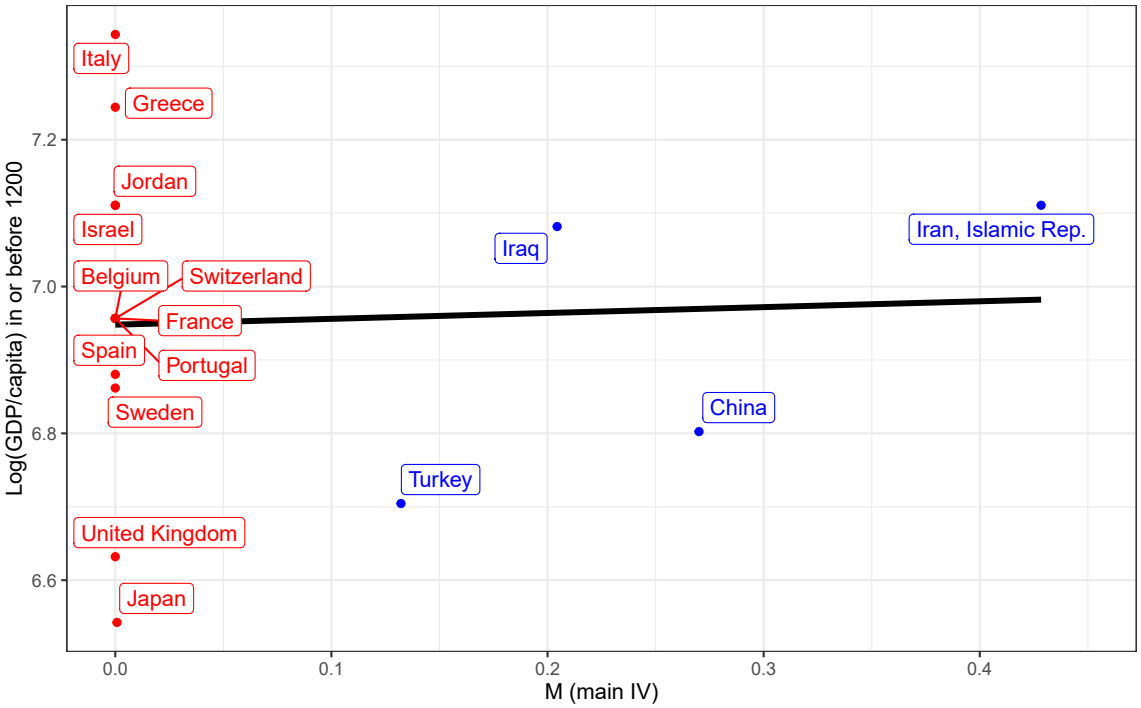
The correlation between being invaded by the Mongols and lower economic output relies on the validity of the exclusion restriction to establish a causal link. The exclusion restriction implies: (1) no backward causality, and (2) no correlation between other determinants of growth and $M^i_{\%,t}$ (I will loosen this to no positive relationship). Let's first look at (1).

Assuming GDP/capita today doesn't directly affect where the Mongols invaded is logical, as the future can't cause the past. However, less straightforward is if there is a correlation between where the Mongols invaded and GDP/capita before the Mongols. Simply, if the areas the Mongols didn't invade were already richer, the implication is that a higher GDP/capita before the 13th century is what caused a higher GDP/capita today, thus potentially having nothing to do with Mongol invasions.

Using the Maddison data tables to get estimates for pre-Mongol GDP/capita, we can see no significant relationship between being invaded by the Mongols and GDP/capita pre-1200; see figure 1.14 (Maddison Project Database). Furthermore, many historical accounts can bolster the claim that Western Europe was no richer and likely poorer than the rest of Eurasia before the Mongols; see for example (Landes, 2015). Thus, we can plausibly rule out backward causality given both

the Mongols (see section 2.2.f) and historians agree that Western Europe was more impoverished.[9]

Figure 1.14: GDP/capita before 1200 on $M_{\%,t}$ (From Maddison Data Tables)



To validate (2), I need to show that Mongol invasion has either no correlation or a negative correlation with other potential fundamental causes of growth. Growth literature is rich with stories and theories as to what ultimately drives growth. Generally, it is accepted that all these potential causes can be distilled into a relatively shortlist; for example see discussion in Chapter 3 of (Acemoglu, 2012). With this in mind, I will deal with the list below and the necessary restrictions in turn.

- Other Geographic Variables
- Trade
- Human Capital

As a starting point, consider three geographic factors that Jeffery Sachs promotes as fundamental drivers of growth; see (Sachs, 2003). They are a tropical climate, access to ocean ports, and distance of the country from the world's major trading centers (Rotterdam, New York, and Tokyo). All of Eurasia has and

[9]For books documenting the prosperity of the Middle East before the Mongols see (Freely, 2010, Lyons, 2011). For a book documenting the wealth of China before the Mongols see (Suzuki, 2009).

historically had little to no tropical diseases. When the Mongols invaded, the most important trading centers were along the silk road at the center of the empire. Thus, it doesn't make much sense to consider distance to modern trading centers as this could be a result of the poor institutions the Mongols left. Looking at ocean ports, China, the Middle East, Russia, India, and Western Europe all have similar access to ocean ports. While some areas are geographically isolated, like Tibet, I have already shown that including a landlocked dummy doesn't change the results.

Furthermore, I added a variable for the amount of coastline (a proxy for ocean ports), KM of navigable waterways, percentage of the country that is arable land, deaths by communicable diseases (a proxy for prevalence of disease), as a robustness check. The coefficient on $\widehat{CL_{2016}}$ is lower but still positive and significant; see table 1.5. While many of the results are statistically significant, it should again be noted they are potentially highly endogenous (note: for the remainder of the paper, I will not report the log(population) weighted results to save space).

Moving down the list, another view is that trade is the fundamental driver of growth. The argument suggests that first countries begin to trade, this generates wealth, and then they invest in high-quality governmental institutions.[10]

Importantly, the Mongol Empire was a center of trade. During their reign, the Silk Road was considered the most extensive, or at least one of the significant, trade routes in the world; see (Frankopan, 2015). The Mongols actively protected the Silk Road, which led to a boom in trade; "As a result of the Mongol Empire, international Mongol trade was born on a level never seen before" (History on the Net). Some historians suggest the Mongol Empire should be considered the first genuinely globalized trade system; see (Hill, 2010). However, if trade drives growth, we should have the opposite finding; that is a positive correlation between where the Mongols invaded and GDP/capita. Thus it is remarkable that such a vast trade network negatively correlates with GDP/capita. The clear implication is that trade is not a fundamental cause of growth but rather a proximate one.

Finally, another view is that the fundamental driver of growth is human capital.[11] The suggestion is that high levels of human capital cause growth and productivity from human capital generates good institutions, not the other way around.

However, historical accounts suggest the Mongols were conducive to high

[10]For influential articles suggesting trade is the fundamental cause of growth see (Frankel and Romer, 1999, Alcalá and Ciccone, 2004).

[11]For influential work see (Glaeser and Resseger, 2010, Ehrlich, 2007, Glaeser et al., 2004).

Table 1.5: Second Stage Least Squares with Additional Geographic Variables

	Dependent variable:	
	log(GDP/Capita) in 2016	
	(1)	(2)
$\widehat{CL_{2016}}$	0.047***	0.027***
	(0.010)	(0.007)
Land Locked	−0.029	−0.698***
	(0.238)	(0.222)
East-West Axis Proximity	0.531	1.232***
	(0.456)	(0.275)
Coastline	−0.00000	0.00001**
	(0.00001)	(0.00000)
Percentage of Arable Land	−0.016**	−0.013***
	(0.006)	(0.003)
KM of Navigable Waterways	0.00001	−0.00001***
	(0.00001)	(0.00000)
Communicable Diseases Deaths	0.002	−0.038***
	(0.021)	(0.011)
Weights	None	Population
Observations	87	87
R^2	0.715	0.922
Note:	*p<0.1; **p<0.05; ***p<0.01	

Coastline is simply miles of coastline with the ocean. KM of Navigable Waterways measures KM of rivers that a large boat can use. Communicable Diseases is a proxy for disease prevalence, given most tropical diseases are spread communicably

levels of human capital. English scientist Roger Bacon observes that the Mongols "succeeded by means of science". It is well documented that the Mongols would take the best engineers, merchants, and scholars from the lands they conquered; see Marco Polo's infamous stay in the Yuan Dynasty. It has been noted that Europe borrowed technologies from the Mongol Empire much more so than the Mongol Empire borrowed from Europe. Jack Weatherford writes that after European exposure to the Mongols, Europe "absorbed the technologies for printing, firearms, compass, and the abacus". Weatherford continues, "the new technology, knowledge, and commercial wealth created the Renaissance" (Weatherford, 2005).

The above begs the obvious question: If the Mongols had more advanced technology, better engineers, and used the scientific method (suggesting more human capital), why are the areas more impoverished today? Why did these technologies spread so fast into Western Europe and not create wealth where they originated? If human capital drives wealth, why then didn't it work this way in the Mongol Empire? It appears that the institutional structure left by the Mongols had such a negative effect on growth, it outweighed the positive impacts the Mongols had on trade and human capital.

1.3.5 Difficult Counterfactuals

In this section, I will discuss some counterfactuals that are difficult to address quantitatively. With work addressing broad historical questions, it is difficult or even impossible to test against every alternative theory. And, even to test against alternative stories couched in the assumption that the Mongols played a huge role in explaining the Industrial Revolution, but did so in a different way than presented in this paper. I will offer a brief discussion of three competing hypotheses that are difficult to test against. I will title them (1) distinctive geographic features, (2) plague, and (3) the Weatherford Effect.

By distinctive geographic features, I refer to granular physical characteristics that will differ by region in some dimensions. For example, we can say Europe, the Middle East, and China all had access to the ocean, but which ocean and the precise port of entrance will always differ. In (Diamond, 1998) and (Diamond, 1999) the author offers many explanations as to how different geographic features in Europe vs. China generated different paths of development. [12]

[12] for example, Diamond suggests Europe being very mountainous led to different development paths. However, many, including (Hoffman, 2015), have pointed out this isn't, in fact, true.

Given these geographic differences will always exist, it is difficult to rule out each one. For example, in (Fernández-Villaverde et al., 2020) the authors build a model suggesting differences in prosperity between Western Europe and China can be explained by the degree to which river basins conducive to agriculture are situated in a region. Essentially they argue that given China has one large agricultural basin, between the Yangtze and the Yellow Rivers, the result was a large state. Meanwhile, Western Europe contained pockets of such basins conducive to agriculture that were more geographically dispersed, which led to more dispersed countries. The important counterfactual questions become – would the more fragmented European geography matter had the Mongols invaded? If this basin in China wasn't, by luck, very open to the Steppe and Mongol invasion, would we see a large unified China?

As a counter to this argument, note China has not always been unified, and Europe has not always been fractured (to be discussed in more detail). In fact, before the Mongol invasion, the central basin in China saw three different empires controlling different parts of it. Thus, it is hard to argue that these geographic differences were destined to result in China being unified while Europe wouldn't be. Also, it is worth noting that Russia has dispersed river basins, very similar to Western Europe, and ended up with a large unified empire. Ideally, I would add this type of geographic microdata into the paper as a control. With that noted, the more general point is that controlling for all such arguments based on distinctive geographic features is tricky.

The plague known as The Black Death is a very difficult counterfactual to address.[13] How would the world have looked if absent one of either this plague or the Mongols, or both? Mongol invasions began about 120 years before The Black Death spread across Eurasia; in fact, the Mongols played a part in spreading it. Thus, the plagued literally followed the Mongols. Given the variables essentially coexisted at the same time and in nearly the same places, it is hard to tease the effects each had apart.

That said, it would seem the variation needed to do so is present. While The Black Death continued into Western Europe, the Mongols didn't. It seems Mongol invasions have a better track record in explaining the variation we seek to explain. However, some, most notably (Voigtländer and Voth, 2009), have argued The Black Death had very different effects in Europe compared to the rest of Eurasia, leading to very different development paths. Addressing this would ideally be done with microdata, thus showing differing effects of Mongol invasions vs. the spread

[13]The Black Death spread all over Eurasia between 1346 to 1353; see (Wikipedia, a)

of this plague. It would be ideal to look at areas of Europe that experienced The Black Death in the same way as did the rest of Europe but had Mongol invasions; for example Hungary and Poland.

Finally, I will address something I will call the Weatherford Effect. In section 1.3.4 I suggest if there were a violation of the exclusion restriction, it would bias the results and understate them. In the book (Weatherford, 2005), the author makes the case the Mongols were paramount in causing the Industrial Revolution by promoting the spread of innovation via fostering human capital and trade across Eurasia. What if, indeed, this is correct, Weatherford just doesn't account for the fact that the Mongols would negatively affect institutional development and thus force this innovation to take root outside the Mongol Empire?

Thus, we can't say what counterfactual would have occurred if the Mongols had never existed. It might be that the Mongols either ushered in the Industrial Revolution but pushed it to areas outside the empire or deterred it. It is a thought-provoking question that is difficult to deal with. Clearly, the Mongols played some role in the Industrial Revolution; the suggestion here is they played a prominent role in where it would occur. But can we say anything about when it would occur? Did the Mongols push it forward or backward in time? It shows how difficult addressing such broad questions can be. That said, it is what makes economic history both frustrating and fascinating.

1.3.6 Robustness Checks

3.6.1 Specification

The following section intends to show that the results hold up to different specifications of the model. Table 1.6 shows the basic regression with different measures of institutional quality. Listed as the independent variable instead of $\widehat{CL}$ are other measures of institutional quality offered by the World Bank; see (World Bank). In every case, except regression (8), the measure is still statistically significant.[14] Though some of the models do not fit the data well, the coefficient is still positive and significant for institutional quality suggesting the variable has the proposed

[14]Note that some of the regressions have negative R squared values; normally with a constant term a negative R squared is impossible, in a 2SLS it is possible given the constant term is the predicted intercept from the first stage; see discussion (STATA)

impact. [15]

Table 1.7 demonstrates the same basic regression with different groups of countries. Regression 1-6 removes sequentially bigger groups of Western European countries. Western Europe, in general, is a loosely defined group of countries. I start with the narrowest groups and move east to include all European countries not invaded by the Mongols. Finally, I look at all countries that had a value of $M^i_{\%,t}$ greater than zero; that is, all countries with at least some exposure to the Mongols. The results hold up and change little across the groups. This is important as it shows that $M^i_{\%,t}$ has an effect that isn't just a result of some uniqueness of Western Europe independent of the Mongols. The results suggest that countries outside of Western Europe and not invaded by the Mongols also ended up better off. Western Europe ended up the richest both due to not being invaded and the geographic advantage of being close to the East-West Axis. Importantly though, countries not in Western Europe and not invaded did better as well. The effect isn't just an anomaly of Western Europe.

Table 1.8 shows the results are robust to different specifications of the IV. Regression 1-2 uses only the percentage part of $M^i_{\%,t}$; recall $M^i_{\%,t}$ is constructed by multiplying the country's percentage invaded by the duration of the invasion. Regressions 3-4 use the duration part the $M^i_{\%,t}$. The results are consistent using either as an IV. In regression 5-6, a simple dummy variable is used; 1 if ever invaded by the Mongols, and 0 otherwise (see appendix for further discussion). Finally, I use an IV that is constructed based on the percentage of Genghis Khan's DNA found in a given country; data from (Zerjal et al., 2003, Derenko et al., 2007). There is a thorough discussion of this variable in the appendix. This variable was the initial choice of IV, but I feel it is biased as the papers listed above did not test for the DNA in countries far from Mongolia, and simply, it is likely that most of this DNA came from Mongolia as that is where Genghis spent the majority of his time, as well as many of his offspring.

It is essential to consider a time-invariant IV. As noted in section 2.2.a, the Mongols come from a bigger story. The Eurasian Steppe repeatedly created a world where competition between two ways of life emerged. This is something that has been noted before. Consider historian Walter Scheidel who has noted that regions further from the Eureasian Steppe are more fragmented, he notes "This hypothesis proceeds from the premise that antagonistic relationships between steppe

[15]The R squared is only negative for population-weighted regressions. The negative R squared results from India having high scores on these measures of institutional quality; if India is excluded, the R squared becomes positive.

Table 1.6: Second Stage Least Squares with various Measures of Institutional Quality

	Dependent variable:											
	log(GDP/Capita) in 2016											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Control of Corruption	0.044***	0.081***										
	(0.005)	(0.014)										
Government Effectiveness			0.053***	0.093***								
			(0.006)	(0.017)								
Rule of Law					0.044***	0.110***						
					(0.005)	(0.032)						
Voice and Accountability							0.050***	0.241				
							(0.010)	(0.264)				
Political Stability									0.046***	0.058***		
									(0.007)	(0.007)		
Regulatory Quality											0.047***	0.066***
											(0.006)	(0.008)
Land Locked	−0.174	0.656	−0.081	1.551*	−0.149	0.715	0.111	−0.348	−1.066***	−1.332***	0.055	−0.046
	(0.198)	(0.629)	(0.196)	(0.782)	(0.199)	(1.082)	(0.354)	(3.673)	(0.230)	(0.377)	(0.229)	(0.426)
East-West Axis Proximity	0.621*	0.534	0.409	−0.319	0.374	1.444	−1.178	7.751	1.092***	1.242***	0.171	1.118***
	(0.330)	(0.610)	(0.330)	(0.777)	(0.342)	(0.902)	(0.750)	(6.303)	(0.391)	(0.366)	(0.385)	(0.404)
Weights	None	Population	None	Population								
Observations	89	89	89	89	89	89	89	89	89	89	89	89
R^2	0.741	0.117	0.756	−0.063	0.740	−.156	0.281	−0.354	0.595	0.601	0.691	0.531

Note: *p<0.1; **p<0.05; ***p<0.01

Table 1.7: Second Stage Least Squares While Excluding Various Groups of Countries

	Dependent variable:							
	W/o Western Europe Narrow		W/o Western Europe Broad		W/o Western Europe Broadest		Countries Invaded by the Mongols	
	log(GDP/Capita) in 2016							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\widehat{CL_{2016}}$	0.047***	0.065***	0.044***	0.072***	0.043***	0.075***	0.052**	0.082**
	(0.006)	(0.010)	(0.007)	(0.013)	(0.008)	(0.015)	(0.025)	(0.037)
Land Locked	0.033	−0.196	−0.061	−0.193	−0.063	−0.108	0.168	0.356
	(0.245)	(0.428)	(0.263)	(0.486)	(0.278)	(0.538)	(0.760)	(1.259)
East-West Axis Proximity	0.138	1.736***	0.100	1.971***	0.083	1.980***	−0.786	1.819
	(0.411)	(0.505)	(0.408)	(0.540)	(0.414)	(0.573)	(2.352)	(1.428)
Weights	None	Population	None	Population	None	Population	None	Population
Observations	81	81	75	75	70	70	32	32
R^2	0.656	0.524	0.635	0.333	0.574	0.256	0.074	0.059
Note:								*p<0.1; **p<0.05; ***p<0.01

Western Europe Narrow includes: Belgium, France, Ireland, Luxembourg, Monaco, Netherlands and United Kingdom. Western Europe Broad includes the Narrow group but also: Spain, Portugal, Italy, Switzerland, Lichtenstein, and Germany. Western Europe Broadest includes the Broad group but also: Denmark, Sweden, Norway, Finland, and Austria. Finally, (7) and (8) are only countries with $M^i_{\%,t}$ not equal to 0

Table 1.8: Second Stage Least Squares with different IV's

	Dependent variable:									
	Percentage Invaded IV		Duration of Invasion IV		Invaded Dummy IV		DNA of Genghis Khan IV		Distance to Eurasian Steppe	
	log(GDP/Capita) in 2016									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\widehat{CL_{2016}}$	0.043***	0.061***	0.047***	0.071***	0.044***	0.049***	0.059	0.032**	0.065***	0.051***
	(0.005)	(0.007)	(0.006)	(0.010)	(0.005)	(0.006)	(0.037)	(0.013)	(0.014)	(0.008)
Land Locked	−0.020	−0.119	0.048	0.028	−0.004	−0.297	0.289	−0.561	0.381	−0.254
	(0.219)	(0.390)	(0.230)	(0.472)	(0.217)	(0.324)	(0.381)	(0.355)	(0.373)	(0.360)
East-West Axis Proximity	0.302	1.237***	0.184	0.998**	0.275	1.526***	−0.233	1.954***	−0.415	1.457***
	(0.369)	(0.364)	(0.387)	(0.458)	(0.365)	(0.301)	(1.274)	(0.406)	(0.639)	(0.346)
Weights	None	Population	None	Population	None	Population	None	Population	None	Population
Observations	89	89	89	89	89	89	89	89	89	89
R^2	0.708	0.603	0.693	0.442	0.705	0.723	0.540	0.686	0.465	0.702
Note:										*p<0.1; **p<0.05; ***p<0.01

Percentage is percentage invaded. Duration is the time spend invaded. Dummy is a variable indicating if invaded at any point or not. DNA is the percentage of people in the country with DNA from Genghis Khan (note this likely is a bias IV). Distance from the Eurasian Steppe is distance from capital city to the closest point of the Eurasian Steppe. See Appendix for description

Table 1.9: Second Stage Least Squares using different Empires

	Dependent variable:							
	Mongol Empire		Timur Empire		Mughal Empire		Ottoman Empire	
	log(GDP/Capita) in 2016							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\widehat{CL_{2016}}$	0.047***	0.031***	0.047***	0.030***	0.050***	0.031***	0.065***	-0.033
	(0.007)	(0.006)	(0.007)	(0.006)	(0.009)	(0.007)	(0.019)	(0.324)
Land Locked	0.055	−0.574*	0.055	−0.591*	0.119	−0.572*	0.394	-1.54
	(0.237)	(0.312)	(0.237)	(0.315)	(0.267)	(0.316)	(0.439)	(4.98)
East-West Axis Proximity	0.173	1.975***	0.171	2.002***	0.062	1.972***	-0.414	3.56
	(0.399)	(0.293)	(0.400)	(0.298)	(0.452)	(0.307)	(0.750)	8.00
Weights	None	Population	None	Population	None	Population	None	Population
Observations	89	89	89	89	89	89	89	89
R^2	0.691	0.748	0.691	0.748	0.574	0.256	0.468	-0.715
Note:					*p<0.1; **p<0.05; ***p<0.01			

The table shows results separating the Mongol, Timur, and Mughal Empire

pastoralists and settled agriculturalists precipitated scaling-up of state power and size in response to competitive pressures"; see (Scheidel, 2019, Chap.8).

Naturally, it is no longer the case that the interplay between these two worlds dramatically affects sedentary societies; the Steppe has been tamed; see (Legg, 1990). However, this aids in building the story of persistence. While the Steppe no longer plays a role, nor do the Mongols, in current geopolitics, the threat that it could has existed until recently. [16] The push to 'tame' the Steppe and eradicate the threat is what is ultimately very persistent. If the Steppe resulted in this type of interaction for thousands of years, the geographic effect should still be alive today, and indeed it is. If we look at Table 8, rows (9) and (10), we see the results of using the distance of capital cities to the closest outer edge of the Steppe (see figure 4) as an IV gives similar results. Note this IV is time-independent; the Steppe is still there, as it was during Mongol invasions.

Finally, Table 1.9 distinguishes between the Mongol, Timur, and Mughal Empire. As discussed there are many reasons to think of them as one empire, but not all historians do. The results indicate that they have a very similar effect. The results are not just driven by one of the 3 empires. Rather all three of them separately have the same significant effect. I will discuss the Ottoman Empire in section 4.2.d.

3.6.2 Spatial Correlation

A paper by (Kelly, 2019) noted an important critique of persistence papers. Kelly points out many such articles have error terms that are highly spatially correlated; that is correlated with the distance between countries. This is clearly a violation of the simple premise that the error term is random (uncorrelated) noise. Technically if the error term is significantly spatially correlated the reported t-stats would be inflated, thus potentially implying spurious causality.

In a broader sense, the critique is that IVs in this context pick up historical differences between regions that will always exist. Thus, the explanatory variables reflect the impact of time and not an exogenous shock. This is, of course, a valid concern. The reality is history usually doesn't give us sufficient controls for this. Thus a fix in place of more rigorous controls is to see the degree to which the error term is, or isn't, spatially correlated. Practically, we should be concerned if this

[16] I am using recently loosely, most of the Steppe, aside from Afghanistan, was divided up between Russia and China by 1727, though there was still a major rebellion and effort to revive the Mongol Empire as late as 1924 which the USSR had to deploy troops to quell, see (Isono, 1979)

correlation is abnormally high as it implies a high likelihood of spurious results. [17]

The standard way of doing this is to conduct what is known as a Moran I test, which tests the hypothesis of significant spatial correlation among the error terms; see (Kelejian and Prucha, 2001). The analysis can get complex as there is no standard way to measure the distance between countries. For brevity, I will discuss different measures and results in the appendix; see .3.

To summarize, there is evidence of spatial correlation, but it isn't that conclusive or high enough to invalidate the results. Furthermore, and importantly, the results show that the regions invaded by the Mongols have no significant spatial correlation. The implication is subtle but is in line with the hypothesis. The hypothesis is the Mongols forced regions to become similar, i.e., autocratic. If true, we should find no spatial correlation among the countries invaded. However, the hypothesis doesn't suggest there would be no spatial correlation in regions the Mongols didn't invade. Thus, the presence of spatial correlation in the regions not invaded isn't as significant. In a way, Western Europe's advantage is that it got to keep its heterogeneity; it wasn't forced by an outside entity (the Mongols) to become similar in this dimension. With this noted, it is important to state that the findings of some spatial correlation should be considered when interpreting the results.

1.4 The Persistence of Autocratic Institutions

1.4.1 Mechanisms of Persistence

So how did the Mongols push states down the path of autocratic governance? The answer put forward here is Mongol invasion increased the perceived need for military power for protection. The Mongols altered the anticipated cost and benefit inherent in the trade-off between military efficiency and individual liberties. After invasion at their hands, the perceived need for military power grew, thus pushing countries towards autocracy and away from individual liberties.

The above is the mechanism by which invaded regions became more auto-

[17] It is worth noting that spatial correlation doesn't necessarily invalidate the results. The main critique of Kelly is that spatial correlation likely results in abnormally high t-stats, not per se that the papers are invalid altogether.

cratic, but this doesn't explain why this has persisted until modern-day long after Mongol power has faded. I suggest the institutional shock has persisted for two reasons:

- (1) The Iron Law of Oligarchy – Sociologist Michels first developed the idea; see (Michels et al., 2012). However, I will use the term as described by (Acemoglu and Robinson, 2012): the "iron law of oligarchy means that even when oligarchs are overthrown, the revolutionaries, like the pigs in Animal Farm, often come to resemble them. New leaders overthrowing old ones with promises of radical change bring nothing but more of the same"; thus, institutions can be remarkably persistent.

- (2) A Cultural Shift – Culture supports institutional persistence, given societies with different shared experiences have different core values. These different values result in different economic and political decisions. Conquest by the Mongols resulted in a culture that valued more centralized institutions. Importantly this value system has been passed down through generations, even though the threat that created these values is no longer.

Many economists have issues with the validity of regressing a contemporaneous variable on a variable representing events that occurred hundreds of years ago. How does one justify that something occurring hundreds of years ago affects today's world? Indeed, this is a valid concern. The validity of the results rests on the belief institutions, and in particular autocratic ones, are very persistent through time. It would be ideal if there were perfect institutional quality measures for all empires in history through time. Then, one could show the trajectory of institutions over the period in question. However, these measures do not reliably exist. Thus, I feel the best solution is a middle ground between an assumption (that autocratic institutions are by their very nature persistent) and statistical proof. Proof being, of course, ideal, but also impossible.

In reality, there is no reason to believe institutions are like fossils in ice that remain perfectly preserved for thousands of years. However, there are also reasonable grounds to believe they can be very persistent. Section 4.2.1 will illustrate how a movement towards more autocratic, militaristic, and inward-looking institutions in the areas the Mongols invaded has persisted until the present day. Given a complete look at each country's history would be too lengthy, I will aim to show the broad outline of the sequence of events leading from the Mongols to the state of present-day institutions in certain regions.

1.4.2

4.2.1 Conquest → Consolidation

"He who fights with monsters should be careful lest he thereby become a monster. And if thou gaze long into an abyss, the abyss will also gaze into thee."
(Nietzsche, 1911)

The above quote in the context of the paper can be understood in the following way, if you engage in a battle with someone, you potentially need to become like them to defeat them. A significant reason the Mongols were such a formidable army, at times a seemingly unstoppable force, was because they were so unified. Instead of seeing themselves as individuals, they identified themselves as part of one larger unit and cause. From the perspective of many, to beat them, you had to become like them.

The period during Mongol invasions and the centuries after are often called the era of "conquest and consolidation". I have talked about the conquest part, but it is essential to also talk about consolidation. Consolidation refers to the fact that after the Mongols, empires began to expand geographically and militarily to protect their borders. In other words, the process of 'consolidation' encapsulates the shock the Mongols had on institutional development. To beat them, countries began to mimic them. To follow are a brief set of anecdotes that supports this claim.

4.2.2 China

While China had been unified previously under the Han and Tang Dynasties, prior to the Mongol invasion, China was fractured into four different empires: The Jin, Song, Xixia, and Tibetan. [18] The empires actively traded with the rest of the world via the silk road and sea. That is to say, the empires were open and outward-looking.

A key reason the Mongols were able to conquer most of what is modern day China was the disunity of the above-noted empires. On occasion, a given empire was happy to help the Mongols if it meant defeating their enemy. The problem with this tactic was failing to realize that they were next on the chopping block. For example, see how the Song dynasty allied with the Mongols against the Jin dynasty, only for the Song to see a mighty unified Mongol army on their borders shortly

[18] For an excellent overview of China's history before the Mongols, see (Fukuyama, 2014)

afterwords, (Graff and Higham, 2012). The Mongols had excellent reconnaissance and would often strike at opportune times when empires were fractured and weak; in brief, this is the story of the Mongol conquest of China.

After the Mongols were expelled, Chinese rulers, under the Ming, chose to "look inward"; focusing on consolidating the empire and avoiding future weaknesses caused by disunity. They spent considerable resources building the Great Wall and invading Tibet to fortify their borders, thus protecting them from further invasions from the Mongols (Elverskog, 2006).

Following the Mongols, many historians have noted that China had superior sailing ships compared to the empires of Western Europe. Note the Chinese fleet led by Zheng He that sailed the Indian Ocean between 1405 and 1433; this fleet consisted of 28,000 sailors on 300 ships vs. Columbus, who had 90 sailors on three ships in 1492. Furthermore, Zheng He's largest ships were over four times longer than those of Columbus; see (Morris, 2010). Following these voyages, China's rulers dictated laws that forbade citizens to sail. Zheng He's vast fleet rotted in harbors; many speculate that Zheng He would have beaten Columbus to the Americas if not ordered to stop. Imagine how different the world would look today if this occurred!

Cutting funding to Zheng He was part of a broad policy of looking inward to consolidate power. Money that was previously spent on sailing would build the Great Wall. Funding went from discovery to protection. This decision was a historical blunder of monumental proportions. The future of powerful empires would be built by sea voyages. China was destined to be conquered by skilled sea-going empires; see first opium war with the British. China looking inward stopped the diffusion of important technologies into the country leading to backwardness that can still be seen today.

While China saw periods of upheaval and rule by different dynasties following the Mongols, one thing remained, it was always ruled as one consolidated body under an autocratic leader – The Iron Law of Oligarchy at work. This long shadow of history seems only too visible today. After Mao died in 1976, the country seemed to be moving away from autocracy towards a gradual transition to democracy. This bubble burst as current leader Xi Jinping declared himself ruler for life in 2018, essentially giving him the power Mao had possessed. Or, for that matter, the power that Kublai Khan gave himself, which emanated from Mongol conquests.

As Mark Twain allegedly said, "history does not repeat itself, but it rhymes ". A perceived external threat backs the desire for autocratic government, and once this justification sets in the minds of citizens, it is tough to displace. Authoritarian

rulers are followed by the same as new external threats, real or imagined, emerge. The destruction of China at the Mongols' hands represented the ultimate external threat. The Mongols attempted and almost succeeded in destroying a culture and subjugating an entire people. The Great Wall was designed to keep the Mongols and other external threats out. However, in equal measure, it began to trap the Chinese in.

4.2.3 Russia

"It is wrong to think that Mongol-Tatars invaded Russia as a single state, because the state actually formed as a response to the invasion, to resist and overthrow it." (Manaev)

Before the Mongols invaded, the country was anything but unified. The area was known as Kievan Rus and was characterized as a loose federation of many different principalities. The Kievan Rus Empire was just a fraction of the size of Russia today; one can see this looking at the maps from the year 1200. [19]

Before the Mongols, the largest and most important city in the region was Kyiv. After the sacking and devastation of Kyiv at the Mongols' hands, Moscow rose to prominence as the surrounding geography made it easier to defend. The leader most responsible for the defeat of the Mongols was Ivan the Great, who became known as the "gatherer of the Russian lands" (De Madariaga, 2005). Ivan pushed the Mongols back and claimed vast territories. In the process, Russia started to look more like it does today. The geographic expansion consolidated power to prevent further invasion. While the Chinese built a Wall, the Russian's barrier was territory.

One history book accounts how Ivan the Terrible (coming to power soon after Ivan the Great) put into practice "attack as defense", a plan to attack the Mongols and push them back as to make sure they would never be a threat again. That is attacking them before they attack you. Furthermore, Russia gained strategic physical barriers to protect against further invasion, "Russia gained access to the Caspian, and later the Black Sea, thus taking advantage of the Caucasus Mountains as a partial barrier between itself and the Mongols".

Russia is a fascinating example of the Golden Law of Oligarchy. In 1917 Russia stood on the precipice of a remarkable social experiment. A communist revolution that promised power would reside in the people's hands and that wealth

[19] For an excellent history of Russia see (Hosking et al., 2001)

would once and for all be taken from the wealthy oligarchs and given to the poor. More than 100 years later, the communist experiment failed. A democratic and egalitarian promise ended. Today, the country is still very unequal and ruled by a de facto dictator in Vladimir Putin. Russia is a prime example of the persistence of institutions. During the reign of the Mongols, the fractured regions were forced together under one leader, a path that is difficult to disembark.

4.2.4 The Middle East and Ottoman Empire

Prior to the Mongols the area had seen large empires, the Umayyad and the Abbasid for example, however just prior to invasions "The Muslum world was anything but united" (Ansary, 2009). There were significant fractures in the Islamic world, with the largest schism between Sunni and Shia factions. This division left the Islamic world disunified, which largely accounts for the Mongols ease of conquest.

Before the Mongols, the Muslim world experienced what is known as the "Islamic Golden Age". [20] This was a period of incredible innovation and insight, advancing philosophy and mathematics. This period is dated as ending with Baghdad's sack in 1258, carried out by the great Khan Monke's brother Hulagu. While death tolls, as previously mentioned, are debated, as many as 1.5 million people were killed at the hands of the Mongols in a matter of days. The Mongols sacked and looted the city. The Mongols destroyed the "House of Wisdom", the largest library in the world at the time. They threw enough books in the river to create a bridge a man could ride across on horseback (Norman). Historical accounts suggest the Tigris river literally ran black with ink and then red with blood. The destruction of life and literature marked a resounding end to a period of relative enlightenment and prosperity.

After the Mongols the area was unified under the Ottoman Empire. There is an in-depth historical connection between the Mongols and the Ottoman Empire, or the Turks. Mongol-Turkish culture is bound together by a similar past. The Turks were a nomadic tribe that predated the Mongols. When the Mongols invaded the Turk's region, around modern-day Turkmenistan, a complicated relationship between the two groups emerged. They were often friends and foes. When the nomadic Turks formed the Ottoman Empire in 1299, the founder Osman the Great carried out conquests in much the same way as did the Mongols. Thus, to some extent, you could consider the Ottoman Empire as an extension of the Mongols. Regardless of how you fit the Ottomans into the story, the critical point is that after

[20] see (Ansary, 2009) again

the Mongol conquests, in this new world of domination and rule by outside nomadic tribes, a new, more violent type of Islam emerged. There was a dramatic transition from the Islamic Golden Age to a more militant Ottoman age. One can consider the critical turning point as the sacking of Baghdad.

If one treats the Ottomans in the same light as the Mongols, we can see similar results. Table 9, column (7) and (8), shows that non-population-weighted results are quite similar; however, population-weighted results are not a good fit at all. This is to be expected; essentially, the Ottomans did not invade China or India. Regardless, there is good evidence to suggest the Ottoman's had a similar impact as the Mongols. Whether one treats them as an extension of the Mongols or an empire born out of the ruin the Mongols brought, we see evidence for a negative shock to institutional development.

Consider the following excerpt from Machiavelli's famous 'The Prince' written in 1513. Machiavelli speaks of the difference between the Turk, or Ottoman Empire, and that of France "The whole monarchy of the Turk is governed by one lord; the others are his servants...but the king of France is placed in the midst of an ancient multitude of lords" and that these lords " have their privileges, and the king can not take them away without danger to himself" (Machiavelli, 2008). A remarkable excerpt as it is written hundreds of years before the Industrial Revolution. We see already that France had many more checks on power than did the Ottoman Empire.

It is difficult to fit the Middle East into the story as there is no single large country in the region today; thus, it is unlike China and Russia. However, if one reflects that autocratic power can consolidate in a religion rather than a state, one can see the trend today in the form of extreme religious faith. The Islam of the pre-Mongol world was highlighted by logic and tolerance, which proved to be weak and prone to conquest. Today there is a robust binding militaristic set of institutions not embodied in the state, but rather a religion. While post WW I, the Ottoman Empire was split up, the consolidation it engendered is still alive and well.

In general, social scientists tend to explain the world with factors that they can see or are contemporaneously present. For example, see the religious explanations of the Middle East's divergent development vs. Europe. [21] We still see religion dividing the world today; thus, it seems like a very plausible causal mechanism. Yet history continuously uncovers factors that are not seen today but were very real in the past. The suggestion here is the critical factor is not Islam vs. Christianity per

[21] see, for example, the recent work by (Rubin, 2017)

se, but the break from the golden age of Islam to the Ottoman age. This break was not caused by something inherent in Islam. Instead, Islam changed with an existentially shocked culture.

4.2.5 Europe: East vs. West and the Golden Bull

There were signs that Western Europe would become more unified under one leader in protecting against invasion from the Mongols. Consider the following quote describing Europe after initial Mongol invasions, "Fear of the Mongols now provoked a game of religious dominoes in Europe. The Armenian church entered into discussion with the Greek Orthodox patriarchate in order to build an alliance and gain protection in the event of a future attack" (Frankopan, 2015). There are similar accounts of alliances between many of the Western European powers. There is a strong suggestion that if the Mongols invaded Western Europe, it would not look like it does today. Instead, it would look more like Russia or China, i.e., one large 'consolidated' state.

Consider an interesting observation made by (Roberts and Vincent) when discussing the history of the Magna Carta. Vincent compares the Magna Carta to the Golden Bull of 1222, presented to the king of the Hungarian Empire. Vincent points out how both the documents were almost the same at their core. Yet, while the Magna Carta is celebrated as the first document that inscribed rights to the individual under the King, the Golden Bull of 1222 has almost no historical significance.

The suggestion here is straight forward. The Golden Bull failed in its attempts to limit power given decades later the Mongol Empire invaded the region. The Mongol invasion killed millions as they sacked cites and defeated the Hungarian army rather easily. The attack put Hungary in a state of shock, after which individual liberties inevitably fell down the list of priorities below protection. While the Magna Carta took root, the Golden Bull did not.

4.2.6 The West and the Origins of Liberal Democracy

There is a long-standing argument that Western Europe benefited from competition between states. While the rest of Eurasia prioritized security and thus tended towards large empires that dominated whole regions, Western Europe tended towards many small states fostering competition. If someone wasn't willing to support

your invention in country **x**, you moved to country **y**; "in Europe, emerging nation states... competed economically and militarily" and "such competition discouraged states from opposing technological or institutional innovation" (Szostak, 2021). For further supporting work see (Jones, 2003, Mokyr, 2016b)

History is littered with examples of empires that got to a peak size and prominence and then began to fracture. One can look at how the Roman Republic began to fracture as its geographical expanse got sizable (Sage, 2013). Indeed one could also point to the splintering of the Mongol Empire. At a certain point an empire will become so large it is unwieldy to maintain. Only if acted upon by an outside force will this tendency to reach a certain size and fracture be impeded. I believe this is the difference between Western Europe and the other areas of Eurasia. The external force being the Mongols specifically and the Steppe in general. Exposure to the Mongols/Steppe resulted in a tendency towards a more extensive, militaristic, and by necessity, more autocratic state. Simply put, states exposed to the Mongols/Steppe became more glued together (see figure 1.15 and 1.16 below of Eurasia in 1700 and 1800, Russia, the Ottomans, Mughal, and Chinese Empire grow large)

Figure 1.15: World Empires in 1700 CE

The Mongols, as discussed, did not discourage innovation directly; in fact, in many ways, they sped up the pace of innovation. What they suppressed was competition between states. The Mongols supported science, trade, and human capital, but they eroded the industrial revolution's bedrock – property rights. Property rights emerged when states had to compete with one another. Ruling powers do

Figure 1.16: World Empires in 1800 CE

not have a natural incentive to give inhabitants property rights; why would they? The many small European states had to provide individual rights, or simply, all the good inventions would go elsewhere. The competition between states drove the race towards better and better institutions. When science and innovation were ready to explode, only Western Europe had the governmental structure to facilitate this explosion. Only Western Europe had governments sufficiently small and competitive to allow creative destruction.

I should briefly note, there is a deep irony here. By far, the most significant wars of the 19th and 20th centuries were in Europe. The irony is that less militaristic states ended up more likely to create advanced military technology and immense armies. Inter-state competition, which promoted liberalism, also encouraged military innovations. Which often lead to very illiberal outcomes: colonialism and the World Wars. Thus a set of small European countries with vibrant economies set up massive empires; the 20th century saw the largest empires emanating from a fragmented Europe of the 19th century.

The years surrounding the French Revolution proved a pivotal turning point for Western Europe. Following this, people felt they had rights; that is, people became citizens of a republic to a greater or lesser extent. They then felt a willingness to go to war to defend those rights. The size of Europe's militaries exploded; see Napoleon's Grande Armée. Kings and rulers further ceded power to

raise money for wars and colonization. This yielding of power further cemented property rights, which further cemented innovation, leading to further war and a race to capture more colonies. This dynamic process was largely absent in the rest of Eurasia.

Here, we come full circle, recall the AJR paper's discussion in the introduction; again, see (Acemoglu et al., 2001). I discuss how the paper illustrates how colonial Europe would significantly impact discrepancies in GDP/capita across borders in the modern world. The choice these empires would now make as to what type of institutions they would set up in their colonies would matter greatly. Would they set up institutions of extraction? Or the newly emerging institutions based on liberty and democracy? The important point being, Western Europe now had multiple blueprints to choose from.

1.5 Concluding Thoughts

Ultimately the goal of much of economics, and science, is finding an exogenous shock. While Genghis Khan was endogenous to Steppe politics and lifestyles, he was an unimaginable and unprecedented shock to the areas he invaded. The exciting thing about history, perhaps ironically, is it's a very dynamic and evolving field as new evidence is revealed. The Mongols are a perfect example of this; much evidence about the Mongol Empire has only come to light in recent decades.[22] While I don't want to simplify the story overly, a couple of points seem clear. (1) The Mongols brought with them incredible destruction that was beforehand unseen on such a scale, and (2) it is very plausible this had a long-lasting effect on institutions. Once this is established, it is entirely believable that this effect on institutions has resulted in much of the cross-country disparity in living standards we see today.

[22] see the translation of the "The Secret History of the Mongols" (Waley, 2008).

Chapter 2

Collapse and Convergence: The Collapse of the USSR, EU Membership, and the Importance of Institutions for Growth

2.1 Introduction

Economics as a discipline has a long history of looking to history. In particular, economists are usually interested in finding natural experiments; in the context of this paper, ones that illuminate the key, or fundamental, causes of growth. For example, in the article "Institutions as a Fundamental Cause of Long-Run Growth," the authors look at the immense difference in GDP/capita between North and South Korea; GDP/capita was about 16,000$ in South Korea vs. 1,000$ in North Korea in the year 2000. The authors conclude the only plausible cause of this difference was historical events leading to divergences in institutions; see (Acemoglu et al., 2005). With this noted, the authors conclude, "to establish the major role of economic institutions in nations' prosperity and poverty, we need to look at a larger scale "natural experiment" in institutional divergence"(p.22).

At its simplest, the goal here is to do just this by looking at the collapse of the USSR. After the Soviet Union dissolved, there was a significant gap in GDP/capita between the post-communist countries and the market-based liberal democracies of Western Europe (the EU members). The market-based countries of the West enjoyed significantly better standards of living; note that GDP/capita in

Eastern Germany was one quarter of the GDP/capita in West Germany in 1991 (Judt, 2005). Furthermore, if we look at the Italian GDP per capita in 1993, which was about average for Western Europe at that time, you see the Italian GDP at about 18 thousand per capita in purchasing power parity (PPP) terms. In the same year, the PPP adjusted GDP/capita was about 5 thousand in Poland, 3.5 thousand in the Czech Republic, 3 thousand in Slovakia, 2 thousand in Latvia, and 6 thousand in Slovenia; all post-communist countries. Across the countries in question, we see that GDP/capita in the Eastern bloc was about one-sixth to one-third of what it was in Western Europe in 1993; see World Bank.

In a similar vein to the observation that the likely cause of the difference in GDP/capita between North and South Korea is institutional, one can make a similar observation regarding the USSR. Furthermore, given the collapse of the USSR was large in scale, it affected 27 countries in total, it represents an ideal natural experiment. The collapse was sudden and created a break in institutional paths. The goal is to exploit the break in institutional trajectories to analyze how these different paths affect economic outcomes.

2.2 Background Concepts

2.2.1 The Endogenous Nature of Growth

> *The aggregate production function is just the first step in understanding differences in output per worker. Findings in the production function framework raise deeper questions such as the following: why do some countries invest more than others in physical and human capital? And why are some countries so much more productive than others?*
>
> — (Hall and Jones, 1999)

Accounting for what causes economic growth is a challenging endeavor. At its most basic level, any explanation of growth involves estimating a production function. For example take y = f(I,k,h,G): where I represents institutional quality, k is physical capital per worker, h is human capital per worker, G is a variable that represents geographic quality, and y is income or output per capita. Suppose that y is, logically, increasing in each argument. The endogeneity problem stems from the simple fact that any increase in I,k,h or G will increase y. This increase in y will

in turn increase I,k,h, and G via investment; output today is an input tomorrow. Thus, when looking at the historical process of growth, what is observed is all the inputs going up with production simultaneously. The left- and right-hand side of the production function are endogenous. Growth is a virtuous cycle where the increase of one factor of production further allows you to increase the other factors. The critical question being: what starts the cycle? What is the fundamental cause of growth?

There are many theories as to what fundamentally causes growth. One of the most common theories proposes that good geography starts the cycle. The presence of good geography, in the form of resources, navigable rivers, low prevalence of diseases, etc. allowed for a well-fed agrarian population. This well-fed population could invest in human and physical capital which triggered the virtuous cycle. The theory often referred to as the "Geography Hypothesis", states the fundamental cause of growth is the initial quality of geography. Furthermore, to overcome poverty, a country must overcome its poor geographic endowment via foreign aid or some type of external support. For recent notable works supporting geography see (Diamond, 1999) (Gallup et al., 1999) (Sachs and Warner, 2001).

However, there is another theory that states a higher level of institutional quality is what started this process. For recent notable works supporting institutions see Hall and Jones (1999) (Acemoglu et al., 2001) (Easterly and Levine, 2003) (Rodrik et al., 2004). The point being there are many theories as to what causes the virtuous cycle, and they are all difficult to prove given the endogenous nature of the production function.

2.2.2 The Candidate Explanations of the Fundamental Causes of Growth

There is no perfectly accepted list of the fundamental causes of growth so I will not labor too much trying to justify my list. I think the list below is a good list and, importantly, if other lists are different I believe they are mainly listing the same things conceptually and simply refering to them using different names.

The four I will consider are:

1. Geography
2. Culture

3. Human Capital

4. Institutions

Geography has already been discussed in Section 2.2.1. Institutions will be discussed in section 2.2.4. Thus I will just touch upon (ii) and (iii).

The idea that Culture is the fundamental cause of growth stems from the belief that certain societies fundamentally have different core values due to different shared experiences. These different values accordingly result in different economic decisions such as how much to save, and how much risk to take ect., which ultimately drive growth. There are many different cultural explanations of growth, for two examples note the recent work of two economists, (Mokyr, 2016a) and (McCloskey, 2016), who have offered cultural theories of the Industrial Revolution.

The important shortcoming of culture as the fundamental cause of growth, applied particularly to today's world, is that there is no theory of how culture can change rapidly to the degree it could explain sudden changes in growth rates. Culture falls short of explaining growth miracles such as China, Singapore, etc. Why did China suddenly go from almost zero growth to double-digit growth if culture is slow to change? China's culture didn't change when Mao died, yet China's growth rates seemed to change dramatically.

The theory I will offer is that culture was and is undoubtedly vital in explaining how and which institutions are formed and embedded in a society, but after that, it helps little. Simply put, institutions evolve from culture, but while institutions can change very rapidly, culture can't. Thus, while culture might cause institutions in a meaningful sense, institutions are a more meaningful explanation of growth. In theory, it would be feasible to implement property rights tomorrow, but you can't change a society's preference for property rights tomorrow. Culture doesn't change that quickly, or at least as we understand it anyway. Thus culture can be thought of as a deep-rooted cause of certain institutions but can only help us explain modern growth as important institutions likely emanated from culture.

Human Capital has recently become an important refutation to the idea that institutions are the dominant cause of growth. The argument can be summed up as "knowledge-spillover effects emanating from workers and entrepreneurs with superior education and skill, ... enhance the productivity of others with whom they interact." (Ehrlich, 2007). The suggestion is that high levels of human capital cause growth, and institutions are then formed endogenously. The productivity from human capital buys good institutions, not the other way around.

For example, consider an important critique of (Acemoglu et al., 2001); a famous paper suggesting Europeans caused poverty or prosperity where they colonized depending on if they set of inclusive or extractive institutions which in turn was caused by if they could live in a country, given disease ecology, or not. The critique points out that "the Europeans who settled in the New World may have brought with them not so much their institutions, but themselves, i.e., their human capital" (Glaeser et al., 2004).

The suggestion is that much of the research showing the importance of institutions do not consider that good institution come part and parcel with high levels of human capital. In the literature, it is unclear which causes which. This paper offers an essential contribution as I show human capital can not play a role in the success of post-communist countries while showing that institutions do (see empirical analysis in section 2.5).

2.2.3 The (Conditional) Convergence Hypothesis

An important empirical tool I will use to measure a country's success is the rate of convergence, defined as the rate at which a poorer country, or countries, is catching up to richer countries. Thus it is worthwhile to briefly expand upon the validity of this measurement in the context of economic theory.

Classically convergence rates are derived by regressing a growth rate over a period on the log of GDP/capita at the start of the period for a group of countries including a set of wealthy countries as a type of benchmark; see (Barro and Sala-i Martin, 1990) (Barro and Sala-i Martin, 1992) (Barro, 1991). The estimated slope coefficient, the beta as it is usually called, has the interpretation of the rate at which the poor countries are catching up to the rich. The basic regression is as follows:

$$g_{i,t} \;=\; \alpha \;+\; \beta \log(y_{i,t-1}) \;+\; e_t \tag{2.1}$$

Where:

- y_i - GDP/Capita of country i at the start of the period
- g_i - is growth in GDP/capita for country i from the start of the period to the end

- β - is the rate of convergence

"One hypothesis from the neoclassical growth model is absolute convergence: poorer economies typically grow faster per capita and tend thereby to catch up to the richer economies" (Barro et al., 2003). According to the neoclassical growth model, the only variable, given the usual assumptions, that should determine a countries rate of growth is the level of capital per worker. Thus, the theory suggests capital-scarce countries will see an influx of capital given diminishing returns and will subsequently see higher growth rates. Functionally we can test the model by carrying out a convergence regression. We should see a significant rate of convergence; understood as a statistically significant and negative slope coefficient or β. However, "there is no "unconditional" convergence for the entire world – no tendency for poor nations to become relatively more prosperous" (Acemoglu, 2012). The model seems to make a false prediction.

The idea of conditional convergence has been the crucial building block in addressing this inconsistency (Barro and Sala-i Martin, 1992). The critical idea is that other factors aside from just the abundance of capital per worker will also determine the marginal product of capital. Essentially cross country difference in the fundamental causes of growth will also affect the marginal product of capital. Capital will only flow into capital scarce-countries given certain conditions are satisfied. In other words, if the fundamental cause of growth is in place, we should see convergence.

The basic convergence regression then becomes a functional test of what causes growth. The question of interest becomes: after adding quality of institutions, cultural variables, human capital, and geographic variables to the regression model do we see convergence? If yes, it potentially means one of these variables is driving growth. If, after controlling for endogeneity, we see significant convergence, we can infer causality from a convergence regression (we will return to this in section 2.5.3).

2.2.4 Institutions (property rights and traffic)

I focus on institutions as the driver of growth, thus it is worth expanding upon what they are in more detail. Institutions are "the humanly devised constraints that structure political, economic and social interactions" (North, 1991).

Consider the question just discussed – why is the marginal product of capital often so low in developing countries? One answer is that given a lack of property rights no one has the incentive to allocate capital to its highest value use. Simply put, why bother allocating capital if you have no secure right to the profit stream? In this sense institutions, like property rights, help get "the prices right so that individuals capture the social returns to their actions as private returns" (Hall and Jones, 1999). Institutions are a type of invisible infrastructure that guides interactions between people. They play an important role in internalizing externalities and lowering transaction costs.

The interesting property of institutions is they can take a very long time to develop but don't necessarily need long to implement. Not unlike software, while it could take forever to develop, once it exists it can be downloaded. For a country to use a set of institutions they need not develop them within. Adopting new institutions is certainly not free of charge, but institutions have the same type of non-rival property technology has, see (Romer, 1990), meaning there is no limit to how many people can use them at the same time. While unique historical situations must exist, like the collapse of the USSR, there are instances in history where a country will suddenly shift institutions. They will simply download a set of new institutions, like those of the EU.

A powerful example of the importance of institutions is traffic. While traffic is a physical interaction between people and cars, traffic, as in the actual movement of vehicles, would be impossible without a set of institutions to guide individual actions. The fact that every driver accepts red means stop, green means go, and you yield for pedestrians, etc., really gets drivers from home to work. Just as one sees traffic grind to a halt when drivers don't follow the "rules" one should imagine a market grinding to halt when inadequate institutions don't facilitate exchanges and investment.

The importance of looking at the collapse of the USSR is that it represented a period of rapid institutional change; an occurrence of a sudden shift up in the quality of institutions for some countries but not others. Institutional development is the result of the slow emergence or evolution within a society of rules and norms. It is rare that one can observe a sudden shift in institutions whereby one society rapidly adopts the institutions of another. The collapse of the USSR represents a rare opportunity to see a shift up in one of the hypothesized causes of growth while the other important factors remained relatively constant. It is a chance to isolate the start of the virtuous cycle.

2.3 Historical Context

2.3.1 Divergent Paths

> *Our country has not been lucky. It was decided to carry out this Marxist experiment on us. In the end we proved that there is no place for this idea-it has simply pushed us off the path taken by the world's civilized countries*
>
> Boris Yeltsin (1992) — (Judt, 2005)

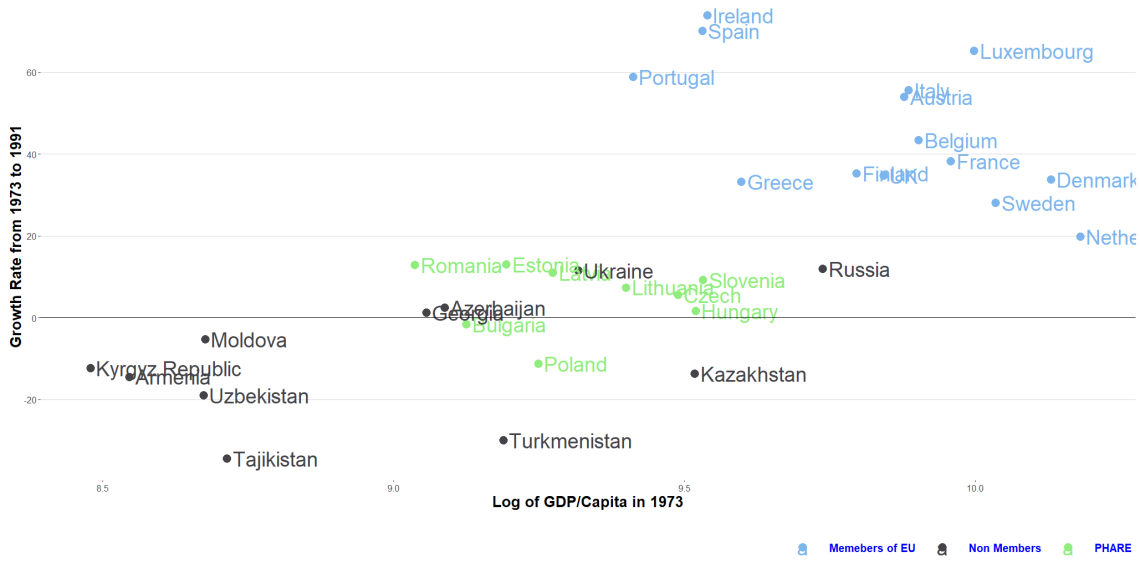
The above quote serves as an introduction to this section in terms of ideas and in terms of a time-line. Months before this quote was recorded the Soviet Union dissolved and ceased to exist. The former Soviet Union became a collection of many states including Russia; the above quote is from Boris Yeltsin the first president of the Russian state. In terms of ideas, this quote sums up the incredible urgency felt by many of the newly born states to move away from Soviet institutions and communism. Most of the newly born states sought to rapidly adopt western institutions; which can be seen principally as a movement to join the EU via something called the PHARE Programme (see section 2.3.4). The end of the Cold War signaled the end of Europe being divided between East and West. While the demolition of the Berlin Wall allowed Berlin to physically reconnect it also allowed Eastern Europe to reconnect to Western European institutions.

Figure 2.1 below illustrates these divergent paths. We see the countries in green and black, the Soviet/Communist Influenced countries, grow at lower rates than the EU countries in blue from 1973 to 1991; also see discussion of the difference in GDP/capita in the introduction. The basic upward slope of the data suggests divergence, the countries that started richer also grew faster. Note in section 2.2.3 we discuss how there is no evidence for global convergence. This data represents evidence of divergence. Also important to note many of the countries in the Soviet sphere of influence had negative growth rates.

2.3.2 The European Union

At the end of the WWII, the EU was just forming. It was started as the Coal and Steel Community in 1951. The idea was to link the countries of France and

Figure 2.1: Growth Rate from 1973-91 vs Log of GDP in 1973 (Maddison Historical Statistics)



Germany economically as to make further war between the countries impossible. The experiment was a dramatic success. Not only did the EU grow geographically and economically the idea of war between the countries of the EU today seems impossible. As of this writing, the EU has a population of about 510 million people and produces about 21% of global GDP.

Let's back up to the end of WWII and consider the USSR. This was likely the height of the USSR's power. It gained influence over the "Eastern Block" via indirect control and imposed its communist institutions on an enormous segment of the globe (see map in the appendix). When the USSR collapsed in 1991 it had a population of nearly 300 million people and influenced about 400 million people in total; that is if you add up the populations of the Eastern Bloc. Thus, the USSR went from very big and influential to complete collapse. In the same time span, the EU went from a meager agreement to get France and Germany to trade Coal and Steel to a very influential set of institutions. This Rise of the EU and the fall of the USSR is undeniably a remarkable story in history!

The EU is a body that enforces institutions. For a country to join the EU said country has to conform to a set of guidelines or institutional framework, that roughly speaking conforms to what is generally called "liberal democracy". On top of many other conditions to join the EU, and to conform to what one might think of as liberal democracy, a country must be democratic, have a balanced fiscal budget, low inflation, rule of law, property protection, market-orientated policies,

and be aligned with the principles of free trade. In general, the EU defines a set of institutions that economists should agree promotes economic growth; the EU is a set of "good" institutions.

Allow me to expand on just why the EU was conducive to growth while the Soviet system was not. While the reasons are many and range from easy to measure to more qualitative reasons that are hard to measure one can get a good understanding from the following non-exhaustive list:

- The EU encompasses a strong set of legal bodies that support private property rights. A strong property right incentives owners of said property to invest; meanwhile, Communism is founded on an opposition to any form of private property.

- The EU is a large free trade zone; a free trade zone gives countries a larger market and thus allows a country to capture the gains from trade: comparative advantage, specialization, increasing returns to scale, etc.

- The EU enforces member states to have low inflation; low inflation decreases the risk of future price instability which increases present investment given a more certain future profit stream.

- The EU relies primarily on a market or price system to allocate resources. As mentioned, this equates supply with demand. The Soviets were constantly in a state of excess supply of certain things like industrial goods; it was often the case that there was not a use of things produced, while at the same time they also experienced shortages of other goods, as mentioned food.

- The EU supports patent and copyright protection which incentivizes innovation. The Soviet system did not support anything like patents or copyrights.

- The EU embodies the Rule of Law. The EU institutes checks on the arbitrary use of power by the state. This allows individuals to feel secure their investments won't be captured by the state.

With the above noted it should also be stressed that it is impossible to list all the things the EU does that would result in a positive effect on growth. The EU is a very large institution with a myriad of rules to follow, however, the above is a good summary of the major reasons one would expect the EU to have high growth rates and the Soviet Union to grow at a slower rate.

2.3.3 The Sudden Collapse of the USSR

> *Virtually everyone professionally engaged in the study of politics and foreign policy believed in the permanence of communism; its worldwide collapse in the late 1980s was therefore almost totally unanticipated*
>
> — (Fukuyama, 2006)

> *The disappearance of the Soviet Union was a remarkable affair, unparalleled in modern history. There was no foreign war, no bloody revolution, no natural catastrophe. A large industrial state – a military superpower – simply collapsed: its authority drained away, its institutions evaporated*
>
> — (Judt, 2005)

Both the above quotes speak to the sudden and unpredictable nature of the collapse of the USSR (along with the soon-to-follow collapse of Yugoslavia). I will not go into great detail, but it is imperative to stress how sudden and unpredictable the collapse of the USSR was. The Countries that opted to join the EU immediately began rapid institutional change at a pace that was breathtakingly fast in a historical context. Notably, while institutional change was rapid other variables that could plausibly affect economic growth remained relatively stagnant. The suddenness thus is the critical aspect that allows us to view this as a natural experiment. The sudden collapse suggests that institutions were the only potential casual factor that varied in a meaningful way.

2.3.4 The PHARE Programme

Following the collapse of the USSR, there was great interest expressed by many countries to join the EU quickly. To address this issue, the EU developed the PHARE Programme; the term PHARE is an acronym for the expression "Poland and Hungary Assistance for the Restructuring of the Economy"; see (Union). The program expanded to also include: The Czech Republic, Estonia, Latvia, Lithuania, Slovakia, Slovenia, Bulgaria, and Romania, along with Hungary and Poland. "The PHARE Programme is the European Union's initiative which provides grant finance to support its partner countries to the stage where they are ready to assume the obligations of membership of the European Union"; see (Union).

The PHARE program was, in essence, a unique response by the EU to a unique situation. Beforehand joining the EU was a slow process undertaken by countries already situated in Western Europe with similar economic systems. The collapse of the USSR resulted in an unprecedented situation. A situation where countries with very different economic systems and a much lower standard of living wanted to join the EU quickly. The collapse of the USSR required the EU to come up with a unique and unprecedented solution. The PHARE program was this solution.

To summarize a complex process – the PHARE program was an EU boot camp. The process was broadly referred to as "shock therapy" to illustrate how rapid it was; note this term was also used more generally to depict any quick transition to a more market economy; see (Klein, 2005).[1] It was designed for a quick and radical transition. Thus, the PHARE Programme becomes critical in the analysis. The fact that the USSR collapsed quickly and that there was an 'immediate' institutional transformation of some post-communist countries and not others results in a natural experiment that can isolate the importance of institutions for growth.

It is important to note the use of the term 'immediate' is important. The countries that didn't join the EU also went through transitions to various degrees. Programs like the 'Washington Consensus' also pushed for transition to more market economies. Thus, the PHARE program represented a much more rapid and enforced path towards market based economies relative to the non-PHARE countries. [2]

2.4 The Natural Experiment

The basic methodology is straightforward. I will define four groups and show a break in trends from the past, pre to post-collapse. I will show that one set of countries, the PHARE or 'treatment' group, did better, and via various methods, including instrumental variable analysis, we can be reasonably certain institutions caused the differences.

This section will be very brief, more technical discussion of empirical analysis will be left to section 2.5; also briefly touched upon in section 2.2.1. Here I will outline the countries to be analyzed and the basic time-line of the natural experiment.

[1] Note Russia was also apart of this program, but it is unclear to the degree it was implemented. The lead economist in charge, Jeffery Sachs, says it was never really carried out there; see (NPR)

[2] for explanation of the Washington Consensus see (Wikipedia, c)

2.4.1 The Four Groups

The three groups to be considered are as follows:

Group 1: EU member countries

- Ireland, Finland, Sweden, UK, Spain, Netherlands, Austria, Belgium, Portugal, Greece, Italy, France, Denmark, and Luxembourg

Neither Finland nor Sweden were members in 1991, but given they were well in the process of joining, they joined in 1995, it will be assumed they are much closer to being in this group than out, thus I will keep them. It can be shown that including or excluding them doesn't change the results.

Group 2: The PHARE countries

- Romania, Bulgaria, Lithuania, Latvia, Estonia, Poland, Slovakia, Czech, Hungary, Slovenia

It is important to make a couple of distinctions in this group. Not all the members were members of the USSR (see map in the appendix). In fact, only Latvia, Lithuania, and Estonia were members of the USSR. The rest were the so-called Satellite States. Furthermore, Slovenia was not a member of the USSR but came from the former Yugoslavia which collapsed at roughly the same time. It can be shown that including Slovenia doesn't change the results, thus I will include them.

Group 3: The Non-members

- Armenia, Belarus, Georgia, Azerbaijan, Turkmenistan, Uzbekistan, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Russia, and the Ukraine

For completeness we can list one more group that are not considered in the anylsis but are worth noting. Post-communist countries that did not join the PHARE program and are not currently (writing in 2021) applying to join.

Group 4: The 5 that Joined Later or are about to Join

- Albania, Macedonia, Montenegro, Serbia, Croatia [3]

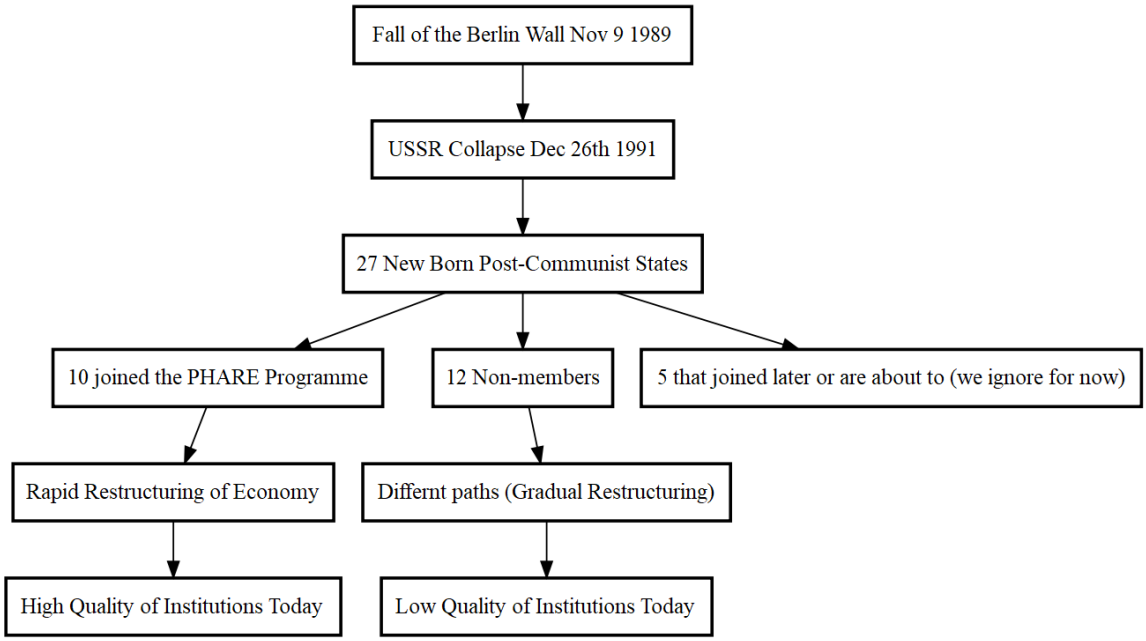
[3]Turkey is also attempting to join, but was never Communist

Post-communist countries whom are currently in the application process to join the EU.

2.4.2 Experimental Design

The two main groups to be compared are the PHARE countries and the Non-members. The PHARE countries will be treated as the treatment groups while the Non-members will be treated as the control group. See Figure 2.2 for the basic outline of the natural experiment.

Figure 2.2: Time Line



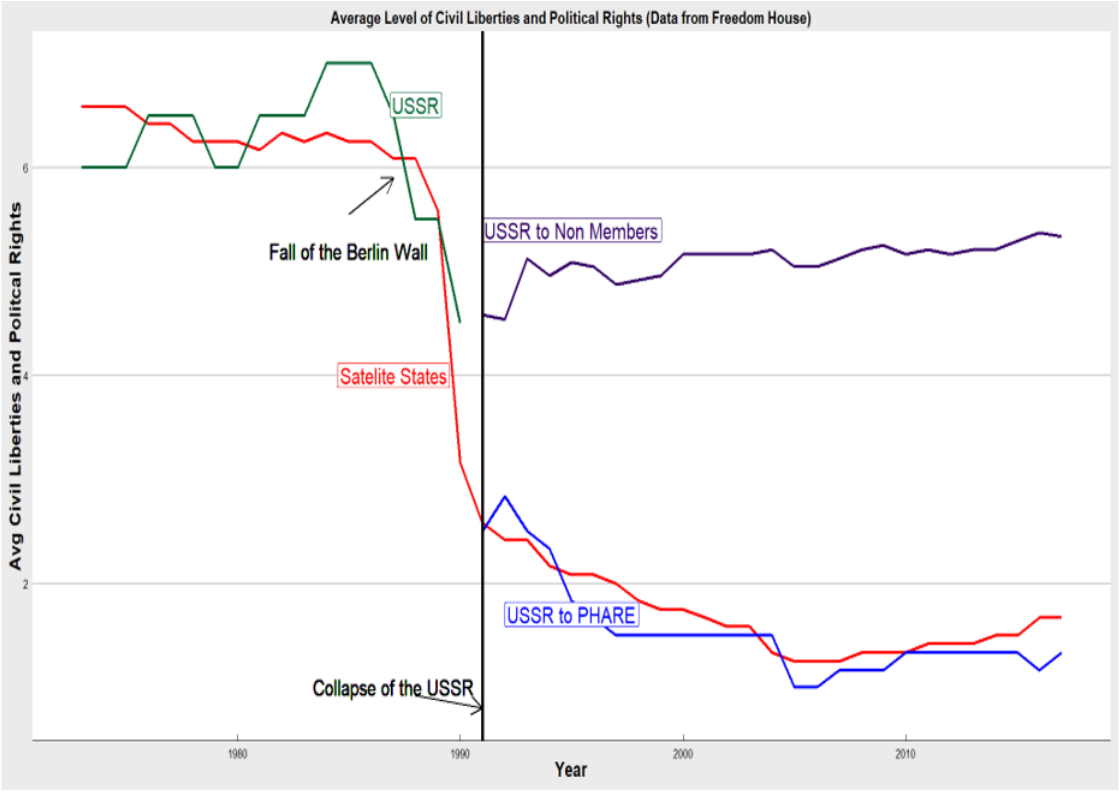
2.4.3 Measures of Institutional Quality

The causal variable of interest is institutional quality. Practically speaking, this has always been a problematic and controversial variable to measure. I will put all these issues aside and assume that standard measurements are accurate or accurate enough to draw conclusions. This section aims to show the measures of institutional quality employed are interchangeable with whether or not a country joined the EU after the collapse. Thus validating the critical claim that joining the PHARE program

resulted in rapid institutional improvement. I will use two primary data sources: Freedom House and the World Bank.

Consider figure 2.3 below, which plots the average rating done by Freedom House in two categories, starting in 1973, over time; see (House). The first is the degree of political freedom (PR) a country has, and the second is the civil liberties (CL) a country's citizens experience (I will call this variable PRCL). The green line represents the USSR and all the countries born directly from it. The red line represents the satellite states; thus, it includes countries within the Soviet Sphere but not technically a part of the USSR. Before the USSR collapsed, the Satellite States had ranks almost identical to those of the USSR; this is important as it validates the claim that there were no significant institutional differences between the USSR countries and the Satellite States. When the USSR collapsed at the end of 1991, we saw a sudden break. The Non-members essentially stagnate with an average rating of 4.7. Meanwhile, all the PHARE countries saw a rapid increase in institutional quality.

Figure 2.3: Average Political Rights and Civil Liberties



Regressing this statistic on the World Governance Indicators (WGI), which measures six different aspects of institutional quality, we see a very strong correlation in; see table 2.1 (the correlation is negative given the political rights and civil liberties range from 1-7 where 1 is the best and 7 is the worst). The WGI indicators started

Table 2.1: Correlation between Average Political Rights and Civil Liberties with World Governance Indicators 1996 to 2017

	Dependent variable: Average Political Rights and Civil Liberties					
	(1)	(2)	(3)	(4)	(5)	(6)
Control of Corruption	-0.057***					
	(0.001)					
Government Effectiveness		-0.064***				
		(0.001)				
Political Stability			-0.058***			
			(0.002)			
Regulatory Quality				-0.065***		
				(0.001)		
Rule of Law					-0.060***	
					(0.001)	
Voice and Accountability						-0.062***
						(0.001)
Observations	684	684	684	684	684	684
R^2	0.787	0.795	0.537	854	0.846	0.940
Note:						*p<0.1; **p<0.05; ***p<0.01

in 1996. If we assume the correlation is just as strong before 1996 as after, we can justify using both measures interchangeably as a good proxy for broader measures of overall institutional quality. Note this is ideal as while the Freedom House measures go back further in history, the World Bank measures are missing much fewer data points.

Thus, it should be considered plausible, and indeed very likely, that the PHARE Programme represented a dramatic increase in institutional quality. Note that the PHARE Programme membership is highly correlated with the WGI's as well (see appendix). Thus, both the WGI and the average CL and PR score seem to be indicating the same thing: that the PHARE Programme represented a dramatic increase in institutional quality for those that joined.

2.5 Empirical Analysis

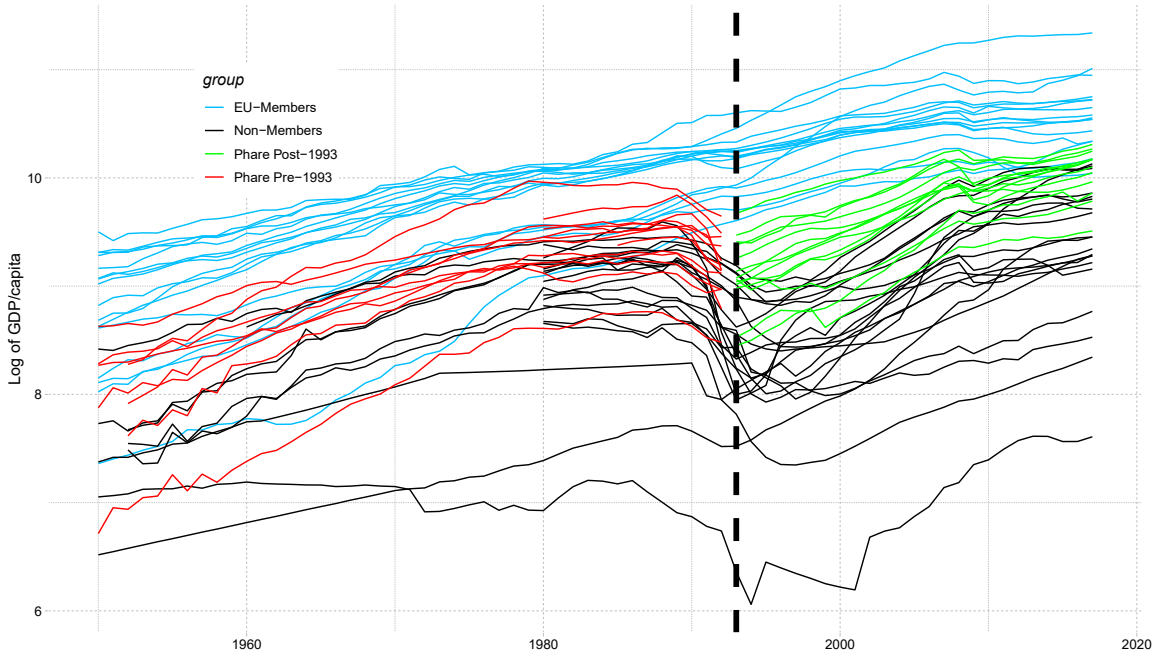
The following section is empirical evidence that the institutional change experienced by the PHARE countries relative to the Non-members caused differences in economic

outcomes. Section 5.1 establishes that there was a break in patterns pre to post-collapse. The remainder of the section, 5.2 - 5.10, only looks at post-collapse data to establish causality.

2.5.1 A Break in Convergence Rates Pre to Post Collapse

I want to show the PHARE countries were not converging as fast or faster pre-collapse than the Non-members. Or for that matter to show that all the countries, PHARE and Non-members, weren't growing faster than the EU member countries before 1991. Showing this is not as easy of a task as it might first appear, as data in the USSR has been notoriously inaccurate and often hard to obtain. The data I will use in this section is from the Madison Historical Statistics database; the project has done a remarkable job compiling data on communist countries before the collapse; see (Maddison Project Database).

Figure 2.4: Time Trend Pre and Post Collapse



In figure 2.4 we see the basic time trends. The figure plots the log of GDP/capita against time. The data runs from 1950 to 2017. Note, many countries don't have data until around 1980; thus, the data represents an unbalanced panel. The EU-Member countries appear in blue and can be seen along the top. The Non-members are black and mostly along the bottom. In the middle, we see the PHARE

countries. Before collapse, the PHARE countries can be seen in red. After 1993, they can be seen in light green.

Table 2.2: First Difference estimation with Dummy for pre and post collapse (1993)

	Dependent variable: $g_{i,t,t-1}$ (1950-2017)	
	(1)	(2)
$\delta_{EU}\log(y_{i,t-1})$	-0.437^{***}	-0.590^{***}
	(0.026)	(0.028)
$\delta_{nonEU}\log(y_{i,t-1})$	-0.042	0.073^{**}
	(0.033)	(0.033)
$\delta_{PHAREpre-1993}\log(y_{i,t-1})$	0.002	0.003^{*}
	(0.002)	(0.002)
$\delta_{PHAREpost-1993}\log(y_{i,t-1})$	-0.006^{***}	-0.007^{***}
	(0.002)	(0.002)
Intercept		0.014^{***}
		(0.001)
Observations	2,786	2,786
R^2	0.275	0.278
F Statistic	216.386^{***} (df = 4; 2782)	267.937^{***} (df = 4; 2781)
Note:		*p<0.1; **p<0.05; ***p<0.01

The first thing to note is we can visually see the member EU countries in blue converging before 1993; this is a well-established fact; see for example (Dowrick and Nguyen, 1989). Essentially convergence can be seen by the gap between the bottom and top countries narrowing with time. It should be noted this in itself represents an important natural experiment which I alluded to in section 2.3.1. With that stated, in this section, I am interested in the convergence pre and post collapse for the PHARE and Non-members. If we look at table 2.2, we see a break in convergence trends via a first difference estimator.

I will say convergence trends as the coefficients do not reflect convergence rates in a first difference or panel format. Without writing out the full equations, note that in a cross-section the sign of the coefficient is determined by

$$Cov[log(y_i) \; - \; \overline{log(y)}, \; g_i]$$

While, in a panel the sign of the coefficient is determined by

$$Cov[log(y_{i,t-1}) \; - \; \overline{log(y_i)}, \; g_{i,t}]$$

and in a first difference is determined by

$$Cov[log(y_{i,t-1}) \; - \; log(y_{i,t-2}), \; \Delta g_{i,t}]$$

Where Δ means change in; in a cross-section, the coefficient captures an expected change in the growth rate given a one percent change in the level of GDP/capita; a convergence rate. In a panel, the coefficient captures an expected change in the growth rate given a one percent deviation from a country's mean GDP/capita. In the first difference, the coefficient captures an anticipated change to the rate of change given a one percent change to the growth rate. The coefficient captures a within-group shift or a trend in the first difference or panel, not an absolute convergence rate. Given this, I use trend, as it doesn't make much sense to speak of countries converging with themselves, more so that a country is showing a given trend over time. It is a subtle but important distinction to make.

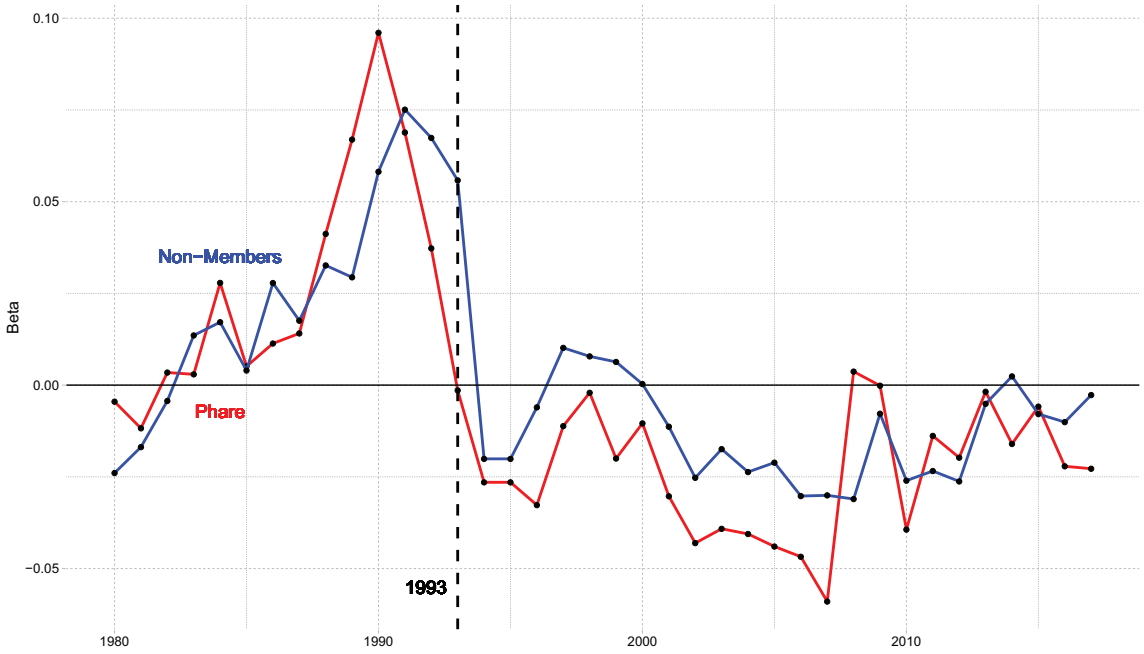
Column (1) shows the estimates with the intercept forced to zero. Column (2) allows the intercept to be different from zero. Typically, we expect a zero intercept with first difference estimation, but this is not the case given time trends. Regardless both columns show similar results. δ_{EU} is a dummy variable if a EU member. δ_{nonEU} is a dummy if in the Non-member group. $\delta_{PHAREpre-1993}$ is a dummy if in the PHARE groups in the time period is before 1993 and $\delta_{PHAREpost-1993}$ is a dummy in in the PHARE group and the time period is 1993 or later.

The first coefficient represents the convergence trend for the EU members. Thus, the poorer EU countries, like Italy, catch up to the more prosperous EU countries, like Switzerland. It shows a very highly statistically significant trend of convergence. The negative and significant coefficient on $\log(y_{i,t-1})$ indicates this. Additionally, the second coefficient represents a divergence in the Non-members group.

What is most important to document is that the PHARE countries were not converging pre-collapse. Instead, they had a slight divergence. Then post-collapse, the countries began to converge. The third and fourth coefficients illustrate this. The fact that the third coefficient is positive and the fourth is negative represents that the PHARE countries went from diverging before 1993 to converging after 1993. The results are somewhat sensitive to the year picked to be the break year between pre and post collapse. However, it can be shown that years between 1991 to 1995 all serve to give similar results.

Important to show, additionally, is that PHARE countries were not already on a different growth, or convergence, path pre-collapse. This can be documented

Figure 2.5: Year by Year Convergence Rates (Beta's) for Non-Members and PHARE Compared to EU Members



by estimating the convergence rates, or beta's, against the EU countries every year. That is estimate equation 2.1 for each year in the sample, once for the group of PHARE countries and EU-members, then again for the Non-members and EU-members. I will demonstrate this further in section 2.5.3. Essentially we want to compare both sets of countries to the same baseline. In this case, the EU-member countries make an ideal baseline. In some sense, the actual convergence rate, while important, is not that important. If you change the baseline, you change the rate. It is the relative difference between them that is of most importance. In essence, you're measuring their speed in a race by how fast they are approaching the same finish line.

I would like to see the PHARE countries converging at a higher rate after 1993 than the Non-members. Furthermore, I would like to see no difference in rates before 1993. looking at figure 2.5 we can see this is the case. Something very noticeable is the very low, in fact, negative, growth during the initial transition period: high rates of divergence between about 1985 to 1992. After this, we see that the PHARE countries did very well from about 1993 to 2008, seeing mixed results after the financial crisis of 2008. Note this is a simliar finding to to recent work with regards to the post communist European countries; "between 1999-2008 there was a period of 'real convergence,' brought to a halt by the crisis of 2008"; quote from (Swain, p.1) taken from a review of (Morys, 2018).

In table 2.3 we see the results of regressing the difference in convergence rates on a dummy variable, labeled $\delta_{post-1993}$, equal to one after 1993. The hypothesis is that the intercept is insignificant, and the slope coefficient on the dummy variable is negative and significant; this is what we see. The implication is simple, before the collapse, the PHARE and Non-members were on similar paths but after they were on different paths. The intercept represents no difference between convergence rates before 1993. The negative and significant slope coefficient suggests the PHARE countries did statistically better; note I minus the PHARE convergence rate from the Non-members rate; thus, it shows the PHARE rate is lower.

Table 2.3: Subtracting the Year by Year Convergence Rates

	Dependent variable: Difference in Convergence Rates
$\delta_{post-1993}$	-0.016666**
	(0.006188)
Constant	0.004714
	(0.939)
Observations	36
R^2	0.168
Note:	*p<0.1; **p<0.05; ***p<0.01

These findings are encouraging, but the results to this point do little to prove what led to the rate of convergence, was it the institutions of the EU, or something else? This is the topic I will turn to in the next sections.

2.5.2 Preliminary Post Collapse Findings

The simplest way to empirically compare the groups is to look at which group, PHARE or Non-members, ended up better off. Defining a dummy variable, δ_T:

$$\delta_T = \begin{cases} 1, & \text{if in the PHARE Programme} \\ 0, & \text{if a Non-member} \end{cases}$$

We can regress GDP/capita on δ_T, results are presented in table 2.4.

Clearly, the PHARE countries end up substantially better off, see table 2.4.

Table 2.4: PHARE countries end up much better off

	Dependent variable: $y_{i,2017}$
δ_T	10619.21^{***}
	(1470.45)
Constant	3974.85^{***}
	(991.37)
Observations	22
R^2	0.723
Note:	*p<0.1; **p<0.05; ***p<0.01

They are on average 10,619$ per capita richer than the Non-members. However, this is not a fair measure of the success given the PHARE countries started off wealthier. The mean GDP/capita for the PHARE countries in 1993 was 3,380$ while the mean was only 1,291$ for the Non-members.

Given this, it would be tempting to do a difference in difference and compare if δ_T predicts a statistically significant increase in GDP/capita. Thus look at $y_{i,2017}$ - $y_{i,1993}$. This will again yield a significantly better outcome for the PHARE countries, they will have on average increased their GDP/capita by 9,209$ more than the Non-members, see results in table 2.5.

Table 2.5: PHARE countries in terms of changes

	Dependent variable: $y_{i,2017}$ - $y_{i,1993}$
δ_T	9208.52^{***}
	(1201.66)
Constant	3453.73^{***}
	(810.16)
Observations	22
R^2	0.746
Note:	*p<0.1; **p<0.05; ***p<0.01

The problem with this approach is it only looks at levels and generally the economic growth rate is considered the benchmark of success. In economics, a country that increases its GDP/capita from 1000$ to 2000$ would be considered

as successful as a country that goes from 20,000$ to 40,000$ given both have 100% growth rates. Thus the ideal measure of success is growth rates.

Regressing all growth rates on δ_T in a pooled panel regression indicates no statistically higher growth rates for the PHARE countries (see column 1 in figure 2.6 below). While the PHARE countries realized a slightly higher average growth of 3.89 compared with the Non-members growth rate of 3.78 this difference is not statistically significant. However, it should be noted, and will be discussed later, that the standard deviation of growth rates was much lower for the PHARE countries at 4.1 vs 7 for the Non-members.

Using growth rates as a measure of success we see the results don't favor the PHARE countries (aside from the fact they had a lower standard deviation). However, only considering growth rates is also flawed as economic theory suggests that poor countries should grow faster (see earlier discussion on conditional convergence and the convergence hypothesis in section 2.3). This will led us into analysis of convergence to follow.

However, before doing so, we can stick with this regression set up and add in the log of GDP/capita at the start of the period thus controlling for initial wealth. Doing so still results in no significant result (see column 2 of table 2.6). However, after controlling for resource exports the PHARE countries do significantly better. I will control for resource exports by using Natural Recourse Rents (NRR), defined as the percentage of GDP derived from the price a resource is sold for above the cost of production.

It is quite common in economics to ignore resource-rich countries (for example Saudi Arabia). There are many reasons to do so. The simplest reason is that many economists don't see exporting resources as a permanent way to grow as the resources, simply put, will eventually run out. More complex reasons have to do with what is known as the "Resources Curse"; see (Mehlum et al., 2006) Humphreys et al. (2007). Many economists believe resource wealth can have a negative effect on institutional development, especially if the resources are controlled by only a few. The important point is that controlling for NRR can be justified as it is variable that is correlated, or perhaps even causes, lower long-term growth rates.

After controlling for the level of GDP/capita and NRR we see a significantly higher growth rate for the PHARE countries. By this standard, the PHARE countries had a 1.6% higher growth rate on average as compared to the Non-members after controlling for initial wealth and NRR. The implication is that PHARE countries relied much less on natural resources to grow likely signifying better long-term

Table 2.6: Significant results if we control for Natural Resource Rents

	Dependent variable: $g_{i,t,t-1}$ (1993-2017)		
	(1)	(2)	(3)
δ_T	0.15	0.74	1.57**
	(0.005)	(0.007)	(0.008)
$\log(y_{i,t-1})$		-0.003	-0.005*
		(0.003)	(0.003)
Natural Resources Rents			0.001***
			(0.0002)
Constant	0.038***	0.063***	0.065***
	(0.003)	(0.02)	(0.02)
Observations	518	518	518
R^2	0.001	0.001	0.002
Note:			*p<0.1; **p<0.05; ***p<0.01

growth potential.

2.5.3 Cross Sectional Convergence

As discussed in section 2.2.3 convergence is a natural way to measure economic success. In this context, a natural approach would be to regress the PHARE member countries' average growth rates from 1993 to 2017 on the log of GDP/capita in 1993 and include the member countries of the EU, i.e., the rich benchmark. This would be perfectly reasonable as the results would indicate the convergence rate in the group. The only catch is it would also pick up the convergence rate of EU member countries, which we are not particularly interested in. We want to know the rate at which the PHARE and Non-Member countries are catching up to the more prosperous EU members, not the rate at which the poorer EU members are catching up to the more affluent members. To resolve this, we can include the average of the EU group and weight it accordingly rather than the average of each country. Thus we are regressing the average growth rates of the PHARE and Non-Members against the average of the EU.

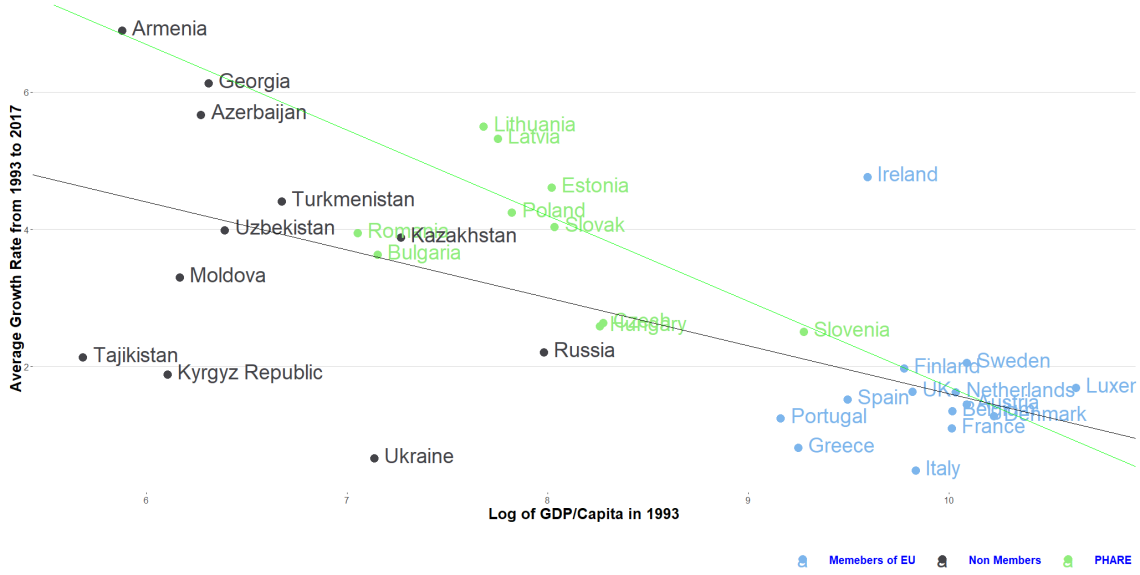
We can interpret the results as an estimate of how fast both the PHARE and Non-member countries are converging to the average EU country; the results

are in table 2.7 below and can be graphically seen in figure 2.6.

Table 2.7: Convergence rates of PHARE countries – significant convergence once institutional quality is controlled for

	Dependent variable: Average Growth Rate (1993-2017)		
	(PHARE + EU)	(Non-Members + EU)	(PHARE + EU + Non-Members)
	(1)	(2)	(3)
$Log(y_{1993})$	-1.272***	-0.734***	-1.065***
	(0.156)	(0.157)	(0.304)
$PRCL_{1993}$			1.503
			(1.333)
Constant	13.92***	8.602***	10.584***
	(1.38)	(1.303)	(1.751)
Observations	20	24	34
R^2	0.79	0.5	0.46
Note:			*p<0.1; **p<0.05; ***p<0.01

Figure 2.6: Average Growth rate vs Log of GDP/capita in 1993



The results suggest that both groups are converging at a statistically significant rate to the EU members but the PHARE countries are doing so quicker. While the Non-members are catching up at a rate of .73% per year the PHARE countries are close to double that at a rate of 1.23% per year. The implication is the PHARE countries are getting the same return on their capital even though they have more capital per worker. This implies, given economic theory, that the PHARE countries are more efficiently using the capital they have.

Furthermore, after controlling for institutional quality using the average level of political rights and civil liberties in 1993 (which I will label PRCL) we see significant convergence. Note: PRCL was initially between 1-7 and decreasing in institutional quality, I simply transformed the statistic linearly to be between 0 and 1 and increasing in institutional quality to mirror δ_T. Being a member of the PHARE Programme, as discussed in section 2.4.3, is highly correlated with institutional quality. The result thus supports the conclusion that institutional quality plays a major role in determining the rate of convergence for a given country; higher quality institutions producing quicker convergence rates.

2.5.4 Panel Convergence with a Fixed Effect (towards causality)

Thus far, the results are somewhat mixed as to which group did do better and, perhaps, more importantly, there isn't necessarily a way to imply causality. If we accept the PHARE countries did better, how do we know the institutional transformation carried out via the PHARE Programme caused this better result? It is possible institutions are endogenous. It is conceivable that countries with higher GDP/capita could join the PHARE Programme and thus get better institutions. Perhaps one of the other potential causes of growth discussed in section 2.2.2 was responsible for these better outcomes.

To imply that δ_T is in fact causal two things must be established: (1) is that δ_T does represent dramatic institutional improvement, (2) is that it was this institutional improvement that caused a higher rate of convergence. Point one has already been established in section 2.4.3. Part two is more challenging to verify.

To establish causality, the first important step is to control for all the time-invariant differences across these countries that could affect GDP/capita. This will be done by incorporating a fixed effect in the panel regression. While a fixed effect is clearly not a panacea, it should be considered an adequate control for things like geography and culture. These are two things that could affect long-run GDP/capita but are not thought to change very quickly (or at least not quickly with respect to this time frame).

Human capital will be added to control the possibility that differences in human capital drive the convergence results. Furthermore, exports as a share of GDP will control for time-variant geographic effects; that is to say the possibility

that PHARE countries grew only given better trade opportunities with the EU and other markets. If this were true, the share of exports in GDP should rise throughout the sample for the PHARE countries and, importantly, rise at a much quicker rate than the Non-members. Adding this variable controls for the possibility that trade alone drives the convergence result.

We estimate the following equation:

$$g_{i,t,t-1} = \alpha_i + \beta_C \delta_{nonEU} log(y_{i,t-1}) + \beta_T \delta_{PHARE} \log(y_{i,t-1}) + \gamma \boldsymbol{X}_{i,t-1} + e_t \quad (2.2)$$

Where:

- $y_{i,t-1}$ - GDP/Capita of country i at time t-1
- $g_{i,t,t-1}$ - is growth per capita for country i from t-1 to t
- β - convergence trends (T = PHARE, C = Non-Members)
- δ_{PHARE} and δ_{nonEU} are dummy variables indicating the group
- $\boldsymbol{X}_{i,t-1}$ - is a matrix of variables to condition on, in this case Human Capital and Trade as a % of GDP
- α_i - the fixed effect of country i

Table 2.8 shows the key results. Given the sample only contains the PHARE countries and the Non-members, δ_{PHARE} represents the marginal effect of moving from the Non-member group to the PHARE group. We can see the PHARE countries show significant convergence while the Non-members do not, given the coefficient on $\delta_T \text{Log}(\text{y}_{i,t-1})$ is statistically significant. Furthermore, the Human Capital coefficient is not significant. The average level of human capital in both these groups was roughly the same at the start of the period.

Additionally, Human Capital can be shown to lag behind increases in GDP/capita in the PHARE group. Thus, human capital is endogenous and driven by increases in GDP/capita caused by improvements in institutional quality. Importantly, suppose the time-invariant potential determinants of GDP/capita and the time-variant geographic components are controlled for. In that case, we can conclude that institutions cause these higher convergence trends (I will back this claim further in the following sections).

Table 2.8: Panel Regression with Fixed Effect: significant convergence for PHARE countries, Human Capital is insignificant

	Dependent variable: $g_{i,t,t-1}$ (1993-2017)
	(1)
$\delta_{nonEU}\log(y_{i,t-1})$	-0.513
	(0.006)
$\delta_{PHARE}\log(y_{i,t-1})$	-3.81**
	(0.015)
Human Capital$_{i,t-1}$	0.039
	(0.071)
Trade as a % of GDP	0.001***
	(0.0002)
Observations	361
R^2	0.08
Note:	*p<0.1; **p<0.05; ***p<0.01

2.5.5 Comparing the Volatility of Convergence Rates

An important addition to the findings thus far is that the Non-members convergence and growth rates are much more volatile; this was alluded to in section 2.5.2. To illustrate the higher volatility of the Non-members it is worth doing a little bit of algebra. If we start with equation (1) for just a single country we have (thus we can ignore the i subscript):

$$g_t \;=\; \alpha \;+\; \beta \log(y_{t-1}) \;+\; e_t \tag{2.3}$$

we can replace the growth rate by using the following:

$$g_t \;\approx\; log(y_t) - log(y_{t-1}) \tag{2.4}$$

Thus obtaining:

$$log(y_t) - log(y_{t-1}) \;=\; \alpha \;+\; \beta \log(y_{t-1}) \;+\; e_t \tag{2.5}$$

Rearranging:

$$log(y_t) \;=\; \alpha \;+\; (\beta + 1) \log(y_{t-1}) \;+\; e_t \tag{2.6}$$

Finally equate $\beta + 1 = \theta$ we get:

$$log(y_t) \;=\; \alpha \;+\; \theta \log(y_{t-1}) \;+\; e_t \tag{2.7}$$

This is a AR(1) process which we can estimate for each country using OLS. It should be noted that $0 \leq \theta \leq 1$ to be stationary (it should be noted that all the β terms are multiplied by 100 to make percentages, but they should be thought as being between 0 and 1 in absolute value). This can give us two things. The first is an estimated steady state (SS). If we set $y_t = y_{t-1}$ we get a steady state of:

$$SS = \frac{\alpha}{1 - \theta} \tag{2.8}$$

and a variance of:

$$\sigma^2_{SS} = \frac{\sigma^2_e}{1 - \theta^2} \tag{2.9}$$

Figure 10 illustrates the results of the OLS regression on each country. We can calculate the average SS and the variance using the average α and θ for each group. Doing so we get an estimated SS for the PHARE countries of 10.04, given this is a log it implies a SS of roughly 23,000$ and a variance of 0.17. Meanwhile, for the Non-members we have a SS of 3,165$ and a variance of .44 (nearly 4 times the variance of the PHARE countries.

It should be noted that these predictions in a sense are meaningless given technological progress or endogenous growth. Basically, we know steady states don't really exist. However, assuming the existence of a steady state for the sake of comparison is perfectly fine. All that really matters is we are comparing the groups under the same assumption, even if the assumption is not particularly useful for

predictive purposes.

In some sense, this illustrates the already discussed fact that there is much more volatility in growth rates among the Non-members. The higher volatility in the Non-members growth rates draws the estimated convergence coefficient in sec 5.3 close to zero. While the growth rates of the PHARE countries follow a pattern predicted by economic theory the growth rates of the Non-members are unpredictably fluctuating; they are close to a random walk. It can be concluded that the PHARE countries are converging, at a relatively fast rate, to a high estimated long-run GDP/capita. Furthermore, While the Non-members are growing they are not doing so consistently or predictably when compared to the PHARE countries.

Figure 2.7: Summary Statistics for AR(1) Regression

group	country	intercept	Theta	Steady State	Exp(SS)	std error resid	sigma^2
PHARE	Poland	0.6	0.96	15	3269017	0.1303	0.01698
PHARE	Hungary	1.785	0.817	9.7540984	17224.7	0.1726	0.02979
PHARE	Czech	1.43	0.86	10.214286	27290.3	0.2016	0.04064
PHARE	Estonia	3.61	0.622	9.5502646	14048.4	0.33	0.1089
PHARE	Latvia	3.01	0.686	9.5859873	14559.3	0.2975	0.08851
PHARE	Lithuania	2.64	0.73	9.7777778	17637.4	0.3235	0.10465
PHARE	Slovak	1.47	0.865	10.888889	53577.7	0.2222	0.04937
PHARE	Slovenia	4.3	0.57	10	22026.5	0.173	0.02993
PHARE	Bulgaria	0.74	0.93	10.571429	39004.4	0.246	0.06052
PHARE	Romania	0.4998	0.965	14.28	1591202	0.2683	0.07198
Non Members	Armenia	1.62	0.814	8.7096774	6061.29	0.2742	0.07519
Non Members	Azerbaijan	1.615	0.81	8.5	4914.77	0.554	0.30692
Non Members	Kazakhstan	0.979	0.904	10.197917	26847.2	0.3232	0.10446
Non Members	Georgia	0.803	0.932	11.808824	134433	0.2726	0.07431
Non Members	Moldova	0.44	0.96	11	59874.1	0.249	0.062
Non Members	Russia	1.71	0.8	8.55	5166.75	0.3225	0.10401
Non Members	Tajikistan	1.48	0.755	6.0408163	420.236	0.4399	0.19351
Non Members	Turkmenistan	0.153	0.99	15.3	4412712	0.5455	0.29757
Non Members	Ukraine	3.18	0.567	7.3441109	1547.06	0.3963	0.15705
Non Members	Uzbekistan	-0.32	0.99	-32	1.3E-14	0.2144	0.04597
Non Members	Kyrgyz Republic	1.747	0.73	6.4703704	645.723	0.3197	0.10221
Non Members	Belarus	2.13	0.755	8.6938776	5966.27	0.344	0.11834

2.5.6 Panel Convergence with World Governance Indicators

A convergence regression, using a fixed effect as in section 2.5.3, with the World Governance Indicators generates significant rates of convergence. With just log of GDP/capita in the regression we see a less significant coefficient. Once the WGI

are added the coefficient becomes highly statically significant and negative. The interpretation is that once institutional quality is controlled for poorer countries tend to grow faster. This further establishes the result that institutional quality produces significantly higher convergence rates; see table 2.9 below.

2.5.7 Panel Convergence with an Instrumental Variable

I will conduct a robustness check using instrumental variables (IVs) and a two-stage least squares (2SLS) approach to establish causality further. It is necessary first to consider what could potentially suffer from endogeneity? Note the primary model estimated thus far is endogenous by construction; see discussion in 2.2.3. The causal variable is primarily δ_T, representing a break in institutional paths. What we are concerned with is self-selection bias. Did the countries that joined the EU do so because they were already growing faster or could do so? That is either the EU only allowed countries with high growth potential to join, or these are the only countries that wanted to join. If this is the case, then there is reverse causality, δ_T might cause $g_{i,t,t-1}$, but $g_{i,t,t-1}$ might also cause δ_T.

What would an ideal IV do? It is essential to be clear as the validity rests on a couple of critical assumptions. The assumption is that all variables potentially correlated with the IV are either already controlled for or time-invariant. The IV is correlated with the levels but not the changes in, for example, culture and geography. In changes, the IV is correlated with GDP/capita only via its correlation with institutional quality.

The IV I will consider is the distance from Brussels to the capital city of each of these countries. The logic is as follows: any time-invariant geographic and cultural effect on GDP/capita should be controlled for by the fixed effect. Furthermore, any time variant geographic effect should be controlled for by trade as % of GDP; see discussion in section 2.5.4. Thus, any geographic factor that predicts PHARE membership should only be related to GDP/capita via its direct effect on institutional change. Clearly, countries closer to Brussels will be more likely to join the EU and, importantly, GDP/capita during this period will have no effect on distance from a capital city to Brussels. The geographic location of capital cities was determined well before 1993. In this framework geography only effects GDP/capita as a vehicle for different institutional paths.

Table 2.9: Using WGI as a control for institutional quality we see a significant increase in convergence (data only from 1996 to 2017)

	Dependent variable: $g_{i,t,t-1}$ (1996-2017)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\log(y_{i,t-1})$	-0.673*	-2.301***	–2.265***	-2.353***	-2.189***	-1.994***	-2.372***
	(0.352)	(0.378)	(0.406)	(0.371)	(0.424)	(0.414)	(0.371)
Control of Corruption		-0.024					
		(0.035)					
Government Effectiveness			-0.02				
			(0.037)				
Political Stability				-0.004			
				(0.037)			
Regulatory Quality					-0.032		
					(0.039)		
Rule of Law						-0.082*	
						(0.043)	
Voice and Accountability							-0.016
							(0.052)
Observations	518	396	396	396	396	396	396
R^2	0.007	0.1	0.1	0.099	0.1	0.11	0.1
Note:							*p<0.1; **p<0.05; ***p<0.01

Table 2.10 shows the first stage regression of δ_T on distance of capital cities from Brussels measured per 100 km. The results are as required, the IV is highly correlated to the potentially endogenous variable δ_T. It should be noted that human capital is uncorrelated with δ_T, thus including it or not does not change the results. Considering the list presented in section 2.2.2 the only factor left significant, assuming geography and culture are time invariant, is institutional quality.

Table 2.10: First Stage Least Squares

	Dependent variable:	
	(δ_T)	(PRCL)
	(1)	(2)
Distance Between Capital to Brussels	-0.023***	-0.015***
	(0.003)	(0.002)
Constant	1.133***	1.024***
	(0.085)	(0.065)
Observations	36	36
R^2	0.587	0.616
Note:	*p<0.1; **p<0.05; ***p<0.01	

After adding the IV via 2SLS we get a higher estimate of convergence (see column 3 in table 2.11). This supports the original results. In fact, the results suggest the original regression was biased by understating the effect of improved institutional quality on GDP/capita. Furthermore, using the PRCL variable instead of δ_T we get similar, in fact, stronger results. This establishes the robustness of the result that institutional quality causes higher rates of convergence.

2.5.8 Growth Accounting (what is driving convergence?)

An interesting question is which factor of production specifically is driving convergence: total factor productivity, human capital, or physical capital? The Answer to a strong degree is total factor productivity (TFP). In table 2.12 we see the basic regression, with growth rates in GDP/capita in column 1, and growth rates of the other factors in rows 2,3, and 4. In column 2 we see a much stronger trend

Table 2.11: Second Stage Least Squares: Panel Regression with Fixed Effect – IV shows a stronger rate of convergence

	Dependent variable: $g_{i,t,t-1}$ (1993-2017)			
	(1)	(2)	(3)	(4)
$\log(y_{i,t-1})$	-0.092	-0.517	0.752	2.245**
	(0.438)	(0.408)	(0.537)	(0.888)
$\delta_T \log(y_{i,t-1})$	-2.098**			
	(0.865)			
PRCL$\log(y_{i,t-1})$		-0.317		
		(0.378)		
$\delta_{IV} \log(y_{i,t-1})$			-4.218***	
			(1.164)	
$\delta_{IV prcl} \log(y_{i,t-1})$				-5.794***
				(1.599)
Trade as a % of GDP	0.017	0.004	0.022*	0.022*
	(0.014)	(0.013)	(0.013)	(0.013)
Observations	512	512	512	512
R^2	0.021	0.002	0.011	0.002
Note:				*p<0.1; **p<0.05; ***p<0.01

towards convergence among the PHARE countries in terms of TFP. This finding is predictable in the sense that the USSR invested highly in both physical and human capital formation but lacked the ability to efficiently put it together; reminiscent of the old USSR joke "we pretend to work, they pretend to pay us". Thus, when the USSR collapsed increases in TFP would be expected given they lagged so far behind. The critical finding here is that the PHARE countries are diverging rather dramatically away from the Non-members in terms of TFP. This is a strong indicator that the institutions of the EU are increasing productivity. Meanwhile, growth rates among the Non-members, to a large degree, are being driven by exports of resources and not increases of TFP or other factors.

Investment in physical capital plays a rather small role but in the predicted direction. With human capital we actually see a reversal of the trend. Here is it the Non-members that show a convergence trend while the PHARE countries do not. Again, this supports the fact that human capital can't be driving convergence in this instance. In fact, it seems to be playing a counter-intuitive role.

Table 2.12: Panel Regression with Fixed Effect: Convergence in factors of production

	Dependent variable: $g_{i,t,t-1}$(1993-2017)			
	$(g_{gdp/capita})$	(g_{tfp})	(g_k)	(g_{hc})
	(1)	(2)	(3)	(4)
$\log(y_{i,t-1})$	-0.124	2.32*	-0.189	-1.07***
	(0.432)	(0.904)	(1.23)	(0.153)
$\delta_T \log(y_{i,t-1}$	-1.64**	-3.296***	-3.38	0.546*
	(0.74)	(1.27)	(2)	(0.211)
Observations	518	347	430	344
R^2	0.017	0.023	0.014	0.159
Note:		*p<0.1; **p<0.05; ***p<0.01		

2.5.9 Looking at the Baltics

To further establish a robust result a good set of countries to look at are the Baltics (Estonia, Lithuania, Latvia) along with Belarus, Ukraine, and Moldova. Why these 6? Using these countries controls for many of the unobserved differences between the PHARE countries and the Non-members that could affect the results.

The first being the potential difference between the Satellite States and member USSR countries. It can be argued that the Satellite States were never transformed institutionally as much as the USSR was and therefore didn't end up as Soviet Communist as the USSR. Thus, the Satellite States had a natural advantage when the USSR collapsed over countries that came from the USSR. Thus, it is plausible that the PHARE countries did better because the PHARE Programme consisted of so many Satellite States while the Non-member group consisted of only USSR member countries. Thus the results were generated by underlying difference between the Satellite Sates and the USSR and not institutional changes. Given all 6 of these countries came from the USSR we can control for this potential confounding difference.

Furthermore, looking at these countries controls largely for geographic differences. Many of the Non-member countries, particularly those in Asia, have very different geographies as compared the PHARE countries. For example, many of the Non-member countries are very mountainous and landlocked (for example Kyrgyzstan). However, within these 6 countries the geographies are very similar. Only Belarus is landlocked, however, it is quite close to the sea and has access to navigable waterways. Furthermore, none of these countries is particularly mountainous. Simply put, it would be difficult to argue that one of these 6 countries had a huge, or even negligible, geographic advantage over the others.

Table 2.13: Balitics + Ukraine + Moldova + Belarus (pooling data)

	Dependent variable: $g_{i,t,t-1}$ (1993-2017)
δ_T	0.025^{**}
	(0.011)
Constant	0.027^{***}
	(0.008)
Observations	136
R^2	0.037
Note:	*p<0.1; **p<0.05; ***p<0.01

In summary, these countries all started out with the same post-Soviet Institutions, had nearly the same starting GDP/capita, and have very similar geographies. With this in mind, I will regress growth rates for this group on δ_T in a pooled panel regression. Recall when doing this regression for the entire sample in sec 5.1 a significant result could not be established. Looking at table 2.13 we see

a significantly higher growth rate for the Baltic countries (the three PHARE countries in this sample of 6). The results indicate the Baltics grew 2.5% faster every year as compared to Belarus, Moldova, and The Ukraine and this was caused by institutional improvement.

2.5.10 Poland vs Ukraine

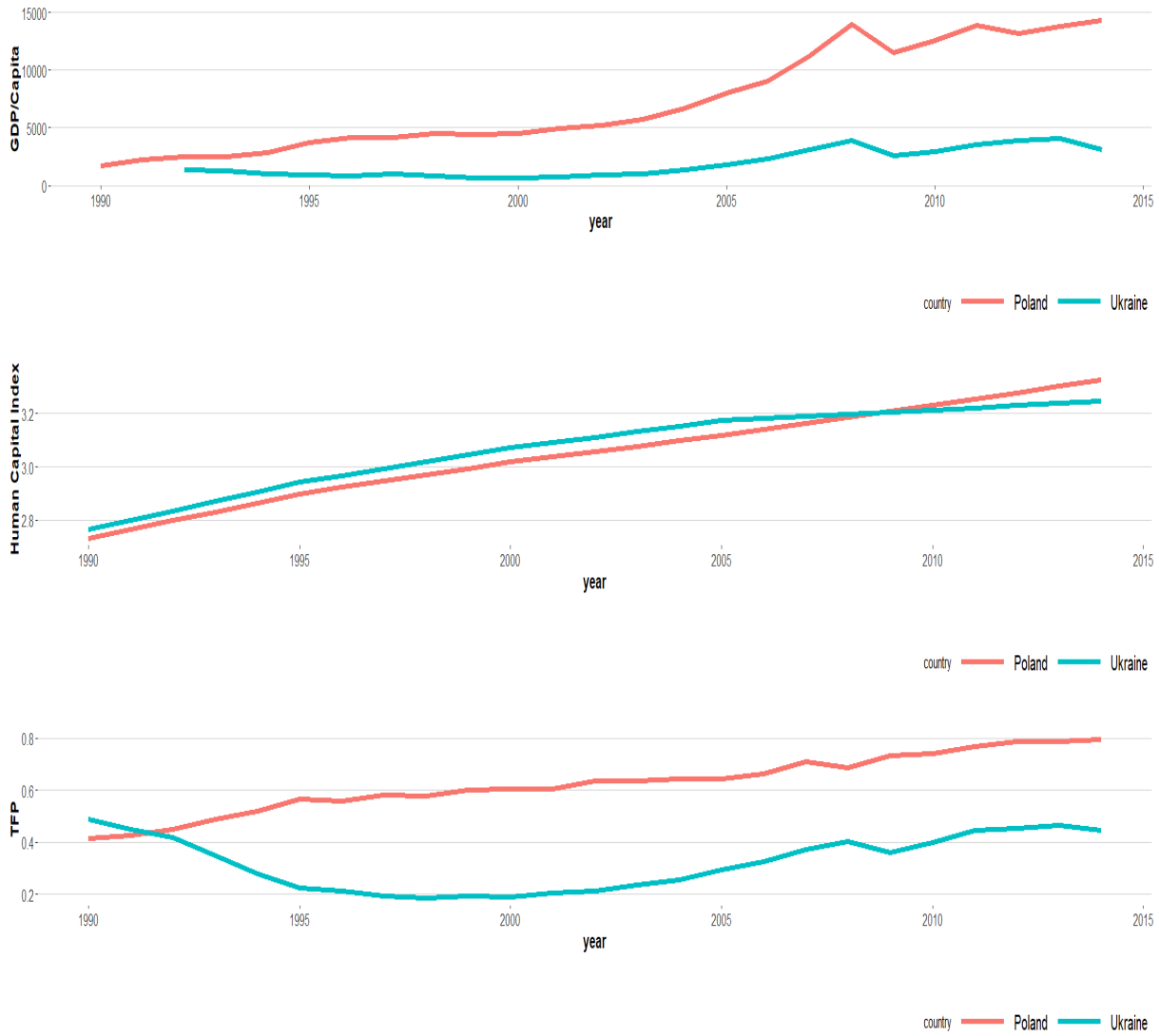
If one was to compare two countries, one from each group, in my opinion, Poland and Ukraine would be the logical choice. While perhaps not as similar as East and West Germany or North and South Korea they are quite alike culturally, historically, and geographically.

According to the Maddison Project Database, Ukraine was about 10% wealthier than Poland in 1973 (Maddison Project Database). At present Ukraine has a GDP/capita of 8,700$ which makes it the 148th wealthiest country in the world, meanwhile, Poland has a GDP/capita of 29,500$ and is the 69th wealthiest country in the world (Book). That is Poland per person is on average 3.5 times richer. That is a staggering number for two countries that have very similar geographies, cultures, histories, and even levels of human capital. Assuming reasonably this difference in economic outcomes must have been caused by a difference in one of the "Fundamental Causes of Growth" (see section 2.2.2 for discussion) we can determine the only plausible difference that could explain these divergent outcomes is institutions.

The comparison particularly points out the inadequacy of human capital in explaining differences in GDP/capita. Ukraine started the post-communist period with a higher level of human capital compared to Poland and Poland did not surpass Ukraine until 2009. Figure 2.8 below shows the drastically diverging GDP/capita through time along with the levels of human capital, and TFP. While Poland was far richer by 2008 it took until this time for that extra wealth to transfer into a higher level of human capital. As discussed earlier when looking at these countries human capital lags behind growth indicating strongly it is endogenous to the process and not a cause of it. We can rule out differences in Human Capital as causing these differences in economic outcomes.

Analyzing geography as a potential determinant of these different outcomes, I will look at the three key geographic factors that Jeffery Sachs promotes: A tropical Climate, access to an ocean port, and distance of the country from the world's major trading centers (Rotterdam, New York, and Tokyo) (Sachs, 2003).

Figure 2.8: Poland vs the Ukraine (from top to bottom :GDP/capita, Human Capital, Total Factor Productivity)



We can rule out tropical climate easily, neither have tropical climates. Both have access to Ocean Ports. Finally, we have the distance to a trading center. Kyiv to Rotterdam is 1,993 km, while Warsaw to Rotterdam is 1,229 km. In this context, though geography clearly matters, it can't account for the fact Poland is 3.5 times richer per person than Ukraine.

Furthermore, the comparison suggests that embedded cultural factors can't explain the differences. It is implausible to suggest that two countries so similar in cultural aspects would have different outcomes if culture drove the divergence.

Looking at TFP growth (the bottom plot in figure 2.8) we see divergent paths in the year 1992. This story clearly mirrors the story told thus far. Joining

the EU led to rapid increases in TFP which drove growth. Furthermore, this rapid increase in TFP was caused by increases in institutional quality.

2.6 Concluding Thoughts: What will the End of Poverty look like?

Much ink has been spilled over the above question. This paper offers a rather simple vision of the end of poverty – every country needs to join the EU. Ok, clearly, this is impossible, but every country can join something resembling the EU. It is hard to imagine a world where every country has functioning markets and accountable government that still has extreme poverty. Functioning markets and an accountable government is at face value the promise of the EU.

The crucial result demonstrated in this paper is that institutions drive conditional convergence; if you have rapid institutional convergence, you will have rapid economic convergence; if slower institutional convergence, then slower economic convergence, etc. If this is so, the implication is that a basic set of institutions must be present to expect a country to escape poverty. While solving geographic problems may have positive effects at the margin, they will likely fall short in achieving the ultimate goal of poverty alleviation.

This historical event is so interesting because a group of countries: (A) had the option to join the EU or something like it, and (B) were very motivated to move away from their present set of institutions. This seems simple enough, but it is amazing how rarely both these conditions can be met. It is extremely difficult for both of these events to align; either the option is there but the political will is not, or the political will is there, but the option is not, or neither. The simple suggestion is that attempts to end poverty should make sure both these conditions are likely to be present. Simply put, create institutions like the EU and promote the importance of the basic institutions they represent to instill a desire and political will to join them. It isn't an easy task, but we should all know by now, ending poverty is not an easy task.

Chapter 3

Escaping Zero: The Shadow of the Future, Institutional Jumps, and Sustained Growth

3.1 Motivation

The Industrial Revolution and the explosion of subsequent growth rates are phenomena that economists have long sought to understand. Indeed, most people grapple with understanding this explosion of economic growth rates in one way or another at some point in their lives. How do we explain a world that changed more in terms of living standards in the last two hundred years of human history than in all human history before then?

To model this transition, we have to model a shift from one set of economic dynamics to another.[1] At a fundamental level, there must be something we can think of that was transformed – something dormant before the Industrial Revolution that is not after. In an influential book, author Robert Wright suggests that the most interesting dynamic shaping human history is the process of humanity becoming more "non-zero". The transition to a modern industrial world runs parallel to humanity becoming more interconnected and interdependent; see (Wright, 2000). With time societies move from competing, playing games that, if you win, I lose, to cooperating, playing games where we both win or lose.

The core idea presented here is that an institutional shift altering payoffs

[1] see, for example, (Galor, 2005)

in a simple game could model the jump in growth rates concurrent with the Industrial Revolution. Thus representing the change in dynamics that Wright suggests. In other words, the abstract and perhaps elusive notion is that the 'something' transformed as growth rates exploded was the payoffs of entering into non-zero-sum games, encouraging a more interconnected and, as it turns out, efficient world.

This paper aims to build on an already existing model presented by Oded Galor; see next section for references. Galor proposes that dynamics related to human capital accumulation shift at a certain population level, which provokes an escape from Malthusian conditions. In this paper, I add to the model by suggesting that it isn't the population level we want to model but the population of people that cooperate. People naturally form groups, but groups can collaborate or compete. Thus, the total population isn't meaningful if the population consists of two groups at war. The suggestion is that cooperation in place of competition will only occur once a certain institutional quality is reached. Only once groups, and eventually nation-states, have sufficient checks on power will societies cooperate, unleashing modern growth.

3.2 Background

3.2.1 Literature Review

> *The inconsistency of exogenous and endogenous neoclassical growth models with some of the most fundamental features of the process of development, has led recently to a search for a unified theory that would unveil the underlying micro-foundations of the growth process in its entirety, capturing the epoch of Malthusian stagnation that characterized most of human history, with the contemporary era of modern economic growth*
>
> — (Galor, 2004, p.1)

The quote above comes from a working paper titled "From Stagnation to Growth: Unified Growth Theory"; the model was initially introduced in 2000, see (Galor and Weil, 2000), the article was more formally published in 2005, see (Galor, 2005), with a follow-up book published later in 2011, see (Galor, 2011).[2] Collectively

[2]I only cite Galor for the remainder of the paper as he has done the most work after 2001, but it should be noted that Weil also played a very important role

the research was a remarkable achievement. The goal was to connect the dots (literally if you see figure 3.1 below) between pre and post-Industrial Revolution growth rates with a unified general equilibrium model.

The paper is quite complex in its full development but begins with a simple overlapping generations model of Malthusian stagnation. Fundamentally any model that hopes to explain this transition must have two things: (1) multiple equilibria and (2) a mechanism to jump from one equilibrium to another. The mechanism Galor proposes focuses on human capital accumulation. Galor proposes that households will begin to value fewer but higher quality children, i.e. they will invest in their children's human capital, under unique circumstances.[3]

The unique circumstance is somewhat complex, but essentially technology drives both population growth and human capital accumulation. With better technology, households' budget constraints are relaxed, as they have more wealth, resulting in more children. However, technology also increases the demand for human capital since human capital complements technology. Since raising children with high human capital is expensive, this effect would drive families to have fewer children. The question is which effect overwhelms the other. In the initial stage, population growth wins out, and we return to a Malthusian equilibrium. However, the second effect wins out with time and some luck, and we escape the Malthusian Trap.

The theory rests on a critical population level or density. When the population remains relatively low, Malthusian conditions persist. At some point, the population is high enough to generate scale effects (or positive externalities), allowing the human capital accumulation effect to dominate. At some population tipping point, a modern economy can flourish, given human capital becomes valuable enough for parents to invest in their children's acquisition of it.[4] Growth is then endogenously driven by a process where higher human capital drives technological progress, which increases the demand for human capital. As noted, children with high human capital are expensive, lowering birth rates. We get a new equilibrium of high human capital, lower birth rates (around replacement level), a large and stable population, and technological progress.

It is beyond the scope of the paper to note all the critiques of Galor's work, but it is essential to address one. Many have pointed out the data often does not sup-

[3]Note the work is closely linked to work by Gary Becker and co-authors; see (Becker and Tomes, 1976).

[4]Note, Galor has three equilibriums: Pre and Post Malthusian, and a Modern Growth Equilibrium

port the model. Why, for example, don't we see development in China which reached population thresholds well before Europe? This likely points to the importance of institutions, which is my focus moving forward. [5] This paper aims to develop Galor's basic model further but focuses on institutions as the jump mechanism. The model presented is similar methodologically to Galor's but has a substantive difference.

Galor focuses on human evolution; he focuses on linking his work to theories of human development. I concur with this methodology, but I add a critical assumption. I suggest that it is very natural for humans to evolve in groups, but only in groups up to a specific size. Thus, though it is somewhat counterintuitive, people are highly amenable to cooperation when the group size is small. However, it becomes challenging, if not impossible, as populations grow. [6] Thus, humans are naturally cooperative in small groups and inherently hostile in large groups; this is a byproduct of evolution. I suggest that unique intuitions can solve this problem; I will return to this in 3.3.4. This is a critical addition to the model as it suggests that while population matters, it isn't deterministic that as populaiton grows, technology does as well. Institutions are required to foster this.

My work relates to Galor's in the sense that we both have scale effects due to large populations. The idea in this paper is that two populations that are non-cooperative with each other won't achieve scale effects. Only once they cooperate can this take place. Thus the focus is less on the total population, but rather the size of populations that can cooperate. In some sense, the idea is straightforward, what good is more people if they are at war with each other? Once a society reaches basic checks on governmental power, societies can induce a credible commitment to upholding cooperation. Thus, a set of institutions triggers the jump in equilibria. In this way it mimics aspects of Galor's population threshold but with an important caveat.

3.2.2 A Brief Review of Game Theory in Macroeconomics

Before moving forward, it is worth grounding my methodology in the literature. I use a game-theoretic framework that is not common in this area of study. However, I will suggest it has a long history in related fields. For example, the literature related

[5] See, for example (Nielsen, 2015)

[6] There is a huge collection of literture related to this, the most common heirarchy is band, tribe, cheifdom, state. In this light, what I am referring to is the jump from chiefdom to state; see, for example, (Ziegler, 2007)

to the 'Big Push' has rich game-theoretical underpinnings. This area is usually considered part of the economic development field, generally under microeconomics. However, remember that the goal is 'micro-foundations' for a macro model. Thus game theory is an ideal starting point. [7]

To illustrate the use of game theory in the context of a macro model, consider its use in one of the most read textbooks in macro, Acemoglu's "Introduction to Modern Economic Growth"; see (Acemoglu, 2012, p.115). The author develops a simple game theory framework to introduce the 'Big Push' idea. In the game, agents can either choose a low or high investment. The model has two equilibria, one where both agents choose low investment and one where both choose a high investment. The idea is fairly simple; investment has a positive spillover effect. If I invest, but you don't, you capture the gain, but I don't, and vice versa. Thus, to invest, you must trust the other party will also. This dynamic captures the elements of many 'Big Push' models. The idea is that foreign intervention is needed to move both parties to the Pareto optimal high investment equilibria. Thus, though not common in this area of literature, I will suggest that developing a game theory dynamic to address macro phenomena is a well-grounded methodology.

3.2.3 Total Factor Productivity and Efficiency/Incentives/Institutions

The formal model I will introduce will focus on two equilibria generated by institutional changes that shift the total factor productivity (TFP) parameter; thus, it is worth discussing the parameter in some detail. We generally model TFP as a scalar magnifying the output of a given set of inputs. [8] Economists commonly think of TFP as consisting of two parts, technology and efficiency. [9]

In practice, we break technology down in many ways. Perhaps the most famous breakdown of technology is the distinction between macro and micro-inventions; see (Mokyr, 1992). [10] Macro-inventions encourage and allow micro-inventions. A micro-invention is an incremental improvement to a macro-invention, for example,

[7] For notable contributions to this literature see for example (Rosenstein-Rodan, 1943, Murphy et al., 1989, Sachs and Warner, 1999, Krause, 2013)

[8] for example see the common Cobb-Douglas production function $Y = \mathbf{A}K^{\alpha}L^{1-\alpha}$ where we think of $\mathbf{A}$ = TFP

[9] this is often modeled as $\mathbf{A} = \mathbf{TxE}$, where T = technology, and E = efficiency; see chapter 10 of (Weil, 2013)

[10] perhaps confusingly this distinction is often referred to as invention, referring to macro, and innovation, referring to micro

better tires for an automobile. [11]

Technology is, of course, critical to growth; this is almost tautological to state. However, the key question I want to address is what drives technology? What is the fundamental cause of growth? Note Douglass North's famous distinction between proximate and fundamental causes of growth; "The factors we have listed (innovation, economies of scale, education, capital accumulation, etc.) are not causes of growth; they are growth" (North and Thomas, 1973). We know increases in proximate factors, such as technology and the other factors listed in the quote above, constitute growth in an accounting sense, but what drives them? North's suggestion is institutions or incentives play a crucial role. North defines institutions as "humanly devised constraints"; they are incentives couched in rules of behavior. Rules that can be enforced formally by legal bodies and informally by culture. [12]

This brings us to efficiency, which is elusive to define. An introductory textbook defines efficiency as "an umbrella concept used to capture anything that accounts for differences in productivity other than differences in technology" (Weil, 2013) – incentives, or institutions, produce efficiency. You might notice some vagueness as to what these terms mean exactly and how they relate. In a sense, that is the point. When something is hard to measure, it is hard to define. For concreteness, I will refer to efficiency as something that you measure in terms of output, even if hard to do so. Institutions are more qualitative; they consist of incentives and drive efficiency.

To illustrate imagine two chefs, I'll call A and B, tasked with making the same dish. They have the same ability or human capital, tools or physical capital, and the same recipe or technology. Chef A gets a huge raise if the dish is better than chef B's. Would anyone be surprised if chef A made the better dish? Chef A has a better incentive to do so, yet how do we measure this? If the dishes were priced and sold, you could use that dollar value to capture efficiency gains in total output. Can we measure institutional quality? We can but only in a qualitative sense. If we rank incentives, the incentives for chef A are better, or a higher rank, than chef B's.

Indeed, this is essentially how measures of institutional quality are constructed. While it is tempting to look at an estimate of institutional quality and think they are precise measurements, the reality is they represent qualitative rankings. There is no metric other than to hold all else constant, see who has a higher output and rank accordingly. The key question is – are they accurate rankings? The

[11] It should be noted there are many different ways to describe this phenomenon. Even Mokyr himself suggested moving away from this taxonomy; see (Meisenzahl and Mokyr, 2012)

[12] again see (North, 1991)

short answer is we hope so. Like anything in economics, holding all else constant is a complex challenge.

To summarize, efficiency ends up being an 'umbrella' concept measured residually. Institutions, in a way, are a black box. They are what make up the difference in output after everything else is accounted for making it difficult to 'measure' them. However, just because institutions are hard to measure does not make them unimportant – quite the contrary.

3.2.4 The 'Jump'

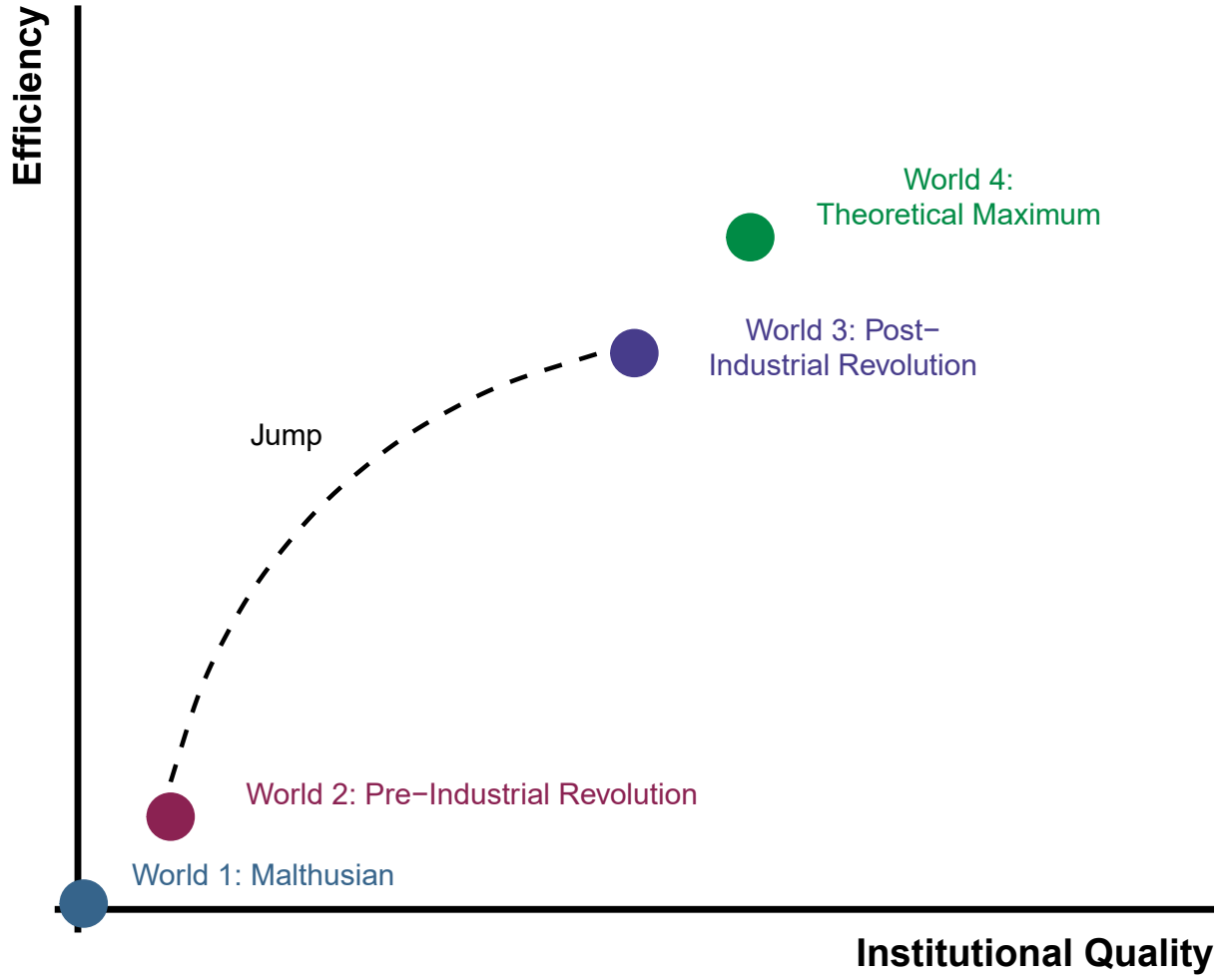
In this section, I will broadly describe the jump the paper hopes to shed light on. In a broad sense, we can think of these 'worlds' as a macroeconomic equilibrium under various conditions, though the exact label is not that important. I will describe two additional worlds for the sake of reference and completeness. Figure 3.1 is a graphical illustration capturing the basic idea presented in the paper.

- **World 1: Malthusian** – There is no growth in this world. If there is a surplus of resources or food, the population quickly grows and subsumes this excess. According to Malthus population grows geometrically while food supply, if it does increase, increases arithmetically. Thus, while the world might see brief periods of surplus resources, they quickly disappear as the world falls back into the 'Malthusian Trap.' (Malthus et al., 1992)

- **World 2: Pre–Industrial Revolution** – This world represents the world before the Industrial Revolution. Most consider this world as a world with no growth; that is the Malthusian World. However, we know this is a simplification, and there was, in fact, low rates of growth overall, with periods where growth rates were relatively high. For example, we know Rome, China, the Middle East, and other areas saw periods where people lived in relative opulence, well beyond the Malthusian trap. However, growth rates overall, while not zero, were still incredibly low.

  Angus Maddison estimates that the pre-Industrial Revolution, the average yearly growth rate was about 0.07%; see (Maddison et al., 1995); thus, the world would double it's per capita wealth roughly every thousand years. In this world, while periods of capital formation and innovation occur, there is virtually no sustained growth.

Figure 3.1: Jump from Pre to Post-Industrial Revolution



- **World 3: Post–Industrial Revolution** – Simply the world we live in, a world with sustained economic growth well above 0.07%. Since the Industrial Revolution countries like the USA, grew at roughly 2% per year. Furthermore we often see 'growth miracles' where countries grow at very high rates for long periods of time. For example China growing at roughly 10% per year since the 80's.
- **World 4: Theoretical Maximum** – There is no reason to believe the world as of present has maximized efficiency and growth. Therefore, this world is just here to illustrate that there could be slightly higher, or even much higher, growth rates if maximized.

Most of human history can be characterized as a world slightly better than

the world described by Malthus. Where for each person born, one more mouth to feed meant someone else couldn't eat. It was a zero-sum world. Then, post-Industrial Revolution, one more person born meant more food for everyone as both population and agricultural output skyrocket together. We escaped the Malthusian trap, we escaped 'zero' sum dynamics.

3.3 Micro-Foundations and Multiple Equilibria

3.3.1 The Prisoners Dilemma: A Brief Review

The model I will present relies heavily on what I refer to as Prisoner Dilemma dynamics. The Prisoner's Dilemma was first conceived of as a partial refutation of Adam Smith's invisible hand. Which, for simplicity, can be thought of as the idea that everyone acting in their own self-interest will result in the greatest good. [13] The idea that Smith's invisible hand was not always correct has a long history. John Nash famously formalized a dynamic where this was not the case; see (Nash, 1951). In Nash's game, players acting in their self-interest did not achieve the greatest good. The best way to characterize the inefficiency of this outcome, that is, how the result wasn't 'the greatest good', is to note that both players could be made better off without making anyone worse off – that is, the game's equilibrium is sub-Pareto optimal.

Nash and others theorizing about such dynamics resulted in the formal game titled the Prisoners Dilemma. [14] The dynamic of the game is such that while both players are best off cooperating in sum, each player is individually better off defecting while the other cooperates. Both players have the same incentive to defect; thus, the equilibrium is for both to defect, making them worse off than if they cooperated. Adam Smith's Invisible Hand fails.

Importantly, no player has the motivation to move back to cooperating unless they can guarantee the other player does likewise; or in a broader and more abstract sense, until they believe the other player has an incentive to do likewise. At this point, we have a type of western showdown. Neither wants to be stuck holding their gun at the other, but it is unwise to lower their weapon until the counterparty

[13] It almost doesn't require a reference as it is so famous, but see (Smith, 2010, 1950)
[14] the game was first formally introduced by (Tucker, 1950).

does first. The equilibrium is for both to keep their weapons drawn indefinitely.

The game was perhaps made famous by Robert Axelrod in his renowned book, which introduced potential 'solutions' to escaping the sub-optimal equilibrium of the game; see (Axelrod and Hamilton, 1981). An example of such a solution is the famous tit-for-tat. The idea is relatively simple: if a player establishes a commitment always to punish a player that defects, a tit for their tat, the player won't defect. Even though the player is better off defecting in a given game, they are worse off overall given the punishment. However, the solution presented by Axelrod requires repeated interactions that have no fixed endpoint. This insight is critical in understanding how to solve real-world Prisoner Dilemmas. I will return to this idea shortly.

3.3.2 Model Assumptions

The following game builds on the ideas presented thus far. It is crucial to keep the game at the proper level of abstraction; it captures broad historical dynamics, not specific events in history. The goal is to capture the idea that populations that don't cooperate don't have scale effects and that there is a critical institutional barrier to inducing these scale effects.

The game I present is played by 'polities,' or groups of people, not individuals. A polity is – "a group of people with a collective identity, who are organized by some form of institutionalized social relations, and have a capacity to mobilize resources."; see (Wikipedia, b). Or simply, for the sake of this paper: a polity is a group of people that evolved in an environment where the following assumptions are true:

1. As humans evolve it is advantageous to coalesce into groups.

2. Once a certain group size is reached, groups choose leaders or a leader, not necessarily in a democratic fashion, to make public decisions.

3. Groups grow only up to a certain population size. Beyond a specific size, a negative feedback loop is introduced, making further coalescing difficult.

It is beyond the scope of the paper to discuss the validity of the assumptions; for the most part, they will just remain assumed properties. However, in brief,

I would state the following: there is broad consensus among scholars all three are 'largely' true.

To be more precise, I will state points (i) and (ii) are universally accepted as fact. Simply humans in groups out-compete humans alone. Historically it is well-documented that humans tend to coalesce into groups and at a certain size leaders are chosen in various ways to make public decisions; see, for example, (Fukuyama, 2014, Chap 3). Evidence suggests a tendency for (i) and (ii) is built into our evolutionary DNA.

Point (iii), however, is more contested. With that noted, there is evidence that once groups get large, there are characteristics that limit their ability to continue to expand and maintain a competitive or evolutionary advantage over smaller groups. While literature related to this is broad, there are some analogies to common economic theories. Regarding the principal-agent problem, it is challenging to observe everyone's actions when the groups get large; thus, you have shirking and a free-rider problem. In terms of the theory of the firm, there are increasing returns to scale, but only up to a particular extent. At some point, they are decreasing returns to scale. Thus, smaller groups will out-compete larger groups at a certain point unless institutional problems are resolved that restrict diminishing returns to population levels from setting in.

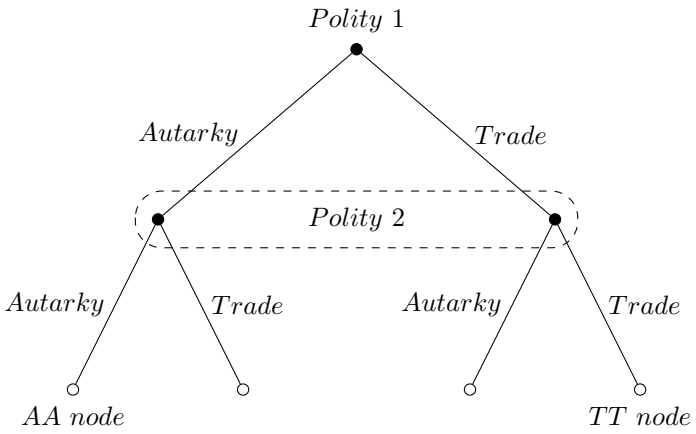
With the above noted, the assumptions won't be overly scrutinized; instead, they are simply assumptions of the model to be debated further. Taken together, (i), (ii), and (iii) puts us in a world where polities grow to a certain size. However, it is important to note the assumptions do not restrict polities from cooperating. That is, they could unite under a larger political entity. The suggestion is that Prisoner's Dilemma dynamics is a barrier to such unions.

3.3.3 The 'War vs. Trade' Game

> *When you play the game of thrones, you win or you die. There is no middle ground.*
>
> — The Game of Thrones (HBO)

The game consists of two polities: polity 1 and 2. Each polity first chooses to either trade with each other or have autarky. I will make the model very simple from the outset in that the only realistic options are to both trade or both choose

autarky. I could build this into the game, but it makes simple sense; you can't trade unless you have a partner. Thus, we have two different paths (Trade, Trade) or (TT), and (Autarky, Autarky) or (AA).



After these paths are chosen a polity can either choose peace, or have war. The subgame that follows the AA path represents a zero sum game; see Table 3.1. The sub game that follows the TT path represents a prisoners dilemma; see Table 3.2. Note: Just as payoffs in game theory don't really represent any thing real, other than to rank preferences, payoffs in the game just represent the underlying macro concept of efficiency. Thus, higher payoffs mean little other than to represent the underlying efficiency gains. Furthermore, it should be noted that when talking about a 'polity' or 'group' we don't even want to think of preferences per say, as it is not clear who's preferences we are speaking of. Thus, it is important to just think of them as ranking efficiency on a macro level. I will address this issue more in section 3.3.6.

Table 3.1: If Autarky Autarky node is reached

1/2	War	$Peace$
War	$.5, -.5$	$1, -1$
$Peace$	$-1, 1$	$0, 0$

Table 3.2: If the Trade Trade node is reached (prisoners dilemma payoffs)

1/2	War	$Peace$
War	$-.5, -1.5$	$2, -2$
$Peace$	$-2, 2$	$1, 1$

The equilibrium of the game is (AA) and (WW). For simplicity I will assume polity 1 will win the war, thus receives a higher payoff. It is likely better to think of nature then choosing a winner with say 50% probability for either polity, but that would needlessly make the game more complicated.

The logic is relatively simple, if players reach the TT node, players will end up with a prisoners dilemma where they each have an incentive to defect and declare war, which yields a payoff of -.5 or -1.5. When the zero-sum game, or AA node, is reached again, both countries have an incentive to declare war which yields payoffs of .5 and -.5. Given the payoff are higher in the AA node than the TT node, the equilibrium is (AA) and (WW).

The idea is straightforward enough – if interconnected through trade, countries will lose more if war occurs since they will be more specialized. In Autarky, there are fewer gains from war, but you lose less if war occurs. However, even in the zero-sum game, war is reached. However, war costs less in a non-interconnected world.

The practical implication is there is always an incentive to declare war and steal the valuable resources of another polity. In the end, a dynamic always resurfaces where there is an incentive for 51% to merge and steal the resources of the other 49%; a prisoner's Dilemma in a group setting. Thus, a zero-sum dynamic emerges to escape this dynamic, avoid ruin and stay separated.

If you play the game, you either win or lose. Cooperation is undermined with time. The quote to start the section is from a popular series titled 'Game of Thrones.' The series depicts a constant battle for power, the reality that defection will undermine any allegiance. To win, you must be the one that encourages the counterparty to be trusting of your actions. Meanwhile, you are the one that defects. You either take advantage or be the one who gets taken advantage of.

3.3.4 Escaping the Zero-Sum Dynamics

As briefly discussed, conditions exist that allow the Prisoners' Dilemma to avoid the sub-optimal outcome. If the game involves repeated interactions with no end in sight, then an equilibrium exists where players cooperate and peacefully trade, which is the Pareto optimal outcome.

Infinitely repeated interactions evoke a principle known as the 'shadow of

the future.' [15] The principle suggests if there is always one more exchange, you will cooperate in this period to signal you will cooperate in the next period. However, if there is some endpoint, then the shadow of the future disappears; this is known as the game 'unraveling.' Suppose the game is in the last stage, the incentive to cooperate to ensure further cooperation disappears. Thus, it is assumed both players will defect or declare war in the last stage. Knowing this will happen in the last stage removes the incentive to cooperate in the second to last stage, and so forth. The game unravels, and there is no cooperation at any stage. The shadow of the future is the persistent incentive to cooperate today to ensure cooperation tomorrow.

How to introduce this into the game? Let me define good and bad institutions as follows:

- **Good Institutions** – The governing body acts as if there is a shadow of the future
- **Bad Institutions** – The governing body acts if there is no shadow of the future

For the moment ignore these vague definitions, they are intentionally simple to introduce a different equilibrium to the game. I will discuss more in section 3.3.6.

Suppose before the game is played nature determines the world is either full of good institutions or bad institutions. If the world is bad the game as described in section 3.3.3 is played out. If good then the (TT) node is altered to the following sub-game.

Table 3.3: If the Trade Trade node is reached with good institutions

1/2	War	$Peace$
War	$-1.5, -2$	$1, -1$
$Peace$	$-1, 1$	$1.5, 1.5$

With these payoffs, the equilibrium of the game now becomes for both countries to choose trade and peace. The Prisoner's Dilemma is now averted, and a stable Pareto optimal and positive-sum equilibrium is reached. It's important to note this is a simplification. The actual game would have infinite nodes circling back to the start. After the game is played, the players would still be in the good or bad

[15] agian see (Axelrod and Hamilton, 1981)

institutions world but would again choose Trade vs. Autarky and War vs. Peace. The game would repeat, with no end game in sight. Drawing this out is needlessly complex, and for the record, in a sense impossible, as the last game would be at time infinity. With that noted, the idea is simple, if the governing bodies that make the choices see the game as repeating infinitely, they will cooperate. The payoffs above illustrate this changing dynamic in a single game. The payoffs reflect the shadow of the future not unraveling. [16] [17]

3.3.5 Good Institutions and Solving the Shadow of the Future Problem

A government of laws, and not of men.

— John Adams

The above quote encapsulates a long drawn out struggle in human history to have representative governments. Government must be bound to and constrained by rules with a long time horizon. A implication is that governments must act as if interactions with other governing bodies are infinite, given they represent laws. While this might sound strange, and in many ways, it truly is, governments in many countries are viewed as a body in line with ideals with long, or even infinite, time horizons.

While the laws are meant to serve real-world citizens in the here and now, if citizens, or those who have a political say, become broad enough to encompass the entire population, then the idea of the citizen becomes, in a sense, ethereal and abstract. The government serves not just the people alive within a set of geographic boundaries today, but those that will become citizens in the future, children and the yet to be born. Thus, in a sense, the citizen lives forever. Therefore, in this way, institutions that provide checks on power and are under the rule of law solve the shadow of the future problem.

[16] Evidence of this would be that war and violence is on the decline in the world, I suggest this is true; see (Pinker, 2012)

[17] There are many stories one could tell as to how this could happen. Perhaps an overarching authority can impose sanctions on each polity if they go to war; reminiscent of the European Union's role in Europe; see Chapter 2.

3.3.6 The Good vs. Bad Dichotomy and how we get there

In this context, Good institutions encourage repeated exchanges, and repeated exchanges encourage good institutions. Good institutions lengthen the shadow of the future, but what does this mean, if anything, in a practical sense? Is a model where institutions are simply bad or good realistic?

Many economists have formulated that institutions can be broadly categorized as, in essence, good or bad, though the labels are always more descriptive. For example, in (Acemoglu and Robinson, 2012) the authors describe inclusive vs. extractive institutions. In (North et al., 2009) the authors describe limited vs. open-access institutions. Both categorizations stress the same thing. Good institutions broadly represent the interest of the majority, while bad institutions represent the interests of a few. Or good institutions give everyone access to at least some political power. How you get from one to the other is, of course, an important and very debated question. [18]

Returning to the model, at a snapshot in time, a random choice, that is nature choosing good or bad institutions, makes sense; it is only luck as to where we are born. Thus, the game depicted serves as a decent model. However, if we zoom out, we need to realize that it isn't nature, or random luck, that ultimately chooses institutional quality, but people. Why do good institutions get blocked in some countries and not others? This is a fascinating question, and for the most part I will leave it unanswered.

The paper uses game theory tools, but these tools have their limitations. Game theory is developed to represent individual preferences and individual choices. Drawing a parallel to group choices representing efficiency is not straightforward. If only it were as easy as allowing society to choose, they as a group would also choose good institutions. However, it is not the group that gets to choose institutions but individual actors with different amounts of power.

This introduces all types of problems. A dictator might prefer low efficiency if the other option means they lose power. This is a classic debate. While more democratic institutions might make the pie bigger, it isn't necessarily bigger for the deposed ruler. [19] Good institutions put limits on the power to stop this blocking

[18] In Chapter 1, I make a case the Mongols played a large role historically

[19] There is a large branch of economics dedicated to this broadly called public choice; see, for example, seminal work (Buchanan and Tollison, 1984)

process. The model offers the idea that having a government that acts as if there is a shadow of the future is important. It is a prerequisite for states to cooperate reliably. However, the model is limited in describing how this is achieved.

3.3.7 Democracy vs. Dominance

It is subtle, but a population can get large in two ways. Form a nation-state, as we would think of them today, by democracy or dominance. Chapter 2 speaks of a story of democratic coalescence at a high level under the European Union's umbrella.

Suppose, in contrast, we never escape the zero-sum-dynamic, but one polity continues to win wars; this is essentially the story of Chapter 1. The idea is that the Mongols forced large militaristic states; while increasing population levels, this didn't encourage economic growth. While Western Europe lagged in population density, they saw growth via democracy and less so dominance. I will not go into this further, it is an expansion of the model that isn't required at this point, but it should be noted that the model fits the thesis.

3.3.8 Introducing the Dynamics to Unified Growth Theory

This section, presently, is not well developed, but I would like to introduce the ideas presented in terms of Unified Growth Theory. In (Galor, 2005) the jump from a Malthusian world to a world with sustained growth within the model is primarily induced by two different constraints. One is binding in the Malthusian world, and the other is binding in the post-Malthusian world. The critical variable is the return to human capital, which depends on scale effects that rely on population levels.

To set a building block for how the model presented here will differ from Galor's, let's define a few keys things.

- N_t – Total population at time t
- A_t – Total factor productivity at t
- g_t – Economic growth rate at time t

We can use a common definition of growth as:

$$g_t = \frac{A_t - A_{t-1}}{A_{t-1}} \tag{3.1}$$

With Galor, growth is a negative function of N_t until a certain critical population level. Then it is a positive function. I suggest that this is only true if the shadow of the future problem is solved. The total number of people doesn't matter if they do not coordinate. Scale effects depend on institutions. A simple way to introduce this to the model is to assume the following:

$$\frac{dg_t}{dA_t} \cdot \frac{dA_t}{dN_t} \begin{cases} \leqslant 0 & \text{if} \quad \text{institutions are bad} \\ > 0 & \text{if} \quad \text{institutions are good} \end{cases} \tag{3.2}$$

That is, the relationship between growth and population depends on institutional quality. To be more precise $\frac{dg_t}{dA_t}$ is always positive, but $\frac{dA_t}{dN_t}$ can be positive or negative. Scale effects are determined not by some level of N, but by some level of Institutional Quality, which we can think of in terms of solving the 'shadow of the future problem' noted in sec 3.3.5. At this stage, this is very simple, but it would be this simple idea that would add an essential caveat to Unified Growth Theory and change the fundamental dynamics of the model.

3.4 Summary

In summary, the Industrial Revolution marked a significant transition in world history. A marked change, or jump, in growth rates. Modeling this transition has not proven an easy endeavor. The contribution here is to appeal to some reasonably fundamental game theory dynamics and ask if they could shed light on or model this transition in some informative sense.

The model presented suggests that groups were stuck playing zero-sum games with each other for much of human history. I call it War, but you can think of it even more broadly as a perception that either my group or your group wins. In this case, each group has to do what is necessary to ensure they are the group that indeed wins; this is hard to avoid, given connecting with another society and becoming interdependent leaves society vulnerable. Thus, there is an incentive for both groups to pretend they are cooperating while secretly deciding to steal the excess production. Or at least the small group of elites ruling has this incentive.

Given that both sides see this, the unraveling of the shadow of the future is destined to occur. We know from game theory that an escape from this type of dynamics, which I refer to as Prisoner's Dilemma dynamics, involves no final stage of the game. I suggest this can be accomplished by transitioning to institutions that don't act as if they represent a small group of interests. Instead, they are bound to ideals that make them represent a broad section of society, including those in the future. These hard-to-achieve institutions allow a shadow of the future. Thus, the paradoxical notion is that there is no end in sight. With this, we live in a world dominated by cooperation which creates a positive feedback loop, or simply population scale effects, as with more wealth, the more there is to lose by leaving a cooperative world.

Relating this to macro, in a sense, is very simple. If there is never trust that cooperation can be sustained, there is no incentive to invest in technology and human and physical capital. Why do so when it could all be expropriated? When good or broad institutions are reached, we gain confidence that cooperation is the new equilibrium. The production function sees a jump in productivity, which creates a positive feedback loop. The population scale effects as discussed by Galor begin to produce sustained growth, but, only after institutional problems are solved.

Concluding Remarks: Escaping Vae Victis

Vae Victus is Latin for 'Woe to the Vanquished,' depending on interpretations. The meaning is relatively simple, to the victor go the spoils, or the conqueror sets the rules, and the conquered must live by whatever terms are imposed on them. This saying goes way back to a conquest of Rome by the Gauls in 390 BC; see (Armstrong, 2016). The Romans offered to pay some amount in gold for their freedom. When weighing the gold, the Romans argued the conquering Gauls were intentionally underweighting the gold to get more out of the deal. When the Romans complained, the Galic leader Brennus threw his sword on the scales, thus requiring the Romans to add the additional weight in gold corresponding to the sword's weight. Brennus then uttered this one short phrase as justification.

I would argue much of human history can be described as a world of Vae Victis. A world where might makes right. A zero-sum world where the temptation for war and conquest is omnipresent. The world is divided between the strong who "do what they can and the weak (who) suffer what they must"; once again, quoting an ancient saying. Yet, for the most part, this is starkly different from the world we live in now.

We live in a very interconnected and cooperative world. We consume products every day made halfway around the world. The rate of technological progress is beyond the imagination of those who endured the ancient world described above. The thought of war between the vast majority of countries is unthinkable. While, of course, there still are elements of war and conquest and might making right. The vast majority of wealth is now generated through cooperative endeavors such as trade and not outright conquest. We predominately, and thankfully, don't live under the rules of Vae Victis anymore. The weak need not suffer what they must, so the strong may do what they can. Economic growth year after year means we can all get better at no one's expense.

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Appendix

.1 Data Description for Chapter 1

To follow is a description of how each M_i data set was constructed:

- M_δ – If a country was ever invaded by the Mongols they are listed as 1. If not they are listed as 0.

  The Countries listed a 1 and thus being invaded by the Mongols are:

  – Afghanistan, Armenia, Azerbaijan, Belarus, Bhutan, China, Georgia, Iran - Islamic Rep., Iraq, Kazakhstan, Kyrgyz Republic, Korea - Rep., Lao (PDR), Lithuania, Moldova, Myanmar, Mongolia, Pakistan, Poland, Korea - Dem. People's Rep., Romania, Russian Federation, Slovenia, Syrian Arab Republic, Tajikistan, Turkmenistan, Turkey, Ukraine, Uzbekistan, and Vietnam

  Just as there are controversial inclusions, there are some controversial exclusions. For Example, Japan. The Mongols spent much time and resources invading Japan. However, it was considered a great military disaster. They lost thousands of troops and never in any sense occupied Japan. So I will list them as 0, again I will show they can be listed as 1 as well. The other significant notable exclusion is India. As mentioned above, the Mongol Empire was followed by the Timur Empire. While India only had a tiny fraction of its country occupied by the Mongols, it suffered substantial invasions from the Timur Empire. I will look at the results, both including and excluding India.

  The Countries listed as 0 and thus not invaded are:

– Albania, Andorra, United Arab Emirates, Austria, Belgium, Bangladesh, Bulgaria, Bahrain, Bosnia and Herzegovina, Brunei Darussalam, Switzerland, Cyprus, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greece, Croatia, Hungary, India*, Indonesia, Ireland, Iceland, Israel, Italy, Jordan, Japan, Cambodia, Kuwait, Lebanon, Liechtenstein, Sri Lanka, Luxembourg, Latvia, Monaco, Maldives, Malta, Montenegro, Malaysia, Netherlands, Norway, Nepal, Oman, Philippines, Portugal, West Bank and Gaza, Qatar, Saudi Arabia, Singapore, San Marino, Serbia, Slovak Republic, Sweden, Thailand, Timor-Leste, Kosovo, and Yemen Rep.

Note: India is marked as not invaded but for reasons to be discussed I will look at it as a invaded country in later analysis.

This is a simple way to construct such a data set, but it gives a good overview of the countries involved. Most of the countries should not be controversial. There are clear historical accounts of Mongol invasion of most of these countries. However, the inclusion of some is controversial and not necessarily well documented in history. For example, Estonia and Latvia are not included while Lithuania is. While attacking Poland, it appears the Mongols went just North into Lithuania, but it's not exactly clear how far north (i.e., did they reach Latvia and Estonia). It is challenging to resolve all these issues; what I will do is include and exclude all these controversial countries to show they do not affect the results. Given the historical nature of this paper, there will also be some disagreements. The important part is to ensure that any significant disagreement will be looked at from all angles.

- M_{dna} – This data set was constructed using the above two noted genetics papers. The paper took samples from various ethnic groups and gave a percentage of people found with DNA believed to be a direct lineage of Genghis Khan. I used Wikipedia to find out where these tribes live today. There were reasonably accurate estimates. I then estimated the number of people in each country today that would have this DNA trait based upon the estimate given. That is, I took the estimate and multiplied by the total population of the country.

  Unfortunately, there appear to be some errors with the data set. For one, there were no estimates for many places the Mongols invaded; thus, much of the Middle East and Eastern Europe are omitted. It is not clear why they did not do the testing in these regions. It is also possible the data suffers from severe migration effects. It is historically documented that the Mongols would

take women back to Mongolia to serve mainly as slaves. Thus, if most of the DNA were spread through the women brought to Mongolia, then it would not accurately show the effect of the Mongols in other parts further from Mongolia. Efforts have been made to contact the writers, and it is hope moving forward the data set can be used. However, as of this writing, it appears the lack of detail required for a good approximation of the effect of the Mongol Empire will exclude it from being used in the analysis.

- $M_{\%,t}$ – This variable, as of this writing, should be considered the most accurate measure. It takes care of many problems that the dummy variable and others do not. It takes into account every country but also gives a measure of magnitude. For example, as discussed that Japan was invaded but didn't suffer much. This variable clearly shows that the Mongols did occupy a tiny part for about four years. Thus, the measure shows there was nearly zero effect, but it accounts for some effect.

  The variable is constructed by using the geacron website discussed above. A marker is used to indicate precisely the geographic location of a modern country on the map generated by the website. The website is then moved forward year by year until it showed that the Mongols have invaded (on this website a distinctive green color marks the Mongol Empire). By the same method, I signify when they left. Of course, it is possible to have the Mongols enter and go many times, as history would have it this never occurred. Every country that was entered was only entered and thus exited once. Therefore the number of years of occupation was calculated this way.

  The percentage of the country invaded is not easy to estimate as it would change over the years. Instead of trying to be overly precise, I used an estimate of 0, .1, .25, .5, .75, and 1. In most cases, this seemed to be quite adequate to capture a good approximation of how much of the country was invaded. The number of years being occupied is multiplied by the percentage giving an aggregate measure. The variable will then be normalized to be between 0 and 1. There are no natural units, but keeping it between 0 and 1 keeps the interpretation the simplest.

  Moving forward, I hope I can improve upon this method. Perhaps with some more advanced techniques to estimate the area occupied, it can be developed. However, it should be considered a good approximation to the degree to which a given country was affected by the Mongol Empire.

  I will also construct a variable the Timur Empire as mentioned above; it will be called $T_{\%,t}$. I can then add this variable as a robustness check.

- $M_{deathtoll}$ – I will not spend much time on this variable, given that as of this writing, I still need to construct it fully. Using the book noted above White (2011), there are estimates of lives lost in areas. The book gives estimates for China, the Middle East, and Eastern Europe. Looking at maps, you can see which cities the Mongols invaded; that is maps of movement by year of the Mongols. Usually, there are reasonable estimates of the death toll in each city. I will use these estimates and cross corroborated with the aggregate data to get a measure of the death toll.

- East-West Axis Proximity – A final variable worth discussing before moving forward is East-West Axis Proximity. The East-West Axis is simply the longest straight line you can draw across Eurasia. It is roughly on the 48th parallel and goes from about Paris to Northern Japan. The measure that I will construct is a number between 0 and 1 that measures the distance from the 48th parallel. For example, If the geographic center of a country is on the 48th parallel, they get a weight of 1. This weighting makes sense as I want to look at the countries with the most significant geographic advantage. It is not realistic that, for example, Indonesia would have had an Industrial Revolution. They could not take part in the benefits described by being in Eurasia. Thus, we want to weight more on the countries that had the most significant geographic advantage.

  To illustrate, consider the example of China. If you Google "latitude of China", it returns the geographic center of the country, which is 35.8617 N. To construct the measure, I take 48 - 35.86 and divide by 48 (since 48 is the max distance a country could be away from the Axis). Then subtract 1 and take the absolute value; this is done to have it increasing the closer you get to the Axis and positive. Thus China receives a measure of 0.75 after rounding. Note: Indonesia, by this measure, is negative as it has a geographic center south of the equator. I will give it a value of 0 and note this is the only country with this feature, that is being centered south of the equator.

.2 Expanded Summary Statistics for Chapter 1

Table 4: Summary Statistics Expanded (for the year 2016 if applicable)

Country	gdp per/capita	Instutional Quality	East-West Axis Proximity	$M^i_{\%,t}$	Population in Millions
Afghanistan	571.07	14.42	0.71	0.98	35.38
Albania	4683.74	59.13	0.87	0.00	2.88
Andorra	42949.67	78.37	0.90	0.00	0.08
United Arab Emirates	41045.11	82.69	0.48	0.00	9.36
Armenia	3917.38	61.06	0.85	0.27	2.94
Austria	48300.95	91.35	0.99	0.00	8.74
Azerbaijan	5812.58	46.15	0.85	0.27	9.76
Belgium	45598.74	88.46	0.92	0.00	11.33
Bangladesh	1062.04	18.27	0.48	0.33	157.97
Bulgaria	7966.88	70.67	0.91	0.11	7.13
Bahrain	22336.76	76.44	0.54	0.00	1.43
Bosnia and Herzegovina	5591.03	47.60	0.93	0.00	3.39
Belarus	6372.40	14.90	0.85	0.19	9.50
Brunei Darussalam	31685.23	76.92	0.06	0.00	0.42
Bhutan	3035.66	26.92	0.57	0.00	0.74
Switzerland	76934.32	95.19	1.00	0.00	8.37
China	6883.90	44.23	0.76	0.27	1378.66
Cyprus	29081.82	80.77	0.74	0.00	1.17
Czech Republic	21863.64	82.21	0.93	0.00	10.57
Germany	46167.83	94.23	0.90	0.00	82.35
Denmark	61370.79	94.71	0.79	0.00	5.73
Spain	31539.51	75.48	0.86	0.00	46.48
Estonia	18387.77	93.27	0.74	0.00	1.32
Finland	46438.82	98.08	0.64	0.00	5.50
France	42054.53	83.65	0.99	0.00	66.86
United Kingdom	42201.64	98.56	0.81	0.00	65.60
Georgia	4074.93	78.85	0.90	0.21	3.73
Greece	22666.29	66.83	0.83	0.00	10.78
Croatia	14718.93	65.38	0.96	0.25	4.17
Hungary	15032.14	74.52	0.99	0.25	9.81
Indonesia	3968.06	46.63	0.02	0.00	261.55
India	1874.23	39.90	0.42	0.52	1324.51
Ireland	70298.66	97.60	0.86	0.00	4.76
Iran, Islamic Rep.	6794.29	6.73	0.68	0.43	79.56

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Table 4 – *Continued from previous page*

Country	gdp per/capita	Instutional Quality	East-West Axis Proximity	$M^i_{\%,t}$	Population in Millions
Iraq	5846.51	7.21	0.70	0.20	36.61
Iceland	50188.50	86.54	0.60	0.00	0.34
Israel	33839.83	86.06	0.65	0.00	8.55
Italy	34397.65	73.56	0.89	0.00	60.63
Jordan	3241.25	54.81	0.64	0.00	9.55
Japan	47444.14	85.10	0.76	0.00	126.99
Kazakhstan	10582.70	53.37	0.97	0.64	17.79
Kyrgyz Republic	1042.28	34.62	0.87	0.55	6.08
Cambodia	1079.63	31.73	0.24	0.00	15.77
Korea, Rep.	25484.04	83.17	0.76	0.27	51.25
Kuwait	35887.10	48.56	0.61	0.03	3.96
Lao PDR	1621.74	23.56	0.40	0.00	6.85
Lebanon	6330.42	43.75	0.71	0.00	6.71
Liechtenstein	168146.02	90.87	0.99	0.00	0.04
Sri Lanka	3769.16	51.92	0.13	0.00	21.20
Lithuania	15944.63	87.02	0.82	0.02	2.87
Luxembourg	107479.51	92.79	0.94	0.00	0.58
Latvia	14713.02	81.25	0.78	0.00	1.96
Monaco	193745.57		0.93	0.00	0.04
Moldova	2461.05	51.44	0.99	0.00	3.55
Maldives	7699.71	37.50	0.03	0.00	0.48
Malta	26510.07	84.62	0.76	0.00	0.46
Myanmar	1403.77	8.65	0.45	0.00	53.05
Montenegro	7492.86	60.10	0.91	0.00	0.62
Mongolia	3866.24	41.83	1.00	0.56	3.06
Malaysia	11219.63	74.04	0.05	0.00	30.68
Netherlands	52727.10	96.63	0.88	0.00	17.03
Norway	90402.60	92.31	0.70	0.00	5.23
Nepal	729.66	24.52	0.59	0.00	27.26
Oman	16692.26	71.63	0.44	0.00	4.48
Pakistan	1119.04	28.85	0.63	1.00	203.63
Philippines	2743.20	52.40	0.24	0.00	103.66
Poland	15101.36	80.29	0.89	0.05	37.97
Korea, Dem. People's Rep.	1300.00	0.00	0.86	0.32	25.31
Portugal	22511.73	79.33	0.83	0.00	10.33

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Table 4 – *Continued from previous page*

Country	gdp per/capita	Instutional Quality	East-West Axis Proximity	$M^i_{\%,t}$	Population in Millions
West Bank and Gaza	2694.52	55.77	0.67	0.00	4.37
Qatar	64303.19	73.08	0.52	0.00	2.65
Romania	10236.86	72.12	0.98	0.00	19.70
Russian Federation	11298.48	32.21	0.67	0.22	144.34
Saudi Arabia	21270.47	54.33	0.49	0.00	32.44
Singapore	54764.86	100.00	0.01	0.00	5.61
San Marino	52811.28		0.94	0.00	0.03
Serbia	6394.46	57.21	0.94	0.00	7.06
Slovak Republic	19298.07	75.00	0.96	0.00	5.43
Slovenia	24445.56	72.60	0.98	0.00	2.07
Sweden	56195.88	97.12	0.71	0.00	9.92
Syrian Arab Republic	2058.00	4.33	0.73	0.11	17.45
Thailand	5911.95	63.46	0.31	0.00	68.97
Tajikistan	976.14	13.94	0.82	0.80	8.66
Turkmenistan	6987.07	1.92	0.82	0.34	5.66
Timor-Leste	3072.42	15.87	0.22	0.00	1.22
Turkey	14062.73	62.50	0.82	0.13	79.82
Ukraine	2909.65	29.81	0.97	0.34	45.00
Uzbekistan	1909.44	3.85	0.88	0.95	31.85
Vietnam	1752.53	35.58	0.27	0.02	93.64
Kosovo	3925.27	43.27	0.91	0.00	1.82
Yemen, Rep.	765.60	12.02	0.30	0.00	27.17

.3 Discussion of Spatial Correlation

The most conventional method is to use euclidean distance measured in latitude and longitude (that is the hypotenuse of a right angle triangle). In Table 5, I report two p-values, the first for the non-population weighted regression, the second for population-weighted. Using euclidean distance shows significant p-values, with the null being no spatial correlation. Thus, this indicates a significant spatial correlation.

However, with considerable variation in distances, this is not necessarily the best measure to use. Countries very close together explode in importance if they are sufficiently far from other countries in the sample. Thus, it can be susceptible to slight changes in specifications. For example, if I remove countries that are within

100 km of each other there is no longer significance. Another popular method that bypasses this concern is to use a binary term that says a country is connected or not given a certain distance apart. However, no distance is accepted as sufficiently 'close.' I will start with 5 and show each step by 25. Thus, if a country is within 5, as measured in the euclidean distance, it is considered a 1, if not a 0. Then repeat for 30, 55, 80 etc. Note: the range goes from 2 (Israel to the West Bank) to 166 (Iceland to Timor Leste, which is about 12,500 km apart). Note Latitude ranges from -90 to 90, and longitude from -180 to 180.

The results are mixed. If looking at non-population weighted, there is no evidence of spatial correlation. If using population-weighted, there is some evidence. The best measure is likely somewhere in between no weights and population weights, as discussed in the results section. Thus, though population-weighted results indicate spatial correlation, the results are generated mainly by China and India. Given that they are similar and closer together than most countries in the sample, they will almost guarantee to generate spatial correlation in a population-weighted regression.

Finally, I report a test using the initial euclidean distance but only using countries invaded by the Mongols. Suppose all I am picking up is correlations in this region before the Mongols, i.e., another historical event causing similarities among the countries, then it would show up here. Essentially, in the countries invaded, there is no spatial correlation. In many ways, this fits the story. No one would want to state different regions were all the same. Of course, history would dictate every region would be different. The point is the Mongols forced regions to become similar, i.e., autocratic. So it makes sense there is no spatial correlation among the countries invaded. The advantage Western Europe has is precisely that it got to keep its heterogeneity.

Table 5: Morin I Test for Spatial Correlation

Distance Measurement	**Non-Population Weighted** *p-value*	**Population Weighted** *p-value*
Euclidean	0.0742*	0.0004***
Binary 5	0.0173	0.3501
Binary 30	0.8193	0.0001***
Binary 55	0.5167	0.0776*
Binary 80	0.3507	0.0003***
Binary 105	0.7833	0.7952
Binary 130	0.5167	0.0776*
Euclidean (invaded only)	0.7833	0.7952

*Note: *p<0.1; **p<0.05; ***p<0.01*

.4 Maps for Chapter 2

Figure 2: Breakdown of Alignment Before Collapse

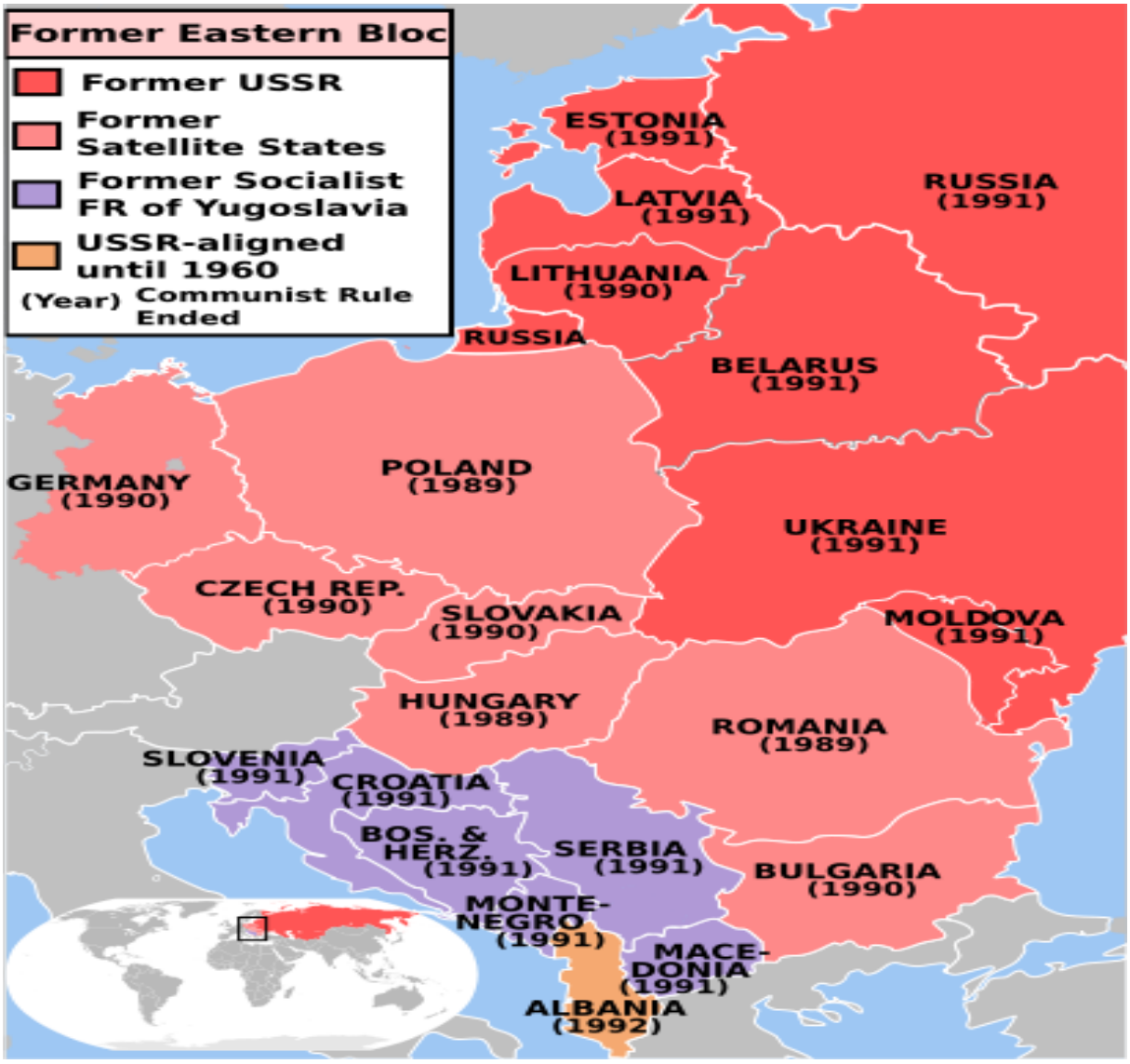

Figure 3: PHARE Countries