

# **Mobility, Creativity, and Technological Development:**

**David Hume, Immanuel Kant and the Economic  
Development of Europe**

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**Abstract**

*Economic success requires the right environment for creativity to affect the economy. The European Enlightenment was the intellectual movement that helped trigger the technological and institutional changes necessary to bring about the economic growth of the West in the nineteenth century. The Enlightenment itself was made possible by the emergence of a comparatively free market in ideas in the late seventeenth century. One reason for that market to grow is the political fragmentation of Europe, which made it almost impossible for rulers and organized religion to suppress heterodox ideas. Another was that intellectuals catered to a constituency that was international. The main mechanism that made that possible was the capability of creative and original thinkers and scientists to move around on the continent, so that no single ruler could control them. A sample of creative people is assembled to measure this mobility and shows how this kind of mobility differed across countries and over time.*

**Introduction.**

There are many forms of human creativity. Not all of them produce economic growth, which is the concern of economic history. Art, literature, history, and philosophy may be the target of much creative efforts, yet it is hard to see how they add a large component to a nation's wealth, nor are they meant to. In what follows, I will be interested primarily in what I have called "useful knowledge" (Mokyr, 2002), the kind of knowledge that can be applied to production, enhance efficiency and choice, and eventually affect the material basis of society and the standard of living. Historically, this creativity has produced the kind of sustained and continuous economic expansion that has taken place in what economists call "the convergence club" — the group of industrialized nations, which have attained high per capita GDP levels and the entire package associated with it in terms of material comfort, health, access to information, leisure, and personal freedoms.

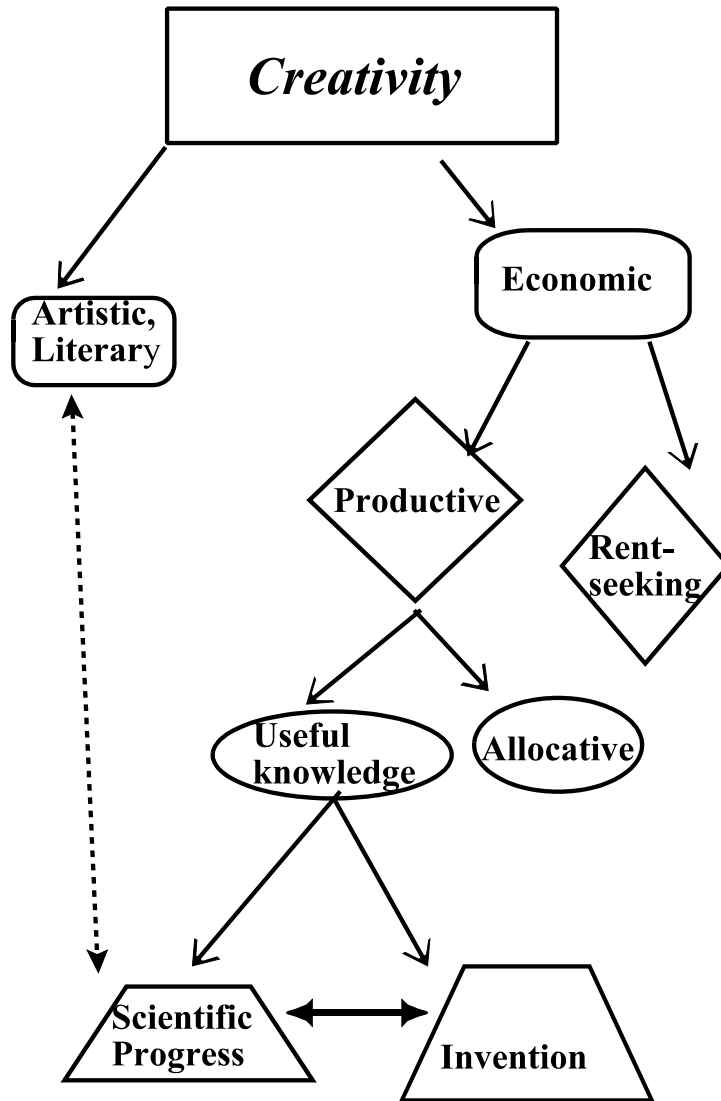
Certain forms of creativity, then, create wealth. Some forms enrich the individual, and do not reduce that of her neighbors — indeed they may create the rising tides that raises many boats. Other forms of creative activity create wealth for an individual, but not for society at large. One of the keenest insights of modern economic analysis is to distinguish between the two. If we accept the notion that *all* individuals are first and foremost trying to do well for themselves (in some form, at least), it follows that they can do so by either securing a larger slice of the cake for themselves at the expense of others or increase the cake by adding to society's resources or its ability to exploit them. An internet cyberpirate or a white-collar swindler, a personal injury lawyer, or a K-street lobbyist for a business association, are all engaged in highly "creative" work. This form of activity is called by economist rent-seeking. It seeks to redistribute rather than create new wealth, and as such it is not neutral but actually reduces the overall pie (Baumol, 1993, 2002; Shleifer and Vishny, 1998). The choice that rational individuals make between those two types of creativity depends largely on the incentives and risks he or she faces in both, and those in turn are determined by society's institutions (North, 2005, Greif, 2005).

Productive creativity, of the kind that enhances wealth, takes two forms. One is what we might call "allocative" creativity. An entrepreneur or a merchant who sees an opportunity to buy cheap and sell dear, or to introduce an existing product in a new market is creative, as is an emigrant who perceives an opportunity in another country or region. These activities do not affect the total amount of useful knowledge in a society, but exploits existing knowledge and makes the allocation more efficient without pushing out the frontier techniques. The second is what we may call "epistemic creativity," and it consists of actually creating new knowledge or combining existing fragments

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of knowledge in altogether new ways. “Invention” (the construction of new techniques proper) is one form of creativity, but scientific progress and discovering a natural phenomenon or regularity on which a subsequent technique rest is equally important. The structure of this set-up is described in fig. 1.



The precise distinction between allocative and inventive creativity may be a bit fuzzy in practice: applying a known technique in a new environment invariably involves some tweaking and adaptation to local circumstances, which requires some modicum of innovativeness as well. Discovering a new market for an

existing product, or a new source of labor for a known production process may be comparable to the discovery of a new natural law that can be applied to some engineering problem. Yet they differ in some important aspects (Mokyr, 1990).

First, allocative creativity depends primarily on the institutions of society: how well are contracts enforced, how secure is commerce, what kind of activities are allowed by law or convention. Inventive activities depend to some extent on institutions as well, but above all depend on what is known. No society that did not have the correct physics would have much chance to develop electrical generators or high-grade stainless steel.

Second, the economic gains from purely allocative creativity are concave and theoretically bounded from above. When an economy is already reasonably efficient and existing techniques are all best-practice, additional improvements become increasingly difficult to attain. Once all markets work quite well, and resources have been allocated as well as can be under an existing transactions technology, no further gains can be made easily. Needless to say, such an upper bound is never achieved in reality, but it implies that diminishing returns set in at some point, and the process cannot go on forever. No such obvious boundary can be perceived in technological creativity. Although many writers have in the past asserted that the total amount we can know is finite, there is no evidence that such a limit exists. A *single* human mind, of course, is finite, but specialization and expertization have created a “division of knowledge” so that *social* knowledge (defined as the union of all individual knowledge) can expand with no obvious limit.

Third, the economic gains from technological creativity are harder to reverse than those from allocative creativity. The institutions that support and supplement efficient markets and allocations those markets, are historically vulnerable (Greif, 2005; North 2005). A political regime change, a war, or pure institutional degeneration of law and order can undermine markets and weaken allocative efficiency. Mancur Olson (1982) has argued that over time rent-seeking coalitions that undermine allocative efficiency emerge inexorably. Growth based on knowledge, on the other hand, is hard to reverse in practice not only because by definition it survives as long as there is one survivor who has it, but also because much of it can be codified and stored.

Finally, allocative creativity has usually been perceived as much less of a threat to the existing order than inventive creativity. Every invention is, in a certain sense, an act of rebellion and disrespect, implicitly stating that the old and traditional way of making a product is inferior to the new way, implying that one’s teachers and parents were ignorant or wrong and threatening the status quo. In our own age, this has become almost axiomatic, with “newer” being almost synonymous with “better” both in science and technology. On the whole, however, most past societies have been influenced by conservative values in the sense that the existing status quo has been able to suppress new ideas and create an environment suspicious of new knowledge (Kuran, 1988). Innovation requires skepticism, but it is hard to confine doubt to the realm of technique, and hence entrenched powers tend to resist it. Existing knowledge in the past has had a tendency to ally itself within the political power structure. As Copernicus knew, doubting the words of Aristotle and Ptolemy could come

dangerously close to doubting the word of God. Words like “heresy” or “apostasy” in many societies denoted someone who deviates from the “true knowledge.” In some cases the repression of innovation led to a virtual crystallization of useful knowledge: especially Islam and Judaism eventually developed a persuasive notion that earlier sages had already discovered everything there was to discover, and that challenging their knowledge was sacrilegious. Bernard Lewis (1982, p. 229-30) has maintained that Islamic tradition became convinced that all useful knowledge had been acquired and that in the Islamic tradition the term *bidaa* (innovation), acquired the same negative connotation as “heresy” did in the West.

Commercial activity and other forms of allocative creativity did not threaten the status quo in the same way, and hence conservative societies — especially late-Islamic and Jewish — excelled in many forms of allocative creativity, but made little progress in technology. To be sure, certain forms of allocative creativity were frowned on by the guardians of the status quo, especially “usurious” interest. But on the whole, commerce was regarded as less of a threat to the ruling orthodoxy than those who challenged existing understanding of nature. Historically speaking, therefore, economic growth based on allocative creativity was far more common because it was not resisted as fiercely by the intellectual status quo. The irony, however, is that economic growth based on commercial expansion was easily reversible by changes in institutions and the political environment, whereas new knowledge, once sufficiently “fixed” in the population, turned out difficult to eradicate.

As was noted many decades ago by Simon Kuznets, the sustained economic growth experienced in the economies of the convergence club and technological creativity are inseparably linked. This focuses the attention to the waves of technological advance we know as the first and second Industrial Revolutions. What I would like to discuss here is where this technological creativity and the growth of useful knowledge came from and what the roots of this advance were. In what follows, I plan to propose a hypothesis on this matter, inspired by the experience of Europe in the past centuries.

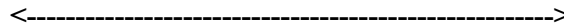
### **Institutions and Creativity**

Institutions determine how economic games are played, by setting up the rules of the game and by providing the beliefs and conventions upon which these rules rest and which produce regularities in economic behavior. As such, they set incentives and penalties for various activities and a hierarchy of values. Among others, such institutions determine how creativity is to be valued, what areas of creativity were permissible and rewarded. Even in a pure market economy, institutions have to set the rules that determine the rate of return on the creativity that creates new useful knowledge, since new knowledge, being non-rivalrous, is not properly rewarded by free markets. Societies need to solve the problem of intellectual property rights and find ways to penalize possible opportunistic behavior that may threaten allocative creativity. By setting these rules in a variety of ways, society determines how agents are going to allocate their time and efforts between allocative and inventive knowledge.

Creativity, then, is forged and directed by the institutions of society that set the incentives for it. These incentives are rarely purely financial: honor, security, and the joy of creating played important roles, but these were all part of the institutional set-up of society. Two variables especially played a role. One of them was the valuation that society placed on innovative creativity: those who investigated and manipulated nature to solve technological problems often ran up against religious authorities who were otherwise agnostic to purely allocative initiatives. The other is the institutional imprimatur placed on redistribution vs. productive activity: in some societies taxation, monopolies, guilds, and other predatory and exclusionary practices were more acceptable than others.

To show the main effect of these institutions on the direction of creativity, table I distinguishes the four types of creativity and their dependence on the institutional framework

	<b>Allocative Creativity</b>	<b>Innovative Creativity</b>	
<b>Productive Creativity</b>	Examples: commerce, finance, technological transfers	Examples: new inventions, scientific discoveries, improving existing techniques.	Low Value of Rent Seeking
<b>Redistributive creativity</b>	Example: Lobbying, creating exclusive coalitions, predatory behavior, price-fixing	Example: Designing new military technologies	High levels of rent-seeking acceptable



Valuation of commerce

Valuation of Technology



In what follows, I shall rely heavily on a concept of the “market for knowledge” in which people with divergent views and knowledge try to convince one another of the “truth” of their statements. Yet this “market” derives as much from Charles Darwin as it does from Alfred Marshall. Creativity in human culture, much like creativity in nature, depends on conditions of initial diversity. The evolution of knowledge, much like life, depends on the continuous emergence of variety and the selection among alternative items, although the criteria of selection and the nature of the process are of course very different. Much like in nature, pluralism and diversity in the end, are the determinants of how big the menu is from which society chooses. Somebody has to write the items on the menu, and the more items are on the menu, the more likely it is that society can develop. Yet, as I will argue below, the historical connections between diversity and creativity are subtle and more complex than appears at first glance.

If institutions determine what incentives are applied to creativity, they should reflect that an individual needs a reasonable expectation to capitalize on his or her contribution. This does not mean, of course, that his or her financial reward is in any way proportional to the size of the contribution to society’s economic welfare. As far as inventions are concerned, a patent system may achieve this, but so may simply the advantage of being the first mover to use an improved technique in a large enough market. For knowledge that cannot be exploited directly, “pure” or applied, a reward or prize awarded for a specific achievement, or an appointment to a patronage position such as tenure at a university or court councillor.

In both areas of knowledge, knowledge of natural regularities and phenomena (which I have termed “propositional”) and its direct mapping into technology, a discoverer or inventor needs to be some assurance that there will be no penalty by the threatened orthodoxy or vested interest. In other words, what is required is an institutional environment that tolerates heterodoxy and deviancy. Creative individuals should expect a reward and not fear penalty. In a “free market” in ideas, we should envisage the owners of new ideas trying to persuade the “buying public” to accept their ideas on the basis of the accepted rules of rhetoric such as logic, elegance, or experimental evidence. Success in this game is measured through both credit and profit: credit is awarded for theories that are associated with the discoverer’s name and new techniques; profit means that actual resources are paid to the creative individual. In this kind of market, creative people who might believe they have come up with a true contribution will try their luck.

There is no reason to suppose that most past societies have felt it necessary to make an effort to reward innovative or *technological* creativity. Far more likely to be rewarded in past societies were religious status and military/political prowess. In ancient Rome, the story goes, an inventor had invented unbreakable glass and offered it to the evil Emperor Tiberius, who after ascertaining that no one else knew of the secret, had the man executed fearing for the profitability of his glass blowing enterprises. In some market-oriented societies commercial and financial abilities were rewarded (if often with some mixture of disdain and envy), but a set of incentives that was

intended to advance useful knowledge that could eventually be transformed into better production techniques was rare before the earliest patent laws that date from the fifteenth century. Despite the fact that the organized rewards to invention were questionable, medieval and Renaissance Europe was remarkably inventive (Mokyr, 1990). In 1450, Europe was intellectually still a conservative place, in which “tradition” and “orthodoxy” were the hands-down favorites to suppress new knowledge, if perhaps less so than elsewhere.

After 1450, creative people in Europe who wanted to challenge old ideas — technological as well as philosophical — increasingly had more of a chance to do so. Religion came under attack as much as natural philosophy in large part because the areas overlapped. Jan Hus had still been suppressed, but the wave of reformers in the sixteenth century was simply unstoppable. The risks that innovators took did not, of course, disappear quickly, and there is no simple progression from a controlled system toward a more open “market” for ideas. Innovators in one area did not feel that a free market for ideas they enjoyed should be extended to others. Phillip Melanchton, a leading reformer and a rebel if there ever was one said of Copernicus “some think it a distinguished achievement to construct such a crazy thing as that Prussian astronomer who moves the earth and fixes the sun. *Verily, wise rulers should tame the unrestraint of men's minds.*” (cited by Kesten, 1945, p. 309, emphasis added).

Moreover, when we speak of “Europe,” we only speak of parts of it — and not always the same part. There were local reversals and set-backs, some of which I will document below. But the forces of reaction were irreversibly weakened all the same. By the late seventeenth century, Europe had become a marketplace of ideas, in which a bewildering array of novel ideas in religion, philosophy, science, mathematics, but also in farming, power technology, materials, and manufacturing were being proposed. The selection criteria by which some of those were selected and others rejected are socially set and depends very much on the institutions involved, but for most of the Continent, coercion and violence were no longer an option.

The flowering of creativity in Europe after 1450 led to a number of “revolutions,” which created the new environment. While the printing press and the effective use of gunpowder compete with the Reformation and the European Discoveries of the sea-routes to the East and the West in high-school textbooks, scholars today focus just as much on Galileo, Newton, and the seventeenth-century Scientific Revolution between them. Perhaps the pivotal figure in the rise of economic modernity was Francis Bacon, the prophet of what I have called “the Industrial Enlightenment” (Mokyr 2002, 2005). Bacon suggested that knowledge was collective, a social phenomenon, to be organized and distributed, and that its purpose was to be applied and used by society for material purposes (Farrington, 1979). The most heretical notion that Bacon proposed (following a century of progressive thought on the topic) was that knowledge was not only its own best reward, to be pursued for metaphysical reasons, but that it had the potential to improve material life. As such he founded the “Baconian program,” the most ambitious revolution in scientific research ever attempted, which purported nothing less than a radical change in the agenda of science, aimed at its application to the useful arts, that

is, to production technology. Close to a century was to pass before a serious attempt was made in implementing these ideas. At the risk of oversimplification, it could be said that Bacon persuaded Europe that it *should* be done, whereas Newton showed that it *could* be done. Be that as it may, by about 1700, Europe had embarked on the *Industrial Enlightenment*, which provided the intellectual background of the Industrial Revolution. The European Enlightenment, as I have argued elsewhere (Mokyr, 2005), was the first intellectual movement in human history to result in sustained economic growth.

### Political Fragmentation and Creativity

Why was this movement successful? The causes of Europe's economic success are still much in dispute. Its geography has been often singled out, as have religion, culture, its classical inheritance, the impact of Judeo-Christian beliefs, the emergence of the institutions of capitalism, and accidents. Of particular interest, and one that I want to focus on here, is the one that focuses on politics. This idea, as has been pointed out repeatedly, originated in the eighteenth century with, as it happens the two most distinguished philosophers of the Enlightenment age, David Hume and Immanuel Kant (Bernholz and Vaubel, 2004). Hume, in his classic essay "of the Rise and Progress of the Arts and Sciences" [1742, (1985)] thought that

The divisions into small states are favourable to learning, by stopping the progress of authority as well as that of power. Reputation is often as great a fascination upon men as sovereignty, and is equally destructive to the freedom of thought and examination. But where a number of neighbouring states have a great intercourse of arts and commerce, their mutual jealousy keeps them from receiving too lightly the law from each other, in matters of taste and of reasoning, and makes them examine every work of art with the greatest care and accuracy. The contagion of popular opinion spreads not so easily from one place to another. It readily receives a check in some state or other, where it concurs not with the prevailing prejudices.

Kant, in the eight proposition of his 1784 essay "Idea of a Universal History" agreed that

Now the States are already involved in the present day in such close relations with each other, that none of them can pause or slacken in its internal civilisation without losing power and influence in relation to the rest; and, hence the maintenance, if not the progress, of this end of Nature is, in a manner, secured even by the ambitious designs of the States themselves. Further, Civil Liberty cannot now be easily assailed without inflicting such damage as will be felt in all trades and industries, and especially in commerce; and this would entail a diminution of the powers of the State in external relations. This

Liberty, moreover, gradually advances further. But if the citizen is hindered in seeking his prosperity in any way suitable to himself that is consistent with the liberty of others, the activity of business is checked generally; and thereby the powers of the whole State, again, are weakened. Hence the restrictions on personal liberty of action are always more and more removed, and universal liberty even in Religion comes to be conceded. And thus it is that, notwithstanding the intrusion of many a delusion and caprice, the spirit of Enlightenment gradually arises as a great Good which the human race must derive even from the selfish purposes of aggrandisement on the part of its rulers, if they understand what is for their own advantage.

Edward Gibbon, undoubtedly influenced by his friend Hume, added a somewhat exaggerated picture of the benefits of the European system of political fragmentation:

Europe is now divided into twelve powerful, though unequal, kingdoms, three respectable commonwealths, and a variety of smaller, though independent, states: the chances of royal and ministerial talents are multiplied, at least, with the number of its rulers . . . The abuses of tyranny are restrained by the mutual influence of fear and shame; republics have acquired order and stability; monarchies have imbibed the principles of freedom, or, at least, of moderation; and some sense of honour and justice is introduced into the most defective constitutions by the general manners of the times. In peace, the progress of knowledge and industry is accelerated by the emulation of so many active rivals; in war, the European forces are exercised by temperate and undecisive contests." (Gibbon, 1789, V.3, p.636)

Modern historians have picked up this idea. Jones (1981) in his classic work on the rise of Europe has referred to the "States System," an idea that has caught on and become quite influential. The basic model looks at the various political entities ("islands" in Jones's simile) in Europe in a fashion similar to the competitive model in economics; this competition had salutary effects on the European societies, since states competed for tax bases and the best citizens, and could not afford to alienate them (North, 1981, p. 27). This meant that governments ended up (most of the time) treating their most successful and creative citizens with respect, taxed them with some restraint, and often followed active industrial policies, sponsoring technological transfer from more advanced nations, attracting skilled craftsmen, financing manufacturing enterprises, and protecting their industries with tariffs. The paradigmatic rulers playing this game were Peter the Great and Louis XIV, but many other rulers followed similar policies. Jean Baechler, another pioneer of the idea, has pointed out that it requires political fragmentation within intellectual and cultural cohesion, so that independent intellectual experimentation takes place in a more or less unified cultural region. If the world were divided into small

insulated islands, the obvious scale economies of generating an invention or a discovery would never be realized. If the world were a single Empire, there would not be enough competition. Some intermediate level would be optimal, a world in which the market for ideas was much larger than the unit of control.

North, Jones and their colleagues pointed to a central issue, but things are never quite that simple, and a unidirectional model mapping political fragmentation into economic creativity is not convincing. As they themselves note, the states system was a double-edged sword. For one thing, unlike economic competition where firms normally play by peaceful rules, the states system in Europe — and elsewhere — often dissolved into violence that at times turned out to be extremely costly, eradicating whatever benefits may have accrued from the states-system. Moreover, the emergent states system in early modern Europe developed a somewhat messy and confused set of self-serving doctrines that later generations have dubbed “mercantilism” — policies mostly designed to strengthen the state, raise more revenues, and use its power to enrich people with political clout (Ekelund and Tollison, 1997). As such, it is not always easy to identify the consequences of states competition as salutary for the economy at large, even if it benefitted some groups.

Moreover, in post-medieval Europe political fragmentation involved a great deal more than just a competitive set of policies of independent rulers (the term “state” is mildly anachronistic here, as so many of these rulers represented a dynasty or church more than their citizens). Fragmentation of power was as prevalent *within* states as between them. For one thing, power was divided between central authorities and local courts and provincial estates. In Germany and Italy, of course, this had become formalized, but in other “states” such as the Dutch Republic, the central government had little power. Moreover, in many countries there were semi-autonomous organizations that exercised their own justice and sovereignty such as universities, boroughs, and guilds. Even in political units that superficially resembled modern nation states, such as Britain, much of the actual administration was concentrated in the hands of local authorities (JP’s) who often had their own views. Finally, given the technological constraints on information flows between the provinces and the capital, it was rarely possible for the government to control daily affairs. Only in places where religious and secular authorities closely coordinated their efforts well (such as Spain) could the central authorities prevent new entries into the market for ideas. Elsewhere in Europe, control over intellectual matters was spread over many authorities. More than anywhere else, in Europe the expansion of knowledge (useful or not) was farmed out by government to private individuals, and while the authorities sometimes subsidized creativity through patronage and other forms of support, they rarely exercised the kind of direct meddling that was common among the Ch’ing emperors in China. When they tried, they usually failed. It was this fragmentation that led Edward Gibbon to compare Europe favorably with the Roman Empire: “The division of Europe into a number of independent states, connected, however, with each other, by the general resemblance of religion, language, and manners, is productive of the most beneficial consequences to the liberty of mankind. ... but the empire of the Romans filled the world” (1789, Vol. I, p. 100).

To see this somewhat differently, we can rely on an insight from the new institutional economics. In a recent paper, Greif (2005b) has noted that the success of economies in improving their economic performance, mostly from the point of view of the evolution of markets, depended on a set of constraints and limitations that ensured economic agents that the gains from economic activity would not be expropriated wholesale by those with a monopoly on power. Unlike, say, the interpretation of Epstein (2000), which focuses on the contribution of states to economic development, Greif correctly points out that it was an intermediate position for states that best suited economic development: states were needed to enforce contracts and keep law and order, but at the same time needed to be constrained in their power and known to be so. Within Europe, institutions that constrained the power of rulers emerged, which remained strong enough in most places to bring about such a “Goldilocks” outcome. The argument here is an extension of the same idea: political power had been used not only to expropriate resources but also to enforce ideological and intellectual orthodoxies and suppress heresies. Much of the history of Europe after 1300 was exactly about that. Yet because of the political decentralization and other constraints on European rulers, states ultimately failed in this endeavor. The market for ideas that emerged as a result after 1600 or so was increasingly based on persuasion using the rhetorical conventions of the time and less and less on coercion.

Between 1450 and 1750, some European rulers, secular and spiritual, were still making attempts to suppress heterodoxy and intellectual rebellion, rather than leave intellectual innovations to the verdict of the market for ideas. These attempts could turn out to be extremely costly, especially when they became tangled up with political and dynastic interests, as the French (1572-1598) and German (1618-48) religious wars indicate. These were hardly Gibbon’s “temperate and undecisive contests.” But whatever the costs, it is hard to argue that in the long run the suppression of new ideas was successful outside a few areas such as Spain. By the time of the death of Louis XIV in 1715, ideas largely competed for acceptance on their own merits.

In a Dawkinsian world, ideas are generated by certain processes that could be highly stochastic or even random. The interesting question is about selection mechanisms. Why and how such ideas get “selected” (and what exactly is meant by that) is a question that I will leave aside here (see Mokyr, 2005b). On the whole, however, selection may be based on coercion or persuasion. It is, of course, impossible to literally force people to believe anything, though many indirect mechanisms were experimented with. Under coercion, however, heresy maybe penalized (as many Europeans learned the hard way), and this created an additional cost that has to be subtracted from whatever benefits might have been expected from being a successful (i.e., influential) intellectual innovator. Under persuasion, the probability of success may have been low, but the additional cost of getting in trouble with the authorities was no longer relevant.

After 1600 or 1650, many new ideas may still have been regarded as subversive or heretical by the forces of orthodoxy, but increasingly the lack of suppressive action by those with a stake in the status quo indicates that they had internalized their impotence in suppressing these troublemakers even if

they would have liked to. By the later eighteenth century, the political establishment in many areas took a “if you cannot beat them, join them” attitude (Swann, 2000, p. 42). Many of the great minds of the Enlightenment were co-opted by rulers, and the measures taken against those whose sharp pens or innovative ideas set them on a collision course with the authorities seem in retrospect less than vigorous. In the end, a violent clash between the ancien régime and the new ideas could not be avoided. All the same, by 1815, despite the political reaction, many of principles of the Enlightenment had been accepted and had prepared the ground for sustained growth.

How did it do this? The Enlightenment involved two basic insights into the economy that between the two of them created the intellectual background of modern economic growth. One insight was the Baconian notion that material improvements demanded better and more focused research into natural philosophy, and that institutions, the House of Solomon in *New Atlantis* being the most famous of them, should be set up to facilitate this creativity. The new knowledge of nature was to be widely diffused so as to maximize its chances to be applied to technological matters. The other insight was the realization that the economic game was not zero-sum, so that the gains of one economic agent did not come necessarily at the cost of another. This view implied that rent-seeking. These two insights *together* prepared the conditions under which the Western economies could start growing at an unprecedented and sustained rate (Mokyr 2005c).

The argument made here is somewhat different in emphasis from that of North and Jones who emphasized the limitation that fragmentation imposed on the fiscal powers of governments. This view is problematic, since some of the most successful economies — above all Britain — were also the most heavily taxed, and that most of the taxes paid by Europe in the early years were earmarked to pay for the wars that resulted from political and religious fragmentation. Nor is it the case that political competition consistently induced governments to hold on to their most creative citizens. What mattered was that no power in Europe was strong and encompassing enough to force upon the market for ideas the orthodoxy on which it believed its power rested. Nor were they successful in attempts to ban ideas that had been victorious elsewhere in Europe. The record shows that those societies in which the orthodoxy triumphed paid a high price in terms of long-term economic development.

Although some societies in Europe were on the whole more tolerant than others, no single society stands out as unusually tolerant of novelty. The argument here is not that some tolerant societies sustained Europe’s creativity (although there can be no doubt that this was to some extent the case), but that political fragmentation led to a *coordination failure* in the suppression of innovation. The only way the market for ideas could be controlled was by a concerted effort in which heterodox intellectuals would be suppressed by all authorities who agreed on what orthodoxy to defend. In sixteenth and seventeenth century Europe, such coordination was remote. The only body potentially capable of exercising such control, the church, had lost its control over the countries where the reformation took root, but in some Catholic countries, above all France, its powers had been weakened as well.

Indeed, the political fragmentation of Europe meant that the forces of reaction were themselves often fragmented. Thus for instance the reactionary Pope Paul IV in the 1550s alienated the main Catholic power, the Habsburgs, as well as the English Catholic legate, Cardinal Reginald Pole, the leader of the Catholic reaction in England whom he denounced as a heretic. Outside the church no power could possibly coordinate such an effort. The net result was that the suppression of novel idea remained a local phenomenon, though the localities changed as rulers did. Innovative intellectuals and non-conformists of any flavor were able to play different powers against one another and thus exploit fragmentation to secure themselves against the dominant orthodoxy, as the careers of Luther and Calvin amply attest. More generally, creative intellectuals, dependent on patronage that most of them were, were rarely at the monopolistic mercy of a *single* prince or political entity, whether these were trying to dictate their research program or not. By moving about and exploiting the competition between sources of wealth and political power, they increased the rate of return they realized on their specific skills and attainments.

The weakening of the negative incentives on creativity were reinforced by other favorable effects on incentives that a multacentral political environment provided. Princes and kings competed to provide patronage and protection to the most successful and best-known scientists. In part this reflects their belief that highly intelligent and well-read individuals would provide them with sage advice, and indeed many of the prominent scientists of the time were active as diplomats or advisors. There was also, however, a prestige effect, a competition for being able to attract the most glorious and talented of Europe's citizens.

At the same time, however, European intellectuals of the sixteenth century and beyond increasingly catered to a community much larger than the one that paid their living expenses or was in a position to suppress them if their opinions seemed subversive. New ideas often involve a large fixed costs, and hence the larger the audience, the larger the number of "buyers" to spread these costs over. The idea of a transnational "Republic of Letters," or a *Respublica Litteraria* goes back to the late middle ages, and by the eighteenth century had extended to mechanical and technical knowledge (Darnton, 2003; Daston, 1991). During the Renaissance Europe witnessed the creation of a community of scholars and engineers that transcended political and ethnic boundaries, in which scholars communicated with one another. This community was well established at the start of the Enlightenment movement. It is easy to mistake a sense of belonging to the "Republic of Letters" as a form of personal loyalty to a transnational entity, but for many if not most scientists a loyalty to King or Republic did not conflict with their need for a large and international audience. The Republic of Letters, in practical terms, was a market, not an identity. By catering to a much larger market in terms of reputation and standing, the expected rate of return on producing new ideas increased as the expected costs declined. Even at times of war, intellectual work looked for foreign customers, including those belonging to the enemy while science and scientists could on occasion be harnessed to *raisons d'état*.

The market for ideas in which Europe's intellectuals operated before and during the Age of Enlightenment increasingly resembled an open-source



institution. Individuals were keen on establishing credit rather than maximizing profit, since credit for the priority on an idea established reputations. These reputations were, of course, correlated with patronage and positions, but there can be no doubt that they were also desirable on their own account (David, 2004). The community in which reputations were established was the international of intellectual peers, and patronage to some extent was as well (e.g., the patronage awarded by the French to the Dutch mathematician Huygens or that of Descartes in Sweden).

My argument is thus not that in Europe people were inherently more creative than elsewhere. Instead, the argument is that those individuals in Europe faced incentives different than elsewhere because their institutions were different. On the one hand they faced a larger, if more competitive market (thus increasing expected benefits for entrants who believed they had an exceptionally good product), on the other hand they faced less likely suppression (reducing the likely costs).

The rest of this paper is devoted to the historical verification of this proposition. There can be little doubt that one main mechanism operating was simply the mobility of people. Gibbon noted keenly that in Europe “a modern tyrant” would discover that “the object of his displeasure would easily obtain in a happier climate, a secure refuge, a new fortune adequate to his merit [and]... the freedom of complaint” (1789, Vol. I, p. 100). European intellectuals were footloose, moving about despite the physically taxing conditions of travel in pre-1800 Europe. Such mobility, precisely in the spirit of the model suggested above, was not only intended for flight from a politically oppressive environment (and at times from creditors, jealous husbands, and other sources of distraction), but also to sell the idea to larger markets than one’s original society.

To be sure, personal mobility does not exhaust the benefits of diversity. Political fragmentation also meant that the arms of censorship could not reach across borders and that literature prohibited in one jurisdiction could be and was printed elsewhere and smuggled back into a country, rendering various lists or prohibited books essentially meaningless. But much of the market place for ideas did take through personal contact and innovative thinkers needed to be mobile even if they were not controversial. Desiderius Erasmus was as peripatetic as one could get in an age of poor transport. Born in Rotterdam, he studied in Paris, holding appointments in Basel, Leuven, and Cambridge. During his stay in Leuven he felt victimized by critics who opposed his devotion to a more progressive text interpretation and took refuge in Basel. There is little evidence that, as the most eminent and widely respected humanist scholar of his age and one who refused to take strong positions on the most disputed issues of his day, he was ever seriously threatened by people who disagreed with him. But two and a half centuries later, Jean-Jacques Rousseau still found himself persona non grata at Montmorency after the 1762 publication of *Émile*, and ended up travelling throughout Europe, especially in Switzerland and Britain, though by that time intellectual suppression seems to have lost some its ferocity and Rousseau could live out his last decade in France. Voltaire famously purchased his property in Ferney in the 1750s close enough to the Swiss border to make an escape if push came to shove, but

within France to escape repressive Geneva regulations on having a private theater on his estate. Perhaps the most telling episode is that of the publication of Claude-Adrien Helvétius's *De l'Esprit* in 1758. It was condemned by the Sorbonne and burned in public; Helvétius found himself in England, later on in Potsdam. Yet the entire reaction did not last, and in 1765 he was allowed to return to France and back in favor again. Outrageous ideas were expected and accepted.

In between, every country, even the most tolerant, experienced the flight of some of its most original citizens. Even the Netherlands and Britain knew periods during which heterodoxy could be a dangerous occupation. Both Thomas Hobbes and Hugo Grotius escaped hostile and oppressive government in the seventeenth century and found refuge in Paris. London and Amsterdam repaid France the favor on many subsequent occasions, most famously by the Netherlands hosting René Descartes for many years. As Lorraine Daston (1991, p. 372) notes, seventeenth-century Europe was awash "in streams of learned refugees who found kindred spirits in foreign parts." The friendships and collaborations between people with very different origins clearly helped provide the cosmopolitan character of the Republic of Letters. But above all, this mobility delineated the constraints on government to control original thought and creativity.

This is not to suggest, of course, that fleeing intolerance was the main reason why scholars moved around. One advantage of mobility was that students were not confined to a single university or teacher, but could move about and sample different approaches, thus allowing them to look at different suppliers in the market for ideas. As Descartes, one of the most peripatetic of all intellectuals in early modern Europe, said in his *Discourse on Method*, he was "studying the book of the world." Furthermore, scholars and scientists could move about to find niches where they could make a living. The by-product, perhaps unintended, consequence of this mobility was that most rebellious and heretical thinkers could flee if they had to. Political conditions and the patronage picture they implied could worsen suddenly as rulers died, wars were lost, territories changed hands, and many intellectuals were understandably nervous. But the well-known examples of Miguel Servetus, burned at the stake in Geneva in 1553 and Giordano Bruno, executed in Rome in 1600, and the less known cases of Lucilio Vanini, burned alive in Toulouse in 1619 for atheist beliefs and Ferrente Pallavicino, executed in Avignon in 1642 for disrespect to the Pope, are exceptions. They were the victims of a powerful but retreating and ultimately doomed reactionary force, and they had been careless.

After 1650 such persecutions slowly give way to an atmosphere of greater tolerance and more peaceful competition in the market for ideas, in which evidence, logic, and other rhetorical tools were employed to sell ideas, and the coercive power of the state played a secondary role. The test linking mobility to intellectual creativity is complicated by a standard identification problem: some of the central innovators of the time never had to seek refuge elsewhere in the first place, because the authorities in their state had realized early on that suppression was made impossible because the option of fleeing always existed. Fleeing, as noted, was not the only option, since political

diversity and multacentralism allowed many leading intellectuals to play one power or authority against a competing one. All the same, one scenario that is consistent with the argument that the emergence of a market in ideas thanks to political fragmentation was instrumental in bringing about the enlightenment is that mobility would actually decline between 1500 and 1800, as the need to flee oppressive agents of the orthodoxy declined over time.

To repeat: what counted for the growth of intellectual innovation was that the political fragmentation of Europe implied that not all states were equally intolerant *at the same time* and *on the same issues*. “Heretics” and “deviants” rarely failed to find some place of refuge. The result was that the suppression of novel ideas by violent means was tried everywhere, but was doomed. By the Age of Enlightenment, few failed to grasp this fact in Europe and the market for ideas was increasingly allowed to emerge and do its work. None of this should confuse the emergence of such a market with the elusive ideal of complete “freedom of expression.” David Hume was denied a tenured professorship because of his atheism, and his writings on the history of religion, such as the *Dialogues* were suppressed “in point of Prudence” (Gay, 1969, p. 73. Kant, too, felt the harsh side of suppression when he was reprimanded by the King of Prussia. In France, the best-known writers found themselves “playing a game of harmless charades” with the censors (id., p. 77). There remained considerable uncertainty and some risk to authors, but there was no way of stopping the new ideas.

### Ten successful rebels

Before turning to a more systematic analysis of the mobility of leading intellectuals in Europe, it is useful to provide some notable examples of rebellious or otherwise troublesome intellectuals whose innovations could survive and catch on because of their ability to take advantage of the fragmentation of European political power. I have chosen examples from different fields of knowledge, but left out individuals whose main contribution was theological.

**Lorenzo Valla** (1407-1457) Humanist, philologist and professional rebel, most famous for his demonstration that the “Donation of Constantine” was a forgery, he attacked other sacrosanct icons such as Cicero’s style, Livy’s history, and St. Thomas’s theology. He seemed to “delight in challenging established authorities,” and his work was “an attempt by a humanist intellectual to change rhetorical study from a process that involved the ‘passive’ acquisition of erudition into an ‘active’ discipline that would be capable of engaging practical problems” (Connell, 1996, pp. 1, 6). Valla masterfully exploited the high degree of fragmentation of the political structure in Italy in his time through his talent of making allies as well as enemies (Fubini, 2003, p. 141). After a falling out with his colleagues in Pavia, he moved to Naples, where he was protected by King Alphonso V of Naples from the recriminations of Pope Eugenius V and the Naples Inquisition (Trinkaus, 1948). At some point he had to flee Italy to seek refuge in Barcelona. So chaotic were the politics of Italy and the Papacy at the time, however, that Eugenius’s successor, Nicholas V, actually appointed him Papal secretary in 1447.

**Bernardino Ochino (1487-1564)** highly controversial Siennese Franciscan monk and preacher, committed to free inquiry and controversy, and famous for an unusual eloquence. He managed to alienate both the Catholic Church, especially attracting the hostility of the reactionary hardline Cardinal Giovanni-Pietro Caraffa (later Pope Paul IV, 1555-1559). An equal-opportunity gadfly, Ochino also alienated most protestants. One Catholic writer noted that “the writings of that pernicious apostate... excite disgust in heretics themselves” (Benrath, 1877, p. 296). He was summoned to appear before the Roman Inquisition established in 1542 (one of the first “heretics” to be so persecuted) and fled to Geneva in 1547, eventually ending up in England, whence he was driven by the ascension of the intolerant Mary Tudor. Returning to Zurich, he was again expelled and ended up in Poland (at that time a relatively tolerant nation) but was banished from it in 1564 at the instigation of the papacy and died in Moravia. Among other things he advocated divorce and was suspected of supporting polygamy (Benrath, 1877, *passim*).

**Paracelsus** (1493-1541), sometimes known as the “medical Luther,” a notoriously quarrelsome and provocative physician and chemist, who relentlessly attacked the accepted doctrines of his time as codified by classical authors such as Galen. Known as the “wandering Swiss Doctor” he was consistently anti-establishment and anti-elitist (Breger, 1998, p. 101). In 1527, he publicly burned the canonical medical books of Galen and Avicenna in Basle and barely escaped arrest. By being constantly on the move and considering himself a subject of no king, he succeeded in constantly annoying men seemingly more powerful than himself yet escaped jail or worse despite repeatedly being threatened by the authorities (Debus, 2002).

**Petrus Ramus** (1515-1572), a French philosopher and logician made a career out of slaughtering the holiest of holy cows, namely Aristotle’s logic. His promotion lecture (1536) was actually entitled “Everything that Aristotle ever taught is wrong.” Early in his career he was prohibited from teaching philosophy but allowed to teach other topics. Accused of subversion and undermining the conventions of knowledge, he used the political leverage of his personal friend Cardinal Charles de Lorraine to be reinstated, but had to flee repeatedly Paris for his life to escape the fury of the Catholic reaction and had his library burned. Touring through Switzerland, he was warned by Theodore Beza (Calvin’s successor) to avoid Geneva on account of his fierce anti-Aristotelianism (Ong, 1979, p. 28). He found himself, imprudently perhaps, in Paris in 1572 (he had been promised the personal protection of the King), and was murdered in the St. Bartholomew’s massacre.

**Tommaso Campanella**, (1568-1639), an Italian monk who studied astronomy, astrology, and occult philosophy and soon became skeptical of the Aristotelian orthodoxy. Accused from an early age of heresy by the Inquisition, his ability to play one power against another in fragmented Italy ran out when he was sentenced to life imprisonment in 1599 (for anti-Spanish activity rather than for heresy) and spent twenty seven years in a Neapolitan jail. His

conditions there were sufficiently benign that he could write seven books in jail as well as a pamphlet defending Galileo during his first trial in 1616. He could accomplish this in part because the Emperor Rudolf, Duke Maximilian of Bavaria, and other Catholic notables were exerting influence to protect him. In the end, he was released from jail through the intervention of the Pope Urban VIII, but got in trouble again. He had succeeded, however, to endear himself to the French authorities (anxious to embarrass the Spanish, and through the intervention of the French ambassador he made it out of Italy to France, where he was honored by the court of Louis XIII and eventually accepted even by the suspicious Cardinal Richelieu and died in Paris (Headley, 1997, pp. 117-127).

**Jan Amos Comenius** (Komensky) (1592-1670) a precocious Enlightenment genius, who was early in life persuaded by the writings of Francis Bacon that the “millennium” could be achieved by advances in natural philosophy and applied his belief in progress in educational reform. A Protestant, he fled his native Moravia in the early years of the thirty-years war and settled in Poland in 1620 and then invited by another early Baconian, Samuel Hartlib, to settle in Britain, but once again had to flee because of the British Civil War. Via Sweden and Hungary he ended up back in Poland, but chased away by the outbreak of War, he escaped to Amsterdam in 1657, where he lived the rest of his life. Like many seventeenth century rebels and original thinkers, he took strong religious positions which often got him in trouble, but he survived repeatedly by fleeing in time, losing his family and his books in the process. One of the leading intellectuals of his age, he wrote the leading Latin language textbook of his generation was among others invited to become President of the newly founded Harvard College (Spinka, 1943, pp. 53, 84).

**Johan Baptist Van Helmont** (1579-1644), Belgian physican and chemist, the first to identify “gases” as such and to conduct careful quantitative experiments in Biology. He was repeatedly threatened and penalized for his adherence to heterodox views of nature and medicine and for being a (skeptical) follower of Paracelsus. His book *De magnetica vulnerum* was impounded and in 1624 the inquisition in the Spanish Netherlands began formal proceedings against him for “heresy and impudent arrogance.” Helmont was condemned by the Louvain Theological Faculty in 1633-1634 for adhering to the 'monstrous superstitions' of the school of Paracelsus (that is, the devil himself), for “perverting nature by ascribing to it all magic and diabolic art, and for having spread more than Cimmerian darkness all over the world by his chemical philosophy (*pyrotechnice philosophando*)”. He spent four days in jail in March 1634, and interrogated repeatedly. It seems that his good political connections protected him against worse consequences (he was closely associated with Marie de Medici, the queen mother of France who was in exile in the Spanish Netherlands). In the end, he was released but placed under house arrest. This was finally lifted in 1636, but church proceedings against him were not formally ended until 1642, two years before his death (Pagel, 1982, p. 14). In the preface of his 1644 work *Opuscula media inaudita*, Van Helmont remarks “that the main body of his work was written “in the full blast of persecutions” (ibid., p. 154).

**Johann Joachim Becher** (1635-1682), German alchemist, engineer, and entrepreneur, one of the founders of phlogiston theory, worked alternately for a variety of German rulers including the Elector of Bavaria, the Emperor, and smaller German princes as a court scientist and counselor, moving each time that his enemies and rivals got the better of him. His biographer (Smith, 1994, p. 9) notes that he “like other mobile individuals resided outside the town walls ... [and] ushered in a new order in which productive knowledge was taken outside the artisanal world and brought within the sphere of the state.” Becher’s ability to exploit the political fragmentation in Europe bordered on the virtuoso, moving rapidly between the Imperial court and various German principedoms. In Vienna he was able to play the Habsburg Emperor against his own *Hofkammer*. When his German patronage ran out, he ended up in England in 1680.

**Pierre Bayle** (1647-1707), A highly critical and skeptical French intellectual, who switched from Catholicism to Calvinism and ended up being accused of atheism. Voltaire said of him that he “overthrows all systems.” He taught at the Protestant University in Sedan, but this institution was closed by French authorities in 1681, whereupon Bayle found a position in Rotterdam in a school founded by Huguenot refugees. His *General Criticism of Monsieur Maimbourg's History of Calvinism* (1683) was accorded the supreme accolade of being burned by the public hangman in Paris, which naturally brought it enormous publicity and greatly increased its potential readership. His brother Jacob ended up dying in jail on account of Bayle’s alleged heresies, reputedly because authorities were frustrated at not being able to get their hands on him (Labrousse, 1983, p. 28). Even in the relative safety of the Netherlands, his rebellious views got him in trouble. In Rotterdam Bayle was summoned Bayle to explain certain things that threatened to scandalise the faithful, was accused of gratuitous obscenity, of showing favour to atheists and sceptics. However, rather than imprisonment, Bayle simply edited his book lightly to excise the most offensive passages. These changes gave rise to so many protests from intending purchasers that his publisher then reprinted the complete text of the first edition as an appendix (Labrousse, 1983, pp. 40-42). All the same, his chair was withdrawn in 1693, but his international reputation due to his famous and widely-read *Historical and Critical Dictionary* was such that he could continue to live peacefully in the Netherlands.

**Christian Wolff** (1679-1754), German post-Leibnizian philosopher, whose background in mathematics persuaded him that theological truths should be based on mathematical logic. By the early eighteenth century the Lutherans had spawned an Evangelical movement known as Pietism. Wolff’s views hugely annoyed his colleagues at Halle, who in 1723 persuaded the rather undereducated king Friedrich Wilhelm that Wolff’s views represented a danger to the realm. The King commanded Wolff to leave his realm in forty eight hours or be hanged; Wolff got out in time, and found himself another position

in Marburg. Even Wolff's Halle opponents professed to be shocked by the king's energetic action against the philosopher, but after his departure an evaluation of Wolff's philosophy was prepared by the theological faculty of the university of Jena. It includes twenty-seven articles denouncing Wolff and Leibniz (Sain, 1997, p. 151). By this time the capricious whims of a ruler no longer posed a serious threat to intellectuals. In 1740 Frederic the Great invited him back to Halle, illustrating both the capriciousness of governments in their attitudes to new knowledge and their impotence — certainly by that time — in suppressing it.

### A prosopographical analysis

To examine more carefully the argument made above, I have assembled biographical data on 1185 scientists and other creative individuals born between 1450 and 1750. The first cut of the database relies on two sources: the *Dictionary of Scientific Biography* edited by Charles C. Gillispie under the auspices of the American Council of Learned Societies (Gillispie, 1970-1990), *The Encyclopedia of Philosophy* edited by Paul Edwards, and the "Galileo Project" database assembled by Richard Westfall at <http://galileo.rice.edu/lib/catalog.html>. The database is imperfect in many ways, not least of it is that it is clearly focused on European scientists and includes only a handful of non-Europeans, and little information is available on the latter. For a comparison between western and non-western, a more in-depth database on Chinese and other Asian scientists in the same period would be necessary. Further research will focus on supplementing it in this direction.

The main issue we will examine is the mobility of scientists. The sources often provide the "causes" of mobility, but these are quite resistant to quantification without more information. On the whole, scientists moved for three reasons: to get an education, to earn a living, or for personal reasons, including a search for religious and intellectual freedom. The problem is, by and large, that separating these causes is not very realistic without a careful study of each individual. At this stage, we will look at three variables that measure mobility: the number of moves made by each individual over his lifetime, whether the individual died in the country in which he was born, and the geographical distance between the town of birth and the town of death. All of those variables are vulnerable proxies to the degree of mobility, and the results, like all analysis of prosopographical data, are suggestive rather than conclusive. Yet something can be learned from them.

The raw data are presented in table 1. The trend of the raw numbers over time is not all that helpful, since it may largely reflect the preferences of the editors as to whom to include and the nature of the surviving records. The geographical patterns, however, do conform to our notions about the changes in where scientists originated in this period, especially the decline of Spain and Portugal after 1600, the rise and subsequent decline of the Low Countries, and the growing dominance of France and Britain by the eighteenth century. Not provided here are finer breakdowns, within each region. The most interesting phenomenon is the rise of Scotland in the British Isles from practically nothing

before 1600 to over 30 percent for scientists born after 1700. Nonetheless, where people are born is less interesting than where they lived their lives and the extent to which the two overlapped, which is what this paper is mostly concerned with.

Tables 2 and 3 represent the number of moves that were estimated for each person, broken down by subperiod and region. These moves refer to any move, whether across national boundaries (such as they were) or not. Given the complex and fluid political arrangement in Italy and Germany, as we shall see, verifying for each move whether it involved crossing a national border or not is far from easy and not obviously meaningful. It is striking, however, that French, British, and Italian scientists moved, on the whole, less than the average, whereas Germans and Swiss moved substantially more, with Swiss and Dutch scholars also being more peripatetic than the average. Over time, if we can see anything, it is that moves peak in the sixteenth century, then decline to a much lower level for people born after 1550, settling down on a steady state level in the second half of the period under discussion. The t-statistics provided in the last column of table 3 show the decline to be statistically significant between 1500 and 1600, but not after. The differences between regions also tend to be on the whole larger than just due to accident. In table 4 I provide the pairwise t-test statistics between some of the main regions (sample size made comparisons of other regions less meaningful). These statistics indicate that there were, indeed, substantial differences between the mobility of scientists, depending on where they were born.

Oddly enough, length of life seems to have mattered less than would be expected. Longer lived people, as one would have expected, moved somewhat more, but not nearly as much as would have been expected had the probability of moving been constant over one's adult life. Of course, such an assumption would have been naive, since young people tended to move more often, in large part in search of employment or a different study environment. Indeed, the raw correlation between length of life and number of moves is negative for the period 1450-1550, then becomes positive and relative large for the 50 years between 1550 and 1600, but becomes insignificant and of inconsistent sign in the second half of the period.



**Table 1:** Raw data of prosopographical data of creative people, born 1450-1750, by period and region of birth.

	1450-1500	1500-1550	1550-1600	1600-1650	1650-1700	1700-1750	Total
British Isles	4	9	23	65	57	90	262
France	12	21	27	62	57	118	297
Germany	20	15	26	22	23	57	165
Italy	20	37	35	23	27	28	170
Low Countries	1	12	20	19	6	8	66
Switzerland	1	8	4	4	9	13	39
Iberia	15	16	7	4	1	9	52
Scandinavia	0	2	4	10	7	24	47
East. & South. Eur.	3	5	13	2	7	17	47
America	0	0	0	2	1	11	14
Middle East & Asia	3	1	4	6	4	5	24
<b>Total</b>	<b>79</b>	<b>127</b>	<b>163</b>	<b>219</b>	<b>215</b>	<b>382</b>	<b>1185</b>

All the same, it seems logical to include lifespan as a dependent variable, as is true for period and regional dummies. This is reported in Table 4. Because there can be hardly any question that the variable “number of moves” is measured with serious error, I have collapsed it into a new categorical variable in which there are but four values: no move, and respectively low (1-5), medium (6-10), and high (> 10) number of moves and re-estimated the relation using ordered probit. The table shows but little sensitivity to the method of estimation. The show a positive but small effect of lifespan, and significant effects (in various directions) for the regional and periodical

**Table 2: Number of “moves” by region, scientists born between 1450-1750.**

<b>Region</b>	<b>Mean number of moves</b>	<b>standard deviation</b>
<b>British Isles</b>	<b>3.46</b>	<b>2.35</b>
<b>France</b>	<b>2.83</b>	<b>2.59</b>
<b>Germany</b>	<b>5.09</b>	<b>3.72</b>
<b>Italy</b>	<b>3.33</b>	<b>2.56</b>
<b>Low Countries</b>	<b>4.44</b>	<b>2.96</b>
<b>Switzerland</b>	<b>5.56</b>	<b>5.41</b>
<b>Iberia</b>	<b>4.07</b>	<b>3.08</b>
<b>Scandinavia</b>	<b>4.57</b>	<b>2.84</b>
<b>Habsburg Lands and Eastern Europe</b>	<b>5.21</b>	<b>3.47</b>
<b>America</b>	<b>2.35</b>	<b>1.78</b>
<b>Asia</b>	<b>1.45</b>	<b>2.65</b>
<b>Total</b>	<b>3.72</b>	<b>3.07</b>

**Table 3: Number of moves by period of birth**

<b>Period</b>	<b>average number of moves</b>	<b>standard deviation</b>	<b>t-test statistic compared to previous period</b>
<b>1450-1500</b>	<b>4.23</b>	<b>4.19</b>	<b>--</b>
<b>1500-1550</b>	<b>4.82</b>	<b>3.68</b>	<b>1.076</b>
<b>1550-1600</b>	<b>3.87</b>	<b>3.23</b>	<b>-2.334</b>
<b>1600-1650</b>	<b>3.37</b>	<b>2.81</b>	<b>-1.635</b>
<b>1650-1700</b>	<b>3.31</b>	<b>2.72</b>	<b>-0.225</b>
<b>1700-1750</b>	<b>3.62</b>	<b>2.73</b>	<b>1.34</b>

**Table 4: pairwise t-statistics between main regions (abs. values).**

	<b>British Isles</b>	<b>France</b>	<b>Germany</b>	<b>Italy</b>	<b>Low Countries</b>
<b>British Isles</b>					
<b>France</b>	<b>2.97</b>				
<b>Germany</b>	<b>-5.57</b>	<b>-7.66</b>			
<b>Italy</b>	<b>0.51</b>	<b>-2.03</b>	<b>5.06</b>		
<b>Low Countries</b>	<b>-2.86</b>	<b>-4.44</b>	<b>1.28</b>	<b>-2.84</b>	
<b>Iberia</b>	<b>-1.63</b>	<b>-3.10</b>	<b>1.79</b>	<b>-1.74</b>	<b>0.65</b>

**Table 5: Analysis of the number of moves (OLS and ordered probit)**

	OLS		Ordered Probit	
	Coefficient	t-statistic	Coefficient	z-statistic
Constant	3.42	7.41		
Lifespan	0.012	2.00	0.0052	2.17
British Isles	-0.75	-2.78	-0.20	-1.92
France	-1.47	-5.69	-0.51	-5.03
Germany	0.73	2.42	0.19	1.66
Italy	-1.24	-4.13	-0.45	-3.79
Spain	-0.73	-1.56	-0.12	-0.66
Born 1450-1500	0.57	1.50	0.02	0.15
Born 1500-1550	1.30	4.13	0.33	2.75
Born 1550-1600	0.22	0.79	0.08	0.80
Born 1600-1650	-0.12	-0.46	-0.12	-1.22
Born 1650-1700	-0.19	-0.81	-0.15	-1.50
	n= 1184, R <sup>2</sup> = 0.0829		n= 1184, pseudo- R <sup>2</sup> = 0.0383	

dummies. German scientists moved more than the reference group, while British, French, and Italian moved less. The first hundred years of the period were clearly a period of high moving activity, compared to the later years.

The other variable that could be inferred from the prosopographies is whether the person died in “exile,” that is, in a different country that he was born or died in exile. The difficulty here is that national boundaries are far from unambiguous. While a person born in Russia who dies in France is clearly dying in exile, is this true for a Saxon dying in Berlin or a Scotsman in London? Since there is no obvious solution to this problem, I have used two alternatives, an inclusive measure that counts as “exile” any death beyond the narrow confines of a country or city state, and an exclusive measure in which Britain, Germany and Italy are considered “entities” so that being born in one place and dying in another within them does not count as “exile.” The dilemma is that by the more inclusive criterion, Italian and German (and to some extent British) scientists would look as if they moved more than French

and Spanish ones, whereas by the exclusive criterion, the reverse would be the case. Yet the political fragmentation of Italy and Germany to some extent are not an artefact but the very phenomenon we are trying to isolate here, and hence the more inclusive or “total” variable here may be more applicable. For completeness, however, Tables 6 and 7 present both. As might be expected, the results differ radically for Germany and Italy, politically fragmented that they were, but in either case, France and Britain show a low tendency toward mobility. Italians tended to move about in Italy (hence the large positive coefficient in the first column in Table 7) but to stay in Italy (as the large *negative* coefficient in the “exile abroad” coefficient indicates).

As a final measure of mobility, I have measured the geographical distances between the city of birth and the city of death, regardless of national boundaries. Like all other measures of mobility this one is not without biases and problems. It is perfectly likely that some of the scientists in the sample travelled much of their life and then returned to their birthplace or region to spend their old age. All the same, the measure captures the ability of creative and learned people to move about toward opportunity and, if necessary, away from bigotry and suppression. [to be completed—]

Despite the fact that our three measures of mobility measure somewhat different aspects of mobility, they all indicate rather similar trends. The main observation is that mobility *declined* over the course of our period, and that this trend is statistically significant. Scientists born in the century between 1450 and 1550 and thus active mainly in the sixteenth century tended to move substantially more than their counterparts in the age of Enlightenment. For the entire period, British, French and Iberian scientists

**Table 6:** Exile Variable, by period.

	Inclusive exile Measure (%)	t-test comparing to previous period	Exclusive exile Measure (%)	t-test comparing to previous period
Born 1450- 1500	44.73		21.05	
Born 1500- 1550	50.00	0.82	26.19	0.72
Born 1550- 1600	45.96	-0.87	21.74	-0.67
Born 1600- 1650	23.74	-4.66	13.70	-2.06
Born 1650- 1700	31.60	1.82	12.26	-0.44
Born 1700- 1750	33.51	0.47	16.49	1.38
Total	35.54		17.26	

moved substantially less than German or Dutch scientists. There is no obvious interpretation of this, except that it stands to reason that scientists born in relatively small countries like the Netherlands or Sweden would move more in search of an education or employment. Yet on the whole, the picture shows a remarkable degree of mobility for all countries and the differences between them are of nuance rather than essence. Even English scientists moved and travelled a great deal, despite the fact that periods of genuine intolerance and suppression in that country were infrequent and brief. A full third of our scientists died “in exile” by the inclusive measure and almost 20 percent by the more exclusive measure. The time pattern is equally revealing: during the period of highest intolerance in Europe, mobility was at its peak. The ten anecdotal cases, admittedly of remarkable cases, are thus not unrepresentative. During the eighteenth century the proportion of people dying in exile declined, in part because it was less necessary to flee suppressive governments. A new equilibrium had emerged that made constant movement less necessary, as governments had by and large come to realize the futility of such actions precisely because creativity was too slippery to be stamped out and after a while they rarely took the trouble of resisting the outcomes of the market for ideas, even when they were unhappy with the outcomes.

**Table 7:** Analysis of “Death in Exile” Variable (Probit estimates)

	Inclusive Exile Variable		“Exile abroad” Variable	
	Coefficient	z-statistic	Coefficient	z-statistic
Constant	0.077	0.35	0.09	0.37
Lifespan	-0.0075	-2.57	-0.010	-3.21
British Isles	-0.27	-2.21	-0.62	-4.52
France	-0.73	-5.62	-0.69	-5.20
Germany	0.99	7.31	-0.17	-1.21
Italy	0.92	6.84	-0.78	-4.78
Iberia	0.39	1.92	0.33	1.62
Born 1450-1500	-0.23	-1.29	-0.19	-0.10
Born 1500-1550	0.09	0.64	0.22	1.42
Born 1550-1600	0.06	0.48	0.10	0.73
Born 1600-1650	-0.34	-2.75	-0.13	-0.93
Born 1650-1700	-0.06	-0.52	-0.13	-0.96
n	1176		1176	
LR P <sup>2</sup>	285		89	
Pseudo R <sup>2</sup>	0.1864		0.0824	

A third way of getting to the mobility of Europe’s intellectuals is to measure the geographical distance between the place of birth and the place of death. This measure, like the other two, is at best a hazardous proxy. Some people may have decided to return to the place of their birth as they approached old age, which would predict perhaps a negative relation between age and distance. It is also clear that in countries like Germany and Italy, where one could move away from an oppressive ruler by migrating a short distance, this variable would mean something else than, say, in Russia. There is thus some information in these variables, but by themselves they should be taken with a grain of salt. However, a pattern revealed by all three proxies to mobility would have some historical significance. The basic patterns of this variables is presented in table 8-9.

Table 8: Distances between place-of-birth and place-of-death, 1450-1750

	Mean distance (miles)	distance = 0 (%)	distance 0-50 (%)	distance 50-500 (%)	distance > 500 (%)
Born 1450-1500	<b>341</b>	<b>21.5</b>	<b>11.4</b>	<b>48.1</b>	<b>19.0</b>
Born 1500-1550	<b>265</b>	<b>23.6</b>	<b>9.4</b>	<b>53.5</b>	<b>13.4</b>
Born 1550-1600	<b>284</b>	<b>24.5</b>	<b>15.3</b>	<b>45.4</b>	<b>14.7</b>
Born 1600-1650	<b>257</b>	<b>26.5</b>	<b>12.8</b>	<b>50.2</b>	<b>10.5</b>
Born 1650-1700	<b>305</b>	<b>30.5</b>	<b>9.9</b>	<b>48.8</b>	<b>10.8</b>
Born 1700-1750	<b>384</b>	<b>23.0</b>	<b>11.8</b>	<b>50.8</b>	<b>14.4</b>
British Isles	<b>349</b>	<b>20.2</b>	<b>13.4</b>	<b>56.5</b>	<b>9.9</b>
France	<b>267</b>	<b>33.0</b>	<b>5.4</b>	<b>53.9</b>	<b>7.7</b>
Germany	<b>215</b>	<b>19.4</b>	<b>11.5</b>	<b>55.2</b>	<b>13.9</b>
Italy	<b>200</b>	<b>29.4</b>	<b>14.1</b>	<b>45.9</b>	<b>10.6</b>
Low Countries	<b>234</b>	<b>22.7</b>	<b>42.4</b>	<b>22.7</b>	<b>12.1</b>
Switzerland	<b>161</b>	<b>59.0</b>	<b>7.7</b>	<b>23.1</b>	<b>10.3</b>
Iberia	<b>992</b>	<b>15.4</b>	<b>7.7</b>	<b>28.9</b>	<b>48.1</b>
Scandinavia	<b>433</b>	<b>12.8</b>	<b>6.4</b>	<b>61.7</b>	<b>19.1</b>
Habsburg Lands and East. Europe	<b>278</b>	<b>14.9</b>	<b>2.1</b>	<b>68.1</b>	<b>14.9</b>
America	<b>997</b>	<b>14.3</b>	<b>35.7</b>	<b>21.4</b>	<b>28.6</b>
Asia	<b>676</b>	<b>16.7</b>	<b>8.3</b>	<b>33.3</b>	<b>41.67</b>
Total	<b>317</b>	<b>25.2</b>	<b>11.8</b>	<b>49.7</b>	<b>13.3</b>



**Table 9:** Analysis of distance between place-of-birth and place-of-death (OLS and ordered probit)

	OLS (depen. variable: distance)		Ordered Probit (classes def. as in table 8)	
	Coefficient	t-statistic	Coefficient	z-statistic
Constant	989.2	7.59		
Lifespan	-6.77	-3.94	-0.002	-1.24
British Isles	-118.9	-1.10	-0.105	-1.10
France	-193.8	-2.78	-0.326	-3.52
Germany	-273.3	-3.35	-0.056	-0.53
Italy	-235.6	-2.90	-0.307	-2.87
Born 1450-1500	-53.9	-0.50	0.078	0.57
Born 1500-1550	-149.1	-1.70	-0.017	-0.15
Born 1550-1600	-134.4	-1.69	-0.090	-0.86
Born 1600-1650	-157.7	-2.23	-0.150	-1.60
Born 1650-1700	-83.1	-1.17	-0.179	-1.89
	n= 1172, R <sup>2</sup> = 0.0308		n= 1172, pseudo- R <sup>2</sup> = 0.0095	

A full model specifying the “push” and pull” factors of mobility would be hard to estimate from these sparse data, but it would include both a search for academic freedom and a search for economic independence, patronage, and education. What stands out that European intellectuals, when threatened in any way, had the option to go elsewhere. As far as these sources show, and as much as is known about the lives of Chinese and Islamic intellectuals, no such options existed. They were, as Gibbon said about the Roman Empire, the entire world and thus it was easier for them to suppress dissent.

There are some instructive counterexamples. The seventeenth century Chinese scholar Chu Shun-shui is one of the few Chinese intellectuals who can be compared with his European counterparts. His pragmatic approach to wisdom, which he felt should be judged on whether it was of use to society. While not Baconian in his approach (his interest were rituals and public virtues), he was an unusually independent thinker. His knowledge was quite broad and extended to fields of practical knowledge such as architecture and crafts. Fleeing from China (he had remained a supporter of the Ming dynasty, overthrown in 1644) first to Annam (Vietnam) and then to Japan he encountered quite a resistance in both places, being twice denied permission to remain in Japan and imprisoned in Annam. In the end, he was allowed to stay in Japan, where he had quite a following and eventually became advisor and mentor to the daimyo Mitsukuni. Chu Shun-shui, in Julia Ching’s words, was hardly a purely abstract philosopher, but “the investigation of things referred to less to the metaphysical understanding of principle of material forces, and more to coping with concrete situations. At the same time, the extension of knowledge applied not only to knowledge of the Confucian classics, but also to all that is useful in life”(Ching, 1978, p. 217). In Japan, she feels that his teachings helped to orient Japanese Confucianism to the real, the human, the objective, and the practical, which for them were stepping stones toward the encounter with Western science and technology” (ibid., p. 215). Yet Chu’s work remained unknown in China and his work was rediscovered by a much later generation of Chinese refugees who fled to Japan after the Hundred Days Reform in 1898. More typical, perhaps, is the career of the scholar Chen Menglei, the editor of the massive *Gujin tushu jicheng* compiled by and published in 1726 (one of the largest books ever produced, with 10,000 chapters, 850,000 pages and 5,000 figures). Chen was arrested and deported (twice), and his name was removed from the project by the Emperor whose wrath he had incurred. The entire project was carried out under imperial auspices. Being banished, in China, was to be expelled from the land of civilization.

### Concluding remarks

I have argued in this paper that economically successful creativity depends above all on institutions. The potential capability of being creative is surely distributed identically over different populations, yet we observe vast differences in the kind of creativity prevalent in different societies. Only a

small number of people are born with the capability of being truly creative, and the environment in which they find themselves will determine if that creativity will affect the culture, society and economy in which they live. Institutions determine to a great extent how much of this “natural” potential of creativity is realized. In Europe the big break came in the late seventeenth century with the Enlightenment and the emergence of a more or less free market for ideas. The test carried out in this paper is that we would expect mobility in Europe, however measured, to go up over time as transportation technology improved over the early modern age. If this did not happen, it could be attributed to a number of things, but it would be consistent with the view that the willy nilly emergence of greater tolerance amongst the ruling intellectual orthodoxy helped create the freer market in ideas we associate with the rise of the European Enlightenment in the eighteenth century and the eventual birth of modern economic growth.

“Explaining” the European Enlightenment is a project that is way beyond the scope of this essay. But it seems fair to say that the Hume-Kant hypothesis as applied to this issue makes perfect sense and is consistent with the facts. In the age of the reformation many governments tried to suppress new ideas and persecuted intellectuals they thought undermined the ideological and metaphysical underpinnings of their regime. Especially in Germany and Italy, where political fragmentation was high, mobility was extremely high. In Britain and France it was comparatively low, though in both there were periods of severe intolerance.

Most important is the consequence that the suppression of ideas became a less and less attractive option for people in power after 1700 and in the end a high rate of mobility to escape oppressive government in most countries that were affected by the Enlightenment became unnecessary. This allowed European creativity to flourish in almost any area imaginable. It seems perhaps far fetched to argue that modern economic growth was entirely caused by it, but even more far-fetched to argue that we could ever explain economic modernity without it.

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