

Opera Composition and the Operatic Canon

Siobhan McAndrew, HM Treasury¹

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This paper, using simple statistical techniques, makes use of two datasets to draw out some patterns in opera composition and current performance. First, trends in opera composition are identified and some estimates given of the diffusion of opera throughout Western Europe. Secondly, the current repertoire is examined to draw out what determined lasting success.

1.1 Opera as a technology

Technology tends to be understood in terms of the application of science to practical or industrial uses. However, it can also be understood more broadly as ‘technical method in a particular field of industry or art’ with ‘technique’ meaning ‘skill in the arts’.² The emergence of opera was a discrete event in music history, with musicians and dramatists adopting new methods to make a new product and new institutions forming to produce it. Innovation in cultural goods is usually termed ‘creativity’, with implications that this is due to individual factors and ‘genius, luck or serendipity’.³ However, economic and social factors are also important, and clearly some societies foster more artistic and technological creativity than others. As Mokyr put it,

“economic and social institutions have to encourage potential innovators by presenting them with the right incentive structure. In part, such incentives are economic; technological creativity is more likely if an innovator can expect to become rich... [or] a society can reward successful innovators by awarding them medals, Nobel prizes, or intangible symbols of prestige.”⁴

Knowledge is non-rival, and therefore the production and allocation of new knowledge cannot be completely governed by competitive market forces. Either knowledge is sold at above its marginal cost, or its development is not motivated by market forces. Thus some departure from a competitive model is needed. However, knowledge can be excludable – this depends on the nature of the knowledge itself, and on economic institutions governing property rights, such as patent protection and copyright law.⁵

Support for art and music can be akin to support for basic scientific research. Opera emerged before copyright legislation in Italy, and in any case, the key innovation was the concept itself rather than the text or music for any individual work; once the concept itself had been tried successfully, it could be easily copied. However, artists needed to be given the resources to experiment in this fashion.

What type of regime best promotes creativity? Baumol argues that, in various places and times, military conquest, political and religious leadership, tax collection, criminal activity, philosophical contemplation, financial dealings, and manipulation of the legal system have been attractive to the most talented members of society. These activities often have negligible or negative social returns and are often forms of rent-seeking. He argues that there has been a strong link between how societies direct the energies of their

¹ This paper draws on a recent D.Phil. thesis, completed at Nuffield College, Oxford, and in no way reflects the views of HM Treasury.

² *Webster's Dictionary*.

³ J. Mokyr, *The Lever of Riches: Technological Creativity and Economic Progress* (Oxford, 1990), p. 13.

⁴ Mokyr, *Level of Riches*, p. 12.

⁵ D. Romer, *Advanced Macroeconomics* (New York, 2001), p. 116.

most able members and whether societies flourish over the long term.⁶ Murphy, Shleifer and Vishny emphasize three factors. First, the larger is the market from which a talented individual can reap returns, the greater are the incentives to enter a given activity - low transportation costs and an absence of barriers to trade encourage entrepreneurship, while poorly defined property rights, however, encourage expropriation and rent-seeking. The second factor is the degree of diminishing returns. The final factor is the ability to keep the returns from one's activities.⁷ DeLong and Shleifer write of 'the incompatibility of despotism and development'. Economies where property is insecure and prone to expropriation will stagnate, while commercial economies with constitutionally-restricted governments will grow.⁸

However, the relationship between political regime and national income is complex. Neoclassical approaches attempt to root the state in individual preferences, while some institutional approaches interpret state institutions as equilibria in an underlying game.⁹ Others suggest that early modern political regimes were highly path-dependent, deriving largely from their geopolitical position.¹⁰ Political historians often identify cultural display as a strategic tool by which early-modern rulers could increase state strength:

"the main currency of imperial competition was cultural achievement. So the representational display expressed in palaces, academies, opera houses, hunting establishments, and the like was not pure self-indulgence, nor was it deception; it was a constitutive element of power itself."¹¹

In maximising fiscal resources the state must create a credible commitment to guaranteeing economic and political rights; support for high culture, through signalling a long time-horizon, helps advertise this commitment, although ultimately fiscal institutions and military power were more important in the long run.¹² Opera, as both a courtly ritual and a public entertainment, is therefore associated with the assertion of power, but later flourishes in strong economies benefiting from political stability.

1.2 The OperaGlass and *Music and Opera* data

The first relevant dataset is drawn from the OperaGlass database – a catalogue published by opera enthusiasts of some 2600 composers and 15000 operas.¹³ This is the most comprehensive listing of opera composers and works available, drawing on numerous sources.¹⁴ Such use of catalogue data is comparable with using patent counts and citations

⁶ W. J. Baumol, 'Entrepreneurship: Productive, Unproductive and Destructive', *Journal of Political Economy* (1990), vol. 98, pp. 893-921.

⁷ K. M. Murphy, A. Shleifer, and R. W. Vishny, 'The Allocation of Talent: Implications for Growth', *Quarterly Journal of Economics*, 106/2 (May 1991), p. 529.

⁸ J. B. DeLong and A. Shleifer, 'Princes and Merchants: European City Growth before the Industrial Revolution', *Journal of Law and Economics* (1993), 36/2, p. 672.

⁹ A. Greif, 'Self-enforcing Political Systems and Economic Growth: Late Medieval Genoa', in R. H. Bates et al. (eds.), *Analytic Narratives* (Princeton, 1998); D. C. North and B. R. Weingast, 'Constitutions and Commitment: Evolution of Institutions Governing Public Choice', *Journal of Economic History*, vol. 49 (1989) pp. 803-32.

¹⁰ P. K. O'Brien and P. A. Hunt, 'England, 1485-1815', in Richard Bonney (ed.), *The Rise of the Fiscal State in Europe c.1200-1815* (Oxford, 1999).

¹¹ T. C. W. Blanning, *The Culture of Power and the Power of Culture* (Oxford, 2003), p. 59.

¹² O'Brien and Hunt, 'England, 1485-1815', pp. 53-54.

¹³ <http://opera.stanford.edu>.

¹⁴ Since compiling the tables in 2003 the OperaGlass catalogue has expanded to 4,600 composers and 25,000 compositions, but it seems reasonable to assume that the expansion largely derives from unfinished, little-known or academic compositions and that the original 'sample' is therefore biased towards viability.

as a measure of innovative output. It has been made respectable recently by the industrial economist F. M. Scherer,¹⁵ and enables us to trace the diffusion of opera.

One issue is how far new works can be taken to reflect operatic activity as a whole. This is problematic given that opera houses since the late nineteenth century have tended to focus on repertory works, and contemporary additions to the repertory are rare, so that 'first performances' are not a good proxy for 'operatic activity'. However, performance data for revivals across such a wide range of countries and over such a long period is unattainable. Secondly, since opera is often associated with statehood, emerging nations with new operatic traditions produce a flurry of new indigenous operas, even in the twentieth century. Thirdly, new operas serve as a proxy for the health of the art as a whole; in fact, rather more new works are produced than would be expected, given that they are unlikely to be revived.¹⁶ Thus the OperaGlass raw data, for its limitations, remains rich and can help flesh out the intuitions of music and socio-cultural historians.

The OperaGlass data is supplemented by data on performances for the operatic seasons of 1997-1998 to 2000-2001, which provide a rough measure of the contemporary repertory, and thus a blunt 'quality measure'. These are drawn from the annual brochure *Music and Opera Around the World* which lists programmes for some 330 venues and orchestras.¹⁷ The measure simply counts every performance listed in the four editions of the catalogue, with no claims that this might constitute the core repertory in perpetuity.

1.3 The invention and diffusion of opera throughout Italy

Why did opera emerge in Italy rather than elsewhere? At first glance it does not appear incredible that the leap to wholly sung drama could have been made elsewhere in Europe. Italy's particular political circumstances were crucial. During the eleventh century communal government began to evolve throughout Italy, under the leadership of a merchant class. Milan, Genoa, Venice, Florence, and Pisa became powerful and independent city-states, promoting the end of feudalism in northern Italy.¹⁸ Stimulated by the freer atmosphere of the cities and the rediscovery of ancient Greek and Latin texts, humanist attitudes emerged and formed the basis of the Renaissance. Concurrently, many of the communal governments of the city-states fell under the rule of *signori* dictators who became hereditary rulers. These families were instrumental in advancing the Renaissance, with Medici patronage the pinnacle.

Epstein views the city-state system as being critical for fostering innovation, compared with the early modern European alternatives of the feudal territory and the monarchical nation-state.¹⁹ Furthermore, Italy often suffered fewer institutional restrictions than elsewhere. Cities acted as commercial hubs which, having encouraged innovations, disseminated them rapidly. Florentine merchants were the first Europeans to adopt Arabic numerals, and Italy led European scientific culture. It is not accidental that opera emerged in this environment. The traditional story locates the birth of opera in Florence in 1597-98, a manifestation of the ever-growing magnificence of Medici celebrations. Courtly

¹⁵ F. M. Scherer, *Quarter Notes and Banknotes: The Economics of Music Composition in the Eighteenth and Nineteenth Centuries* (Princeton, 2004).

¹⁶ Examples for the Royal Opera at Covent Garden has recently premiered Nicholas Maw's *Sophie's Choice* (2002), Thomas Adès' *The Tempest* (2004), and Lorin Maazels' *1984* (2005).

¹⁷ *Music and Opera Around the World 1997-1998* (Paris, 1997), *Music and Opera Around the World 1998-1999* (Paris, 1998), *Music and Opera Around the World 1999-2000* (Paris, 1999), *Music and Opera Around the World 2000-2001* (Paris, 2000).

¹⁸ S. R. Epstein, 'Town and country: economy and institutions in late medieval Italy', *Economic History Review*, XLVI, 3 (1993), p. 453.

¹⁹ S. R. Epstein, paper delivered to the Colloquium at Nuffield College in June 2002 on Kenneth Pomeranz' *The Great Divergence*.

opera was essentially private, and the purpose was to ‘underline the power and magnanimity of the ruling prince and to remind others of his power and the might of the state he headed’.²⁰

The diffusion of opera was first to the nearby courts at Mantua and Rome, and thence to Venice, where Venice’s commercial environment established opera as a genre. With maturation of the genre and satiation of audiences, presented with 22 new works in each of 1696 and 1697, ‘the only criterion of art came to be the artist’s or the audience’s pleasure’.²¹ Scenic and vocal bravura were likely to claim audience attention; composers increasingly strove to exploit the solo voice and ‘stars’ began to emerge. By the eighteenth century, these features were diffusing throughout Italy.²²

Figure 1 below illustrates the diffusion of opera throughout Italy. Florence, the birthplace of opera, does not sustain its lead. Venice, Rome and even Bologna surpass it in terms of quantity. By the second half of the seventeenth century Milan and Naples have discovered opera. Naples’ output accelerates, and although it follows a courtly model rather than a pseudo-commercial one, it follows a similar path to Venice, peaking with 26 new productions in 1770 alone. Milan’s later start is most interesting, since La Scala has been the most vibrant Italian opera house over the late nineteenth and twentieth century. The high point is the 1760-1780 period, when there were 1,023 new operas across Italy – ‘a society [consuming] opera at an astonishing rate... [with] a virtually limitless demand for new operas’.²³

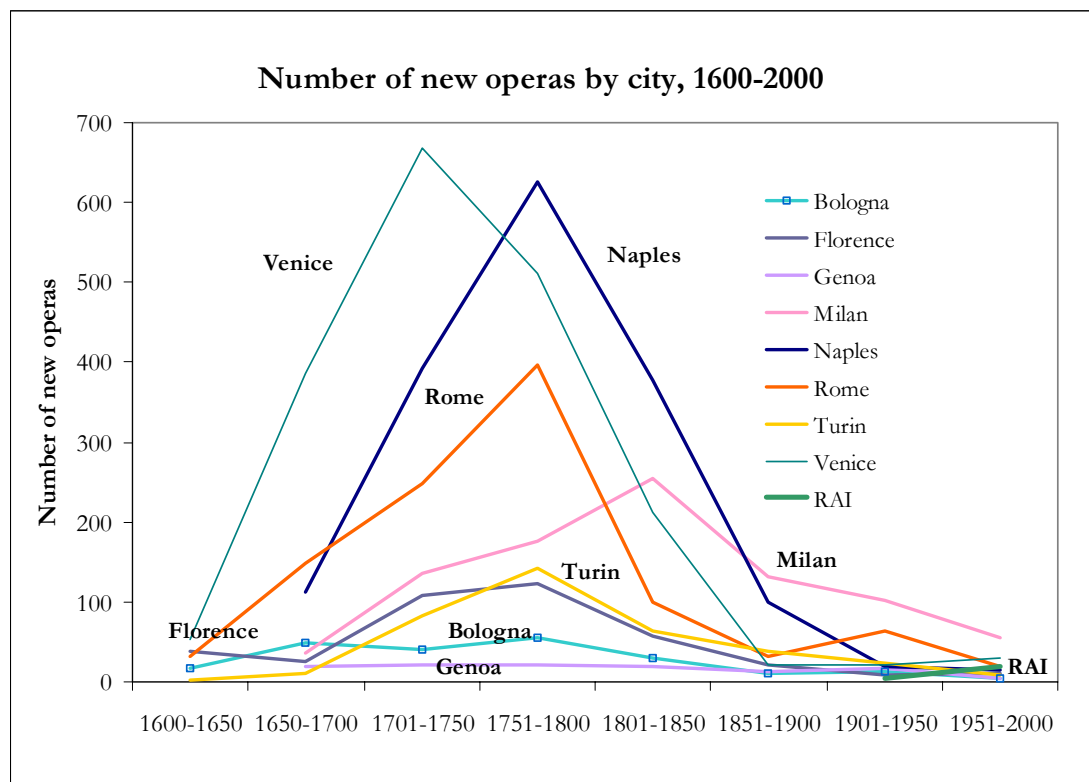


Figure 1: The diffusion of opera throughout Italy. Source: OperaGlass.

²⁰ W. C. Holmes, *Opera Observed: Views of a Florentine Impresario in the Early Eighteenth Century* (Chicago, 1993), p. 9.

²¹ D. R. E. Kimbell, *Italian Opera* (Cambridge, 1991). pp. 123, 127.

²² Holmes, *Opera Observed*, pp. 1, 13.

²³ Kimbell, *Italian Opera*, p. 432.

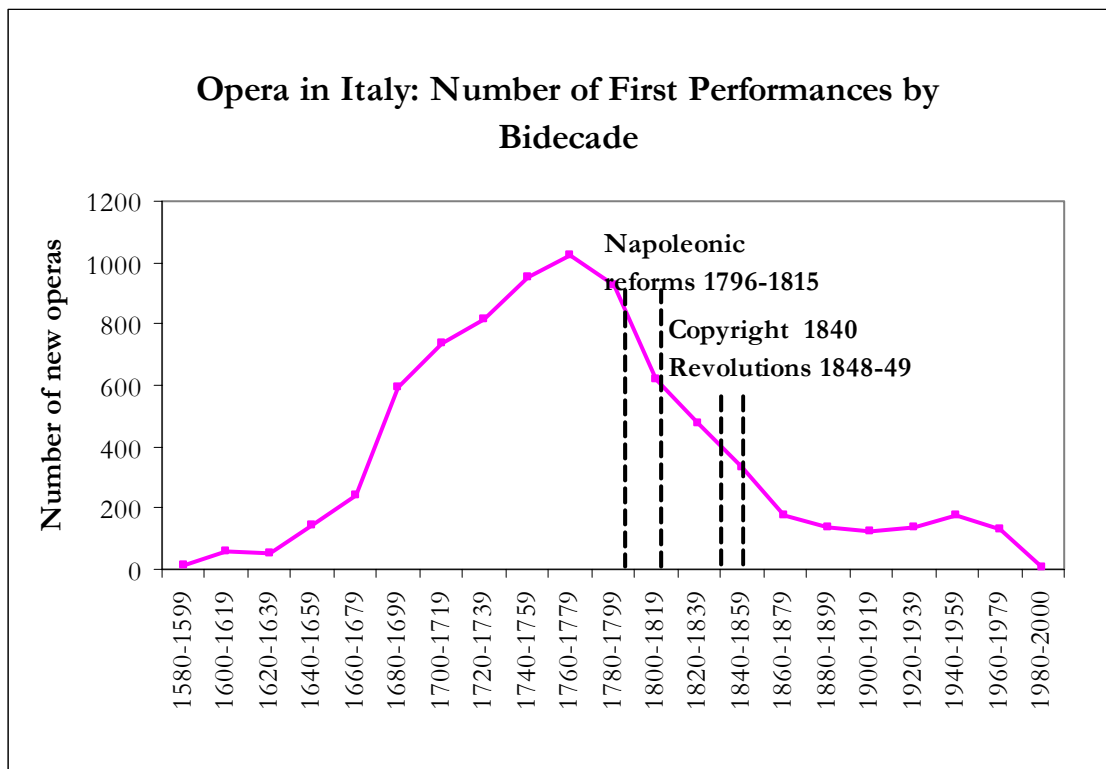


Figure 2: Total number of new operas performed in Italy, 1600-2000. Source: OperaGlass.

This rate of composition was unsustainable. During the Napoleonic period (1796-1815) governments restored to theatres the gambling monopolies which they had gradually lost during the later eighteenth century; this staved off financial pressures for a time, but did not survive the Restoration.²⁴ The *ancien régime* which had given birth to opera was to be shaken with the *risorgimento* and the 1848 revolutions which ‘for the opera world... were an unmitigated disaster’.²⁵ The Second Italian War of Independence of 1859-1860 and further revolutions heralded a new political regime. Some towns profited from the new commercial life of a united Italy, notably Turin, Milan and eventually Rome. However, Naples, Venice and Florence lost their status and opera especially suffered ‘now there was no one with any interest in handing out what had in effect been collective bribes’.²⁶ Parliament gave up subsidising opera houses in 1868; the municipalities were allowed to carry on if they chose, and so in the 1870s La Fenice remained closed as often as not. On the other hand, Milan was now prosperous and the town council maintained the subsidy for La Scala which now led the Italian operatic world.

The new non-aristocratic regime heralded the arrival of repertory opera. About 75% of the current repertory was composed between 1835 and 1910.²⁷ By 1913 the repertory included few works older than *Rigoletto*. The proximate cause, besides a declining market, was the arrival of effective copyright in 1840. The *opera seria* composer Antonio Zingarelli (1752-1837) had once completed an opera within two weeks, but now publishers could invest in promoting a smaller number of composers. This is illustrated by figure 3, which uses data of composers by their date of birth, compared with the numbers of operas generated by Italian composers.

²⁴ Kimbell, *Italian Opera*, p. 419.

²⁵ Kimbell, *Italian Opera*, p. 433.

²⁶ J. Rosselli, *The Opera Industry in Italy from Cimarosa to Verdi: the Role of the Impresario* (Cambridge, 1984), p. 137.

²⁷ Dornic, ‘An Operatic Survey’, <http://opera.stanford.edu>

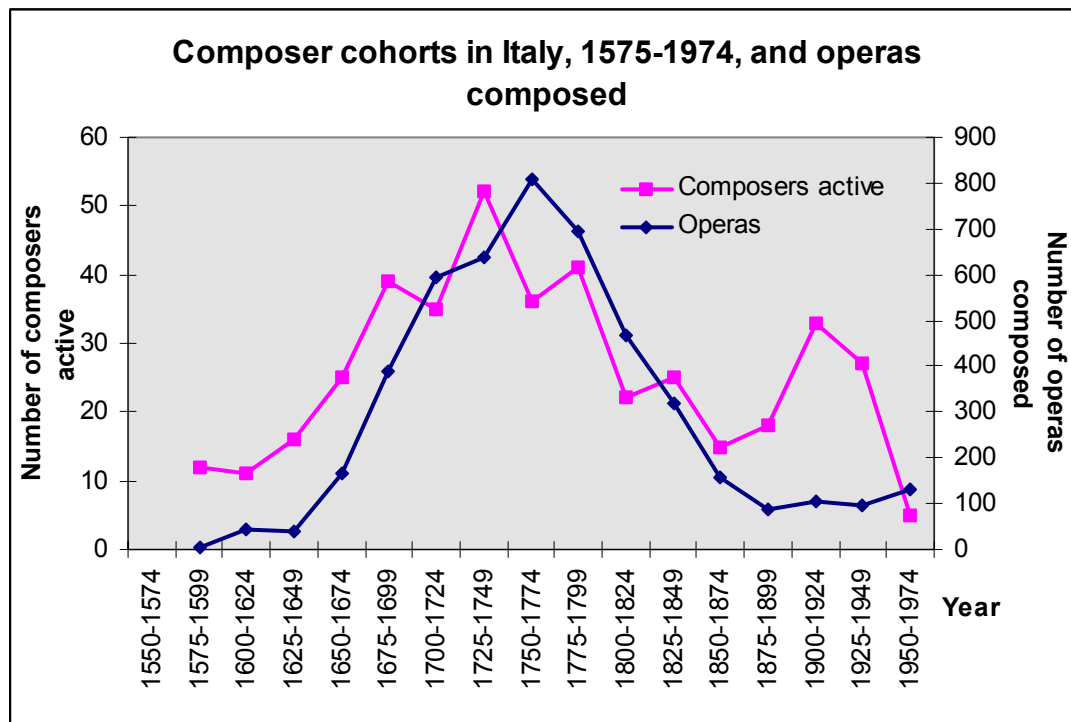


Figure 3: Composer cohorts compared against the numbers of operas composed. Source: OperaGlass.²⁸

The publisher Giulio Ricordi subsidised Puccini for nine years until he scored a hit with *Manon Lescaut*.²⁹ Furthermore, Italy had become more open to European influences and developed a taste for Parisian grand opera, the scale of which also demanded more careful composition. The resurgence of new operas after 1945 suggests a change in the nature of the good as it adapts to an age of mass entertainment. Premieres remain social highlights and a measure of public funding provides support. Furthermore, the Radiotelevisione Audizioni Italiana (RAI), the public broadcast service, is responsible for a significant proportion of twentieth-century works; it is part of its public service obligation to promote opera.³⁰

So, was opera in Italy a product of political competition or commercial vitality? It is a difficult question. It emerged in Florence, but did not flourish there to the extent that it did in the more ‘bourgeois’ Venice; however, the more ‘feudal’ Naples also sustained more opera. On the other hand, the Neapolitan drop-off after 1900 is sharp. Perhaps the more economically adaptive cities, or those more open to European influences, were better able to sustain opera in the longer run, as with Milan. Thus the relationship between ‘the court’ and ‘the market’ was perhaps symbiotic.

A further question is how the raw composition data relates to the current repertory – whether there is any relation between trends in the two patterns, and what determines a particular opera’s chances of securing a place in the core repertory. Figure 4 below

²⁸ The cohort is measured by counting the numbers of composers born in any quarter-century period and adding 25 to their year of birth, assuming they become mature composers and enter the market at the age of 25. This series does *not* measure the number of composers active in any one period which would require detailed knowledge of their working lives.

²⁹ J. Rosselli, *Music and Musicians in Nineteenth Century Italy* (London, 1991), p. 143.

³⁰ <http://www.segretariatosociale.rai.it/INGLESE/regolamenti/contrattoE.html>.

illustrates the shape of the current Italian repertory, by showing the number of performances for operas composed for five-yearly intervals. Figure 5 illustrates trends in opera composition against trends in ‘core repertory’ composition.

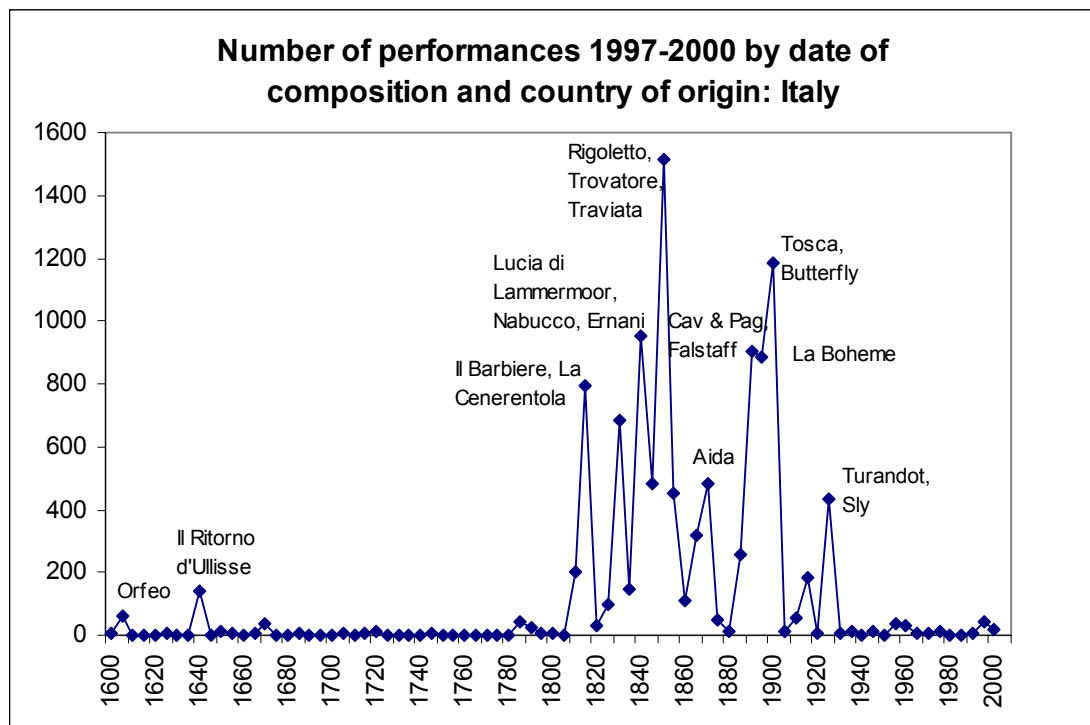


Figure 4: Number of performances 1997-1998 to 2000-2001 for each five-year period of composition in Italy. Source: *Music and Opera Around the World*.

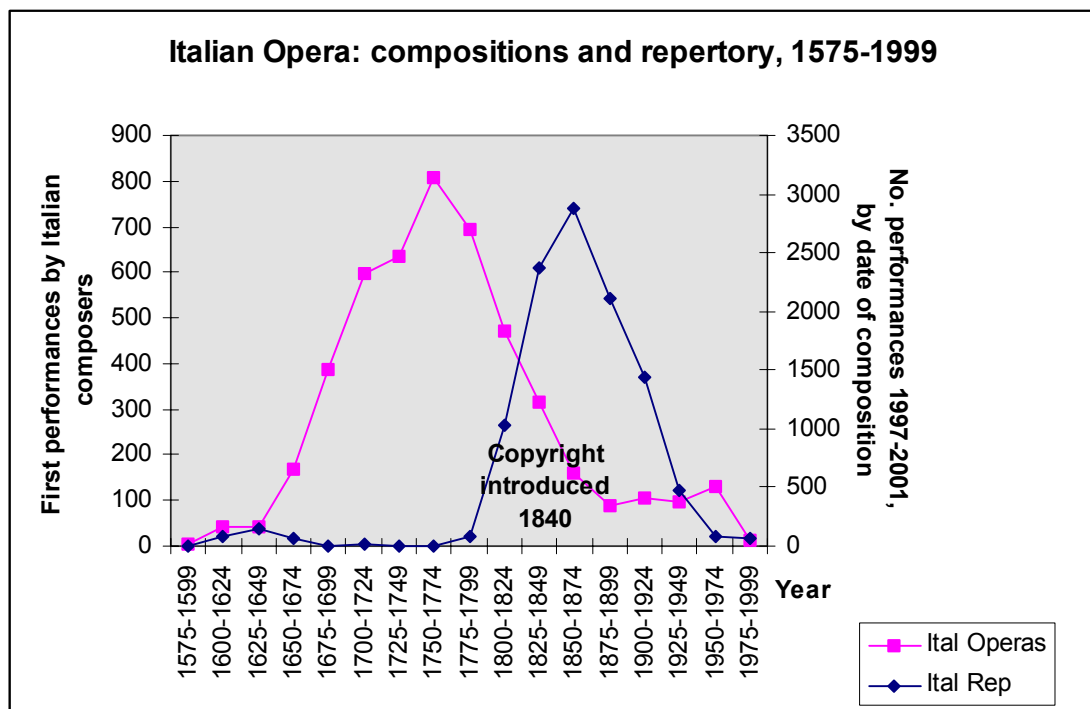


Figure 5: ‘Raw data’ of Italian opera compositions compared with the number of performances, by date of composition, for the present-day repertory. Source: OperaGlass and *Music and Opera Around the World*.

First, there appears to be a hundred-year ‘lag’ between the peak for all opera compositions and the peak for the operas in the current repertory, which peak is driven by eleven operas, ten of which are by Verdi. Secondly, the formation of the core repertory appears to occur just as the total number of operas composed is declining. There may be three reasons for this. First, the increasing need to cater to mass audiences without large-scale patronage means that long-term quality becomes important and so a small number of high-quality works is sought – namely, repertory opera is vertically differentiating from courtly *opera seria* and other popular entertainments. Secondly, the introduction of copyright makes protection of ‘quality’ possible. Thirdly, there may be a learning-by-doing effect; the operas dominating the genre, such as *Rigoletto*, *Il Trovatore* and *La Traviata*, are a product of the collective invention of almost three centuries of opera composers.

1.4 Diffusion beyond Italy.

The diffusion of opera beyond Italy largely followed royal marriages or other political occasions. It had appeal for European rulers: ‘opera seria was the representational genre par excellence, for it was grand, formal, classical, elitist, hierarchical, and ideally suited to the propagation of an absolutist political message’.³¹ The need for both a metropolitan audience and political patronage was key. While opera reached both the cosmopolitan Paris and London very quickly, Paris established permanent operatic institutions while London did not. This may partly have been due to the granting of a royal monopoly in France, unlike in Britain, where Handel faced fierce competition and his attempt to create a permanent subscription-funded company failed. This reflects differing levels of royal support, which depended largely on royal personality, although this in turn perhaps reflected different levels of power. For all the excess of the Restoration monarchs, it did not compare with the display and power of the *ancien régime*. For Germany, Hamburg’s early example fits with that of Venice, while Vienna, as the political and musical centre of the Austro-Hungarian empire, served as a musical hub serving Prague and Brno. Germany was slow to foster an indigenous tradition, with the various princely *Hauskapelle* focusing on Italian works, and travelling Italian troupes satisfying the commercial, impresario-directed market. There were attendant effects on repertory and style; the need to appeal to popular audiences led to a proliferation of ballad opera in England and Germany, while at the other end of the scale, focus on the royal court in France, reinforced by cultural mercantilism, led to the development of an elaborate and distinctive French style.

This graph below illustrates Italy’s leadership; only France provides any significant level of rivalry in terms of generating new works; in the eighteenth century royal glory was partly manifested through opera: ‘the whole genre of lyric tragedy, invented by Lully and continued with Rameau, was identified with the culture of Versailles’.³² Operatic institutions were sustained after the Revolution, and by the mid-nineteenth century Italian musicians were becoming aware of the challenge of French grand opera; the French investments had paid off with a distinct stylistic tradition, with Paris becoming in the nineteenth century ‘the operatic hub of the world’.³³ The pace of acceleration of opera in France, 1750-1800, mimics that of Italy. Until 1850-1874, Germany and Britain follow a similar diffusion pattern, but Germany suddenly accelerates as the nation becomes unified.

³¹ Blanning, *The Culture of Power*, p. 63.

³² Blanning, *The Culture of Power*, p. 361.

³³ D. Charlton with R. Langham Smith, ‘France’, in S. Sadie (ed.), *The New Grove Dictionary of Opera* (Oxford, 1992), accessed online at <http://www.grovemusic.com>.

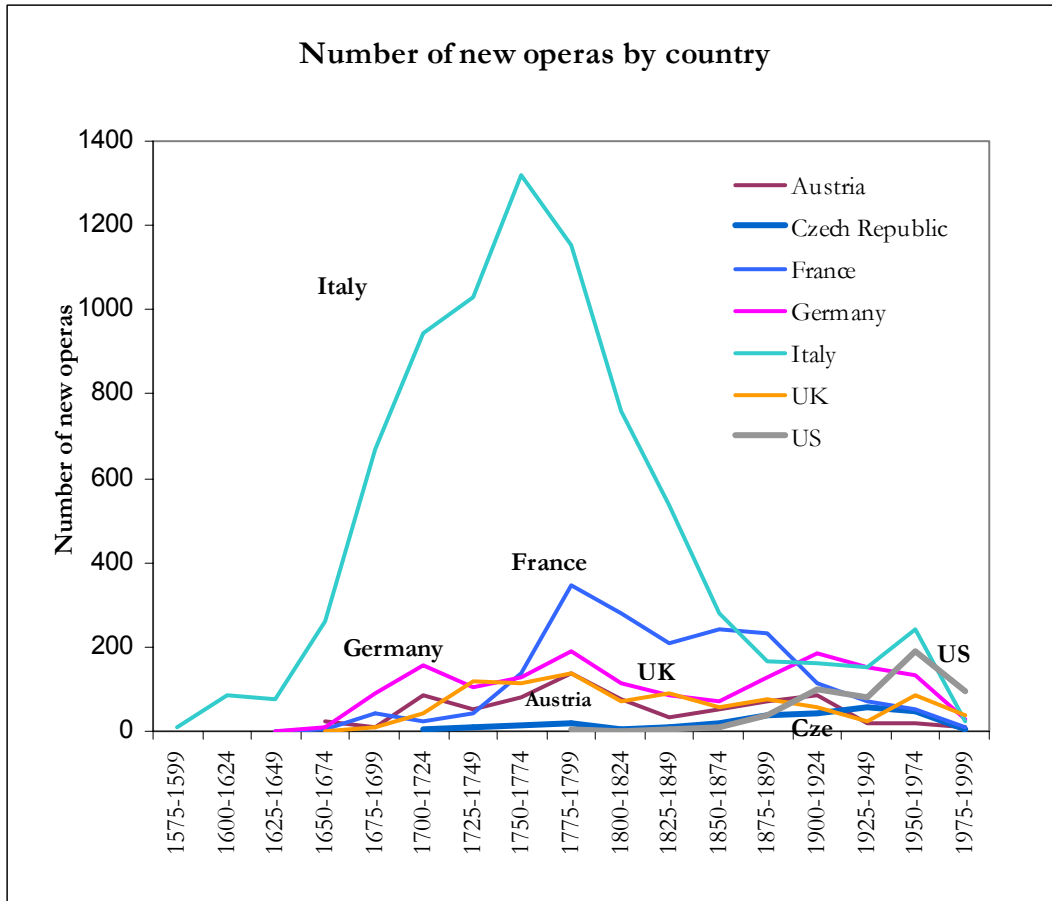


Figure 6: The diffusion of opera beyond Italy. Source: OperaGlass.

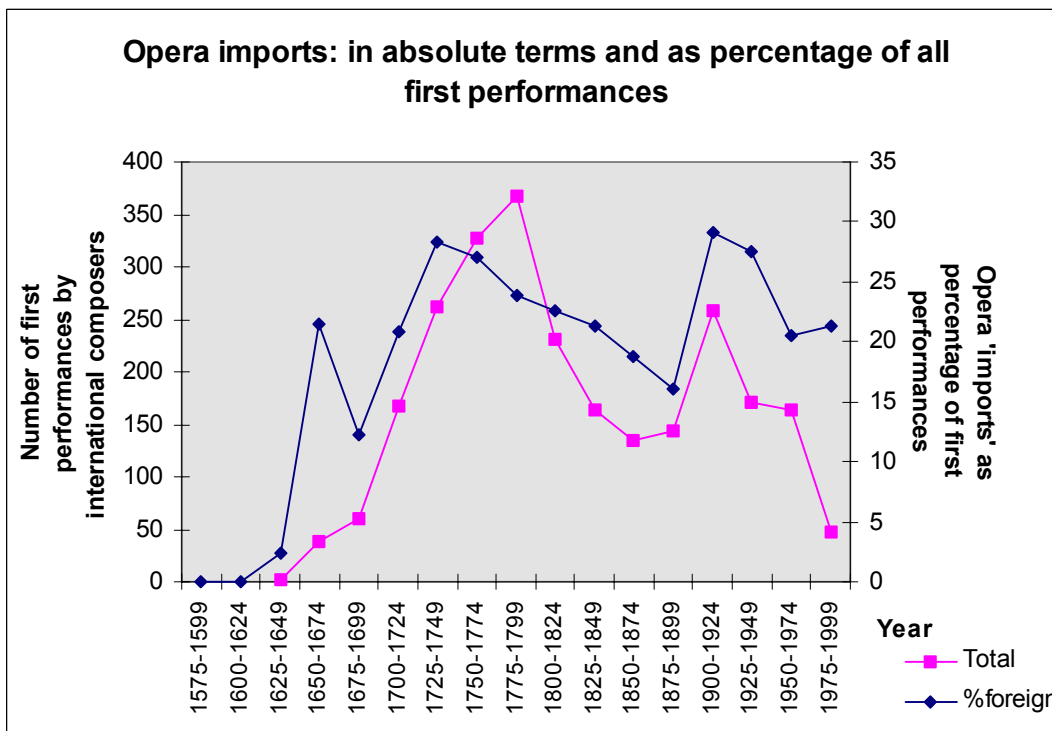


Figure 7: Percentage of worldwide opera first performances by composers born outside the country of first performance. Source: OperaGlass.

Furthermore, the second half of the nineteenth century beyond Italy witnesses a recovery in composition rates which perhaps reflects the growth of bourgeois audiences for opera or an increase in cultural nationalism. A ‘high nationalism’ effect can perhaps be seen in figure 7, which shows the absolute number of operas written by composers born outside the country of first performance (according to present-day boundaries) and as a percentage of all domestic first performances.

Analysis of the evolution of opera in Austria in particular is enlightening.³⁴ Vienna was well integrated into both German and Italian music networks. It was the capital of a large and diverse empire, drawing aristocratic patrons from all over Austria, Bohemia, Moravia, Slovakia, and Hungary. Joseph II’s liberalisation of theatrical competition, and attempt to satisfy both his own desire for a German-language tradition and the demand for high-quality Italian opera, led to a plurality of funding sources. Financial pressure on the Imperial household meant that the lavishness of, for example, the French monarchy, was not possible and composers had to compete for survival. Figure 8 below illustrates Austrian ‘operatic output’. The graph shows that opera in Austria was at first predominantly imported, and that a significant proportion of first performances in Austria were composed by non-Austrians. Since present-day boundaries were used to designate nationality, Czech, Hungarian and German composers are considered ‘foreign’ and so the openness is not surprising.

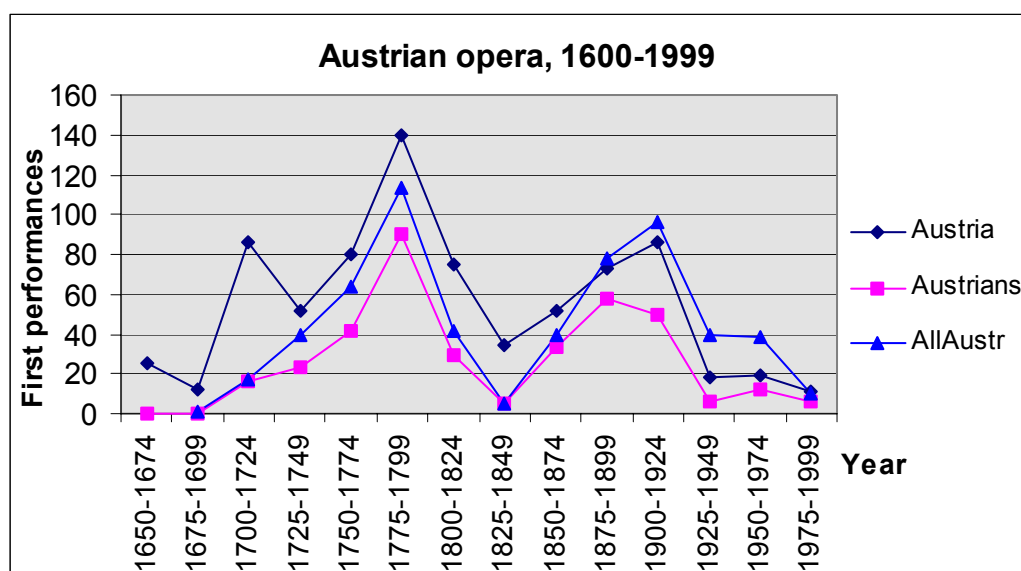


Figure 8: Total first performances in Austria, first performances by Austrian composers in Austria, and first performances by Austrian composers worldwide.

Mozart leads the operatic repertory in the *Music & Opera* dataset, with *Die Zauberflöte* performed 914 times over 1997-8 to 2000-1. *Le Nozze di Figaro* comes second with 787 performances. *Don Giovanni* is seventh and *Così fan tutte* twelfth. The particular economic and political circumstances of late eighteenth century Vienna may have contributed to this. The real cause of this Austrian dominance of the repertory may have simply been the singular genius of Mozart; the next highest ranking Austrian is Johann Strauss with *Die Fledermaus* (composed 1874) sixteenth. Nevertheless, the importance of a ‘thick market’ for talent may also have been crucial.

³⁴ Time and space prevent further examples.

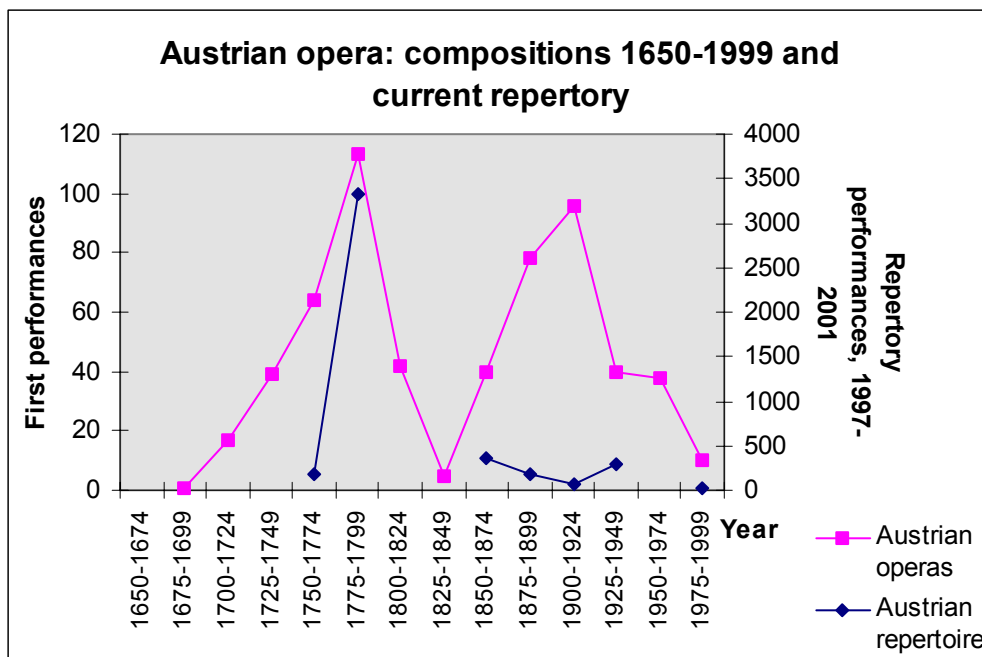


Figure 9: First performances by Austrian composers compared with the number of performances by composition date of Austrian operas in the current repertory.

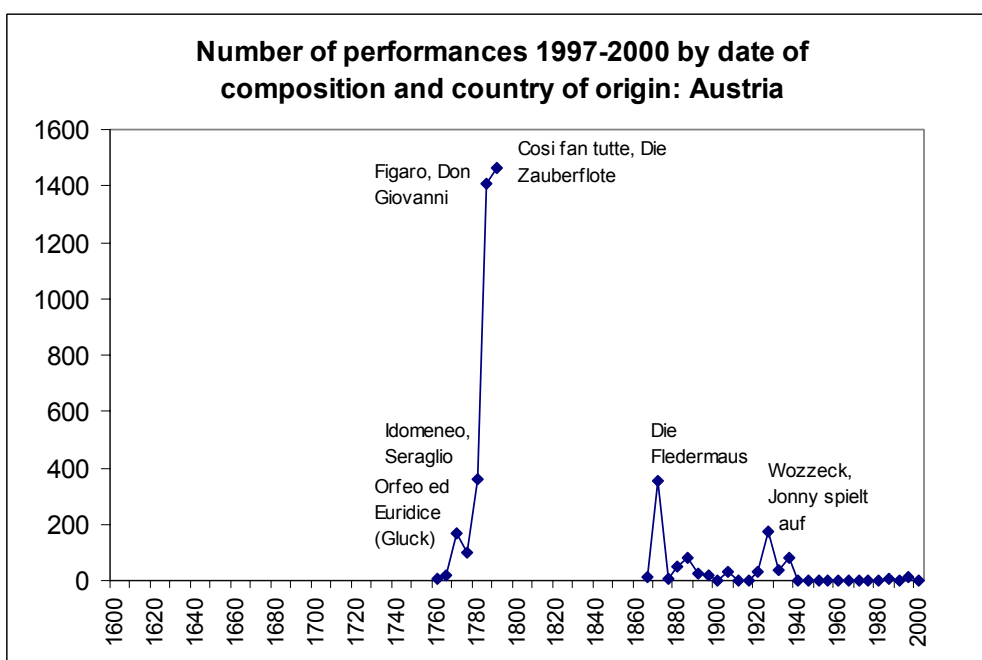


Figure 10: Number of performances 1997-1998 to 2000-2001 of Austrian operas by date of composition.

1.5 Growth of the 'operatic stock' and core repertory as a deterministic process

A simple examination of the aggregate Italian opera first performance data suggests a Gompertz process. Compared with logistic growth, the Gompertz model does not incorporate a symmetry restriction and has a shorter period of fast growth. Andersen argues that such an approach to individual technologies has been relatively neglected since Griliches' major study of hybrid seed corn: 'no recent efforts have been made to

study empirically the long term evolution paths of individual technologies starting with long time series'.³⁵ 'Thinking in S-shapes' is useful for analysis of technological take-off.

Cumulative compositions are used here as a broad measure of opera as a 'creative technology', where it includes the interaction between the universal, transferable element of operatic knowledge, the tacit element tied to local conditions and musical competence, and market diffusion.³⁶ While Andersen uses a logistic model – symmetric about the point of inflection – the cumulative opera series does not appear to demonstrate this property, implying that the stock of operas will continue to grow for the foreseeable future even if at a very slow rate. A Gompertz growth model is therefore applicable, here given by:

$$C(t) = a \exp(-b \exp[-c(t)])$$

$C(t)$ represents the accumulated operatic stock at time t , a represents the upper asymptote – the maximum stock of Italian operas – while b is the minimum and c the rate of growth coefficient through time. A nonlinear regression model was fitted to data extracted from OperaGlass and the following results obtained.

Table 1.1: Parameter estimates and goodness-of-fit for the Gompertz model of Italian opera growth.

Parameter	Estimate	Standard Error	95 % confidence intervals	
			Lower bound	Upper bound
a	3960.02	32.87	3889.51	4030.52
b	11.18	0.86	9.34	13.01
C	0.42	0.14	0.394	0.45
$R^2 = 0.999$				

A logistic model of the form

$$C(t) = \frac{a}{1 + \exp(b + ct)}$$

was also estimated.

Table 1.2: Parameter estimates and goodness-of-fit for the logistic model of Italian opera growth.

Parameter	Estimate	Standard Error	95 % confidence intervals	
			Lower bound	Upper bound
A	3828.08	32.69	3757.96	3898.2
B	83.349	13.19	55.05	111.65
C	0.669	0.25	0.615	0.72
$R^2 = 0.998$				

³⁵ B. Andersen, 'The Hunt for S-Shaped Growth Paths in Technological Innovation: A Patent Study', *Journal of Evolutionary Economics*, vol. 9 (1999), pp. 487-526, p. 488. Anderson applies the approach to US patent stock data for 1920- 1990.

³⁶ Andersen, 'Hunt for S -Shaped Growth Paths', p. 493.

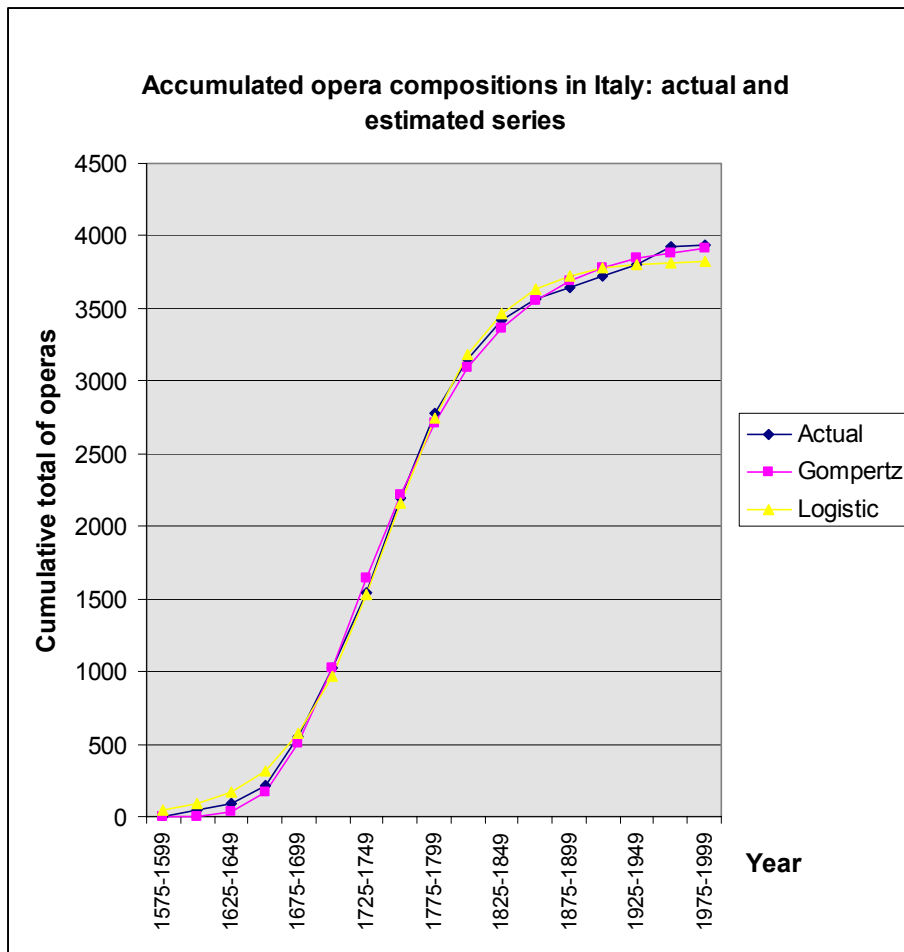


Figure 11: Gompertz and logistic curve estimates of cumulative Italian operas compared with actual data. Source: OperaGlass.

The results and above graph illustrate that opera compositions appear to follow a Gompertz growth model; the co-efficient of variation is smaller, the R^2 fractionally higher, and the estimate fits better visually than the logistic model.

A Gompertz model was also specified for other countries as reported below.³⁷

Table 1.3: Parameter estimates and goodness-of-fit for ‘operatic growth’ of various countries.

Country		Parameter <i>a</i>	Parameter <i>b</i>	Parameter <i>c</i>	<i>n</i>	R^2	
Austria	estimate	734.55	9.34	0.24	13	0.982	
	standard error	87.96	2.71	0.04			
	95% confidence intervals:						
	lower bound	538.56	3.30	0.14			
	upper bound	930.52	15.39	0.33			
Britain	estimate	676.57	12.35	0.27	14	0.992	
	standard error	43.72	2.80	0.03			
	95% confidence intervals:						
	lower bound	580.34	6.20	0.20			

³⁷ The results for the US and Russia were meaningless, probably because of the very small number of cases due to their later entry into the genre. For information, an exponential trend line fits the US series very well and a linear trend the Russian data.

	upper bound	772.8	18.50	0.34			
Czech	estimate	619.17	8.38	0.18	13	0.982	
	standard error	152.43	2.18	0.04			
	95% confidence intervals:						
	lower bound	279.53	3.53	0.08			
	upper bound	958.81	13.23	0.27			
France	estimate	1790.83	27.07	0.37	14	0.997	
	standard error	52.86	5.72	0.03			
	95% confidence intervals:						
	lower bound	1674.50	14.47	0.31			
	upper bound	1907.17	39.66	0.43			
Germany	estimate	1665.99	7.36	0.25	15	0.995	
	standard error	69.99	0.91	0.02			
	95% confidence intervals:						
	lower bound	1513.50	5.38	0.21			
	upper bound	1818.49	9.34	0.30			

Parameter a represents each country's 'operatic ceiling'; b the lower asymptote and c the growth rate. In some cases the standard errors are large – for example, the standard error for parameter a for the Czech territory – but those associated with parameter c are small and so we can have some confidence in these estimates of the 'growth rate' of opera in these countries. Notably, the French growth rate is the highest as predicted by the Epstein schema, followed by that of Britain, Germany, Austria and the Czech territories, in that order. The comparatively high b estimate for Britain predicts that opera made a strong entry, which is consistent with London's openness and wealth.

1.6 The core repertory

A final analysis of the 'repertory' data explains why it will be so difficult for any composer to break in at the level of the established 'stars', and why Mozart is so singular. The graph below illustrates the shape of the current repertory, that it is largely a product of the later nineteenth century and that operatic leadership has changed over time.

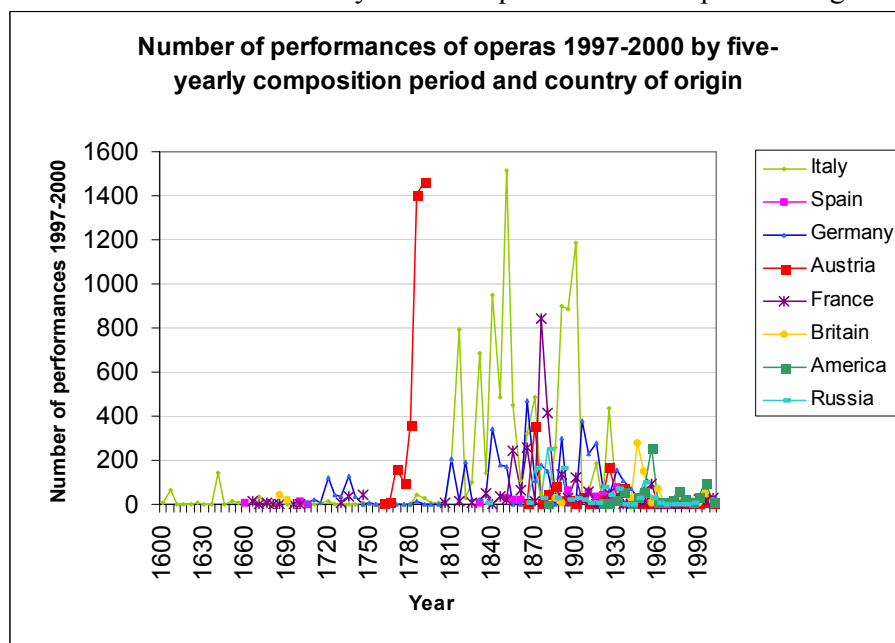


Figure 12: Number of performances 1997-1998 to 2000-2001 by five-yearly composition period and country of origin of the composer.

The 742 operas featured over the four seasons in *Music and Opera Around the World*, 1997-98 to 2000-1, were ranked according to number of performances featured. As predicted by the Paretian rule-of-thumb, the top 148 operas (19.9%) comprise 81.3% of performances.

The dominance of very popular operas and the wide dispersion in numbers of performances suggests that performances follow a power law distribution, and may possibly follow ‘Zipf’s law’. George Zipf was a linguistics professor who analysed the frequency of words in texts, and discovered a tight relationship. The frequency of words, s , is inversely proportional to its rank, r

$$s \sim r^{-b}$$

where $b \approx 1$. Zipf thence found this distribution in a variety of contexts, such as distribution of city sizes and incomes, and hypothesised a ‘law’ of human behaviour.³⁸ This is a particular form of the power law, a distribution function of the type

$$P(\text{Size} > S) \sim a / S^\rho$$

for large S . The positive number ρ is called the power law (sometimes Pareto law) exponent; Zipf’s law is that $\rho = 1$.³⁹ Figure 13 below illustrates the distribution of performances of the 742 operas listed in *Music and Opera Around the World*.⁴⁰

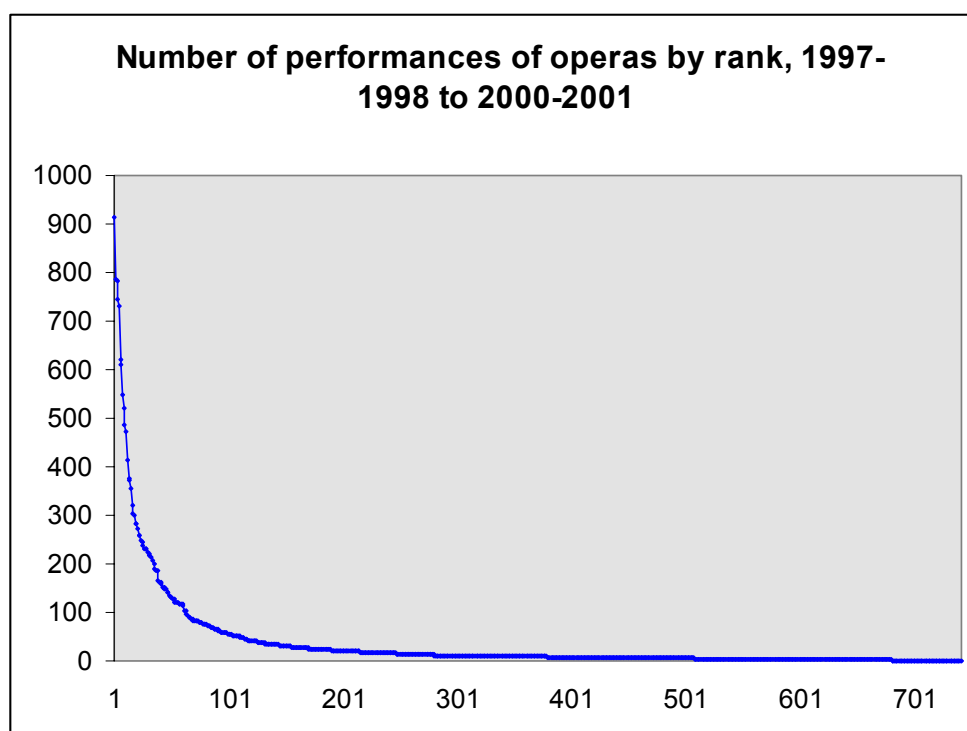


Figure 13: The rank-size distribution of performances, 1997-2001. Source: *Music and Opera Around the World*.

³⁸ A. Rapoport, ‘Zipf’s Law Re-visited’, in H. Guiter and M. V. Arapov (eds.), *Studies on Zipf’s Law* (Bochum, 1982), p. 1.

³⁹ X. Gabaix and Y. M. Ioannides, ‘The Evolution of City Size Distributions: An Explanation’, mimeo, NBER, MIT and Tufts University, August 2003, http://econ-www.mit.edu/faculty/download_pdf.php?id=528, p. 7.

⁴⁰ It is instructive to consider whether the number of performances of a particular opera is a true measure of ‘size’. Possible alternatives include number of recordings, audience numbers for each opera, number of references in the literature, or number of productions in a year. It might be expected that these differing measures of the ‘size’ of a particular opera might generate different estimates of the value of b .

The performance asymptotes do not appear to fit Zipf's Law quite so closely but this may be because the data for the most popular and least popular operas are censored. The small opera societies and festivals which are not featured in the catalogue are precisely those which are likely to rely heavily on both the popular and the esoteric, rather than 'middle' operas such as *Macbeth* (19) or *Norma* (37). Secondly, the high fixed costs of mounting a production mean that it is inefficient to produce an opera for only one performance, and so 1 is an unlikely frequency.⁴¹ Even then, one-off performances tend to be semi-staged concert performances, which is not a 'true' opera production. Thirdly, in the high arts diversity is perceived to be a virtue, which may explain why the values in the upper tail are lower than expected. Thus it may be that the 'true', underlying distribution is Zipfian but that factors particular to the high arts cause a measure of flattening.

The series diverges slightly from the best-fit power trend, for operas ranked above 30, with 230 performances (*Der Rosenkavalier*) and below the opera ranked 621 with 3 performances (*Till Eulenspiegel*). There are too few low- and high-performance operas; otherwise the power trend fits the overall series quite well, leading on to the question of the extent of skewness.⁴²

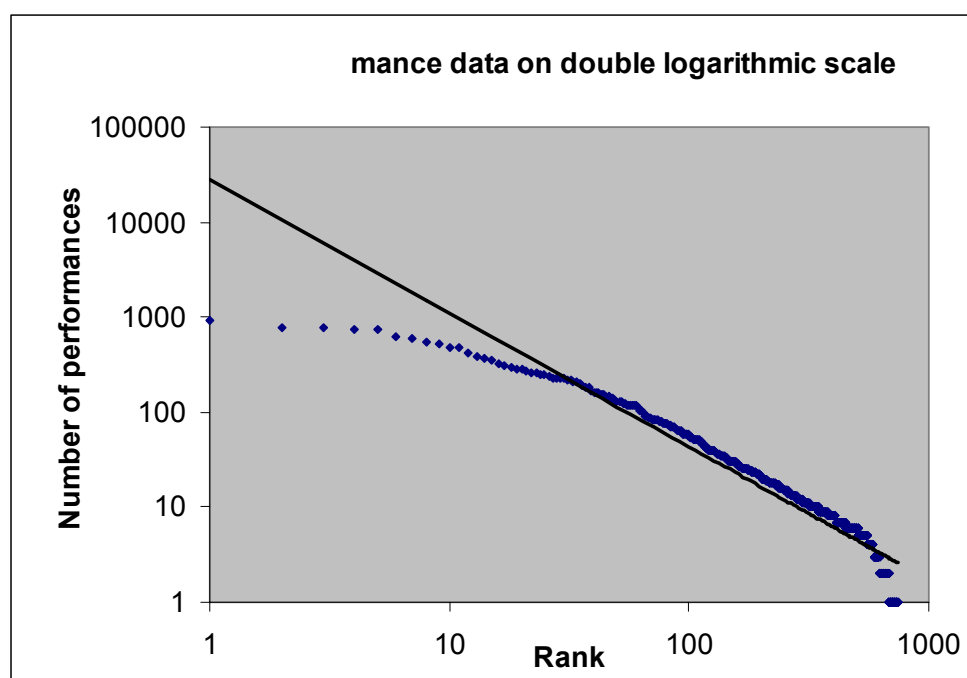


Figure 14: Opera performances, 1997-8 to 2000-1, plotted on double logarithmic scale.⁴³

Power-law scaling arises from various physical, biological and social processes and currently is in vogue for its apparent characterisation of internet connectivity and traffic. It has been suggested that the scaling arises from preferential attachment; the probability that a given node is connected with is proportional to its current connectivity. This leads to a 'winner takes all' star system. Rosen explains that rewards are concentrated on a few individuals because small differences in talent are disproportionately rewarded, partly

⁴¹ Note that the data have been aggregated so that a rank of 150 with 2 performances does not mean that the 2 performances are by the same opera company, or are in the same year.

⁴² Scherer did the same for his recordings data, reporting briefly that the distribution was 'less skew than the so-called Pareto distribution and more skew than the log normal distribution'. Scherer, *Quarter Notes and Bank Notes*, p. 9.

⁴³ NB: the fitted trend line is a power trend included purely for illustrative purposes.

because lesser talent is a poor substitute for greater talent.⁴⁴ Chung and Cox argue that the probability mechanism underlying the consumer's choice of artistic output is stochastic, so that artistic output is concentrated in a few lucky individuals even where talents are equal. Because consumers rely on others' information to become familiar with an artist before consumption, and to discuss the work after consumption, consumers choose the most popular artists, which reinforces their popularity.⁴⁵

Using OLS, the following regression was run on the complete set of performances, omitting the biased observations for operas receiving fewer than four performances:

$$\log \text{rank} = \log \alpha + \beta \log \text{performances}$$

Table 1.4: Regression analysis of performance data.

Parameter	Estimate	standard error	<i>t</i>	
α	7.638	0.019	410.637	$n = 588$
β	-0.796	0.006	-131.762	$R^2 = 0.967$

This was to test whether $\beta = -1$, taking this as a standard for a 'winner takes all' distribution of performances. The result is more skewed than the Zipfian distribution which supports the hypothesis that the operatic repertoire is heavily dominated by the core canon.⁴⁶ This also appears to be true when examining the data on a national level. Examining the distribution of opera performances by nationality of the opera's composer, we find the following results:

Table 1.5: Regression analysis of opera performance data selected by nationality of composer.

Nationality	Coefficient	Estimate	Standard error	<i>t</i>	
Austrian	α	4.809	0.051	94.09	$n = 47$
	β	-0.59	0.014	-40.81	$R^2 = 0.973$
Czech	α	4.334	0.165	26.244	$n = 21$
	β	-0.746	0.053	-13.943	$R^2 = 0.906$
French	α	5.398	0.051	104.887	$n = 64$
	β	-0.787	0.017	-45.935	$R^2 = 0.971$
German	α	5.722	0.061	94.117	$n = 100$
	β	-0.72	0.019	-37.295	$R^2 = 0.934$
Italian	α	5.977	0.053	112.951	$n = 135$
	β	-0.633	0.015	-42.287	$R^2 = 0.93$
British	α	4.811	0.054	89.202	$n = 33$
	β	-0.879	0.02	-44.233	$R^2 = 0.984$
American	α	5.651	0.071	79.687	$n = 44$
	β	-1.17	0.028	-41.341	$R^2 = 0.975$

For each national tradition by country of opera composition, there does appear to be a 'superstar effect' for individual works across countries. This may be even more stark when looking at the distribution of rewards, in terms of number of performances,

⁴⁴ S. Rosen, 'The Economics of Superstars', *American Economic Review*, 71/5 (1981), pp. 845-858.

⁴⁵ K. H. Chung and R. A. K. Cox, 'A Stochastic Model of Superstardom: An Application of the Yule Distribution', *Review of Economics and Statistics*, 76/4 (1994), pp. 771-775.

⁴⁶ If rank is expressed as a function of performances, the value of β is higher the higher the degree of skewness – for example, a sample with a β of -2 is more skewed than one with a β of -3. If the equation was estimated with performances expressed as a function of rank, the value of β would be lower the higher the degree of skewness, so that a sample with a β of -3 would be more skewed than a sample with a β of -2.

associated with individual composers, as shown below in the charts for Britain and Germany.⁴⁷

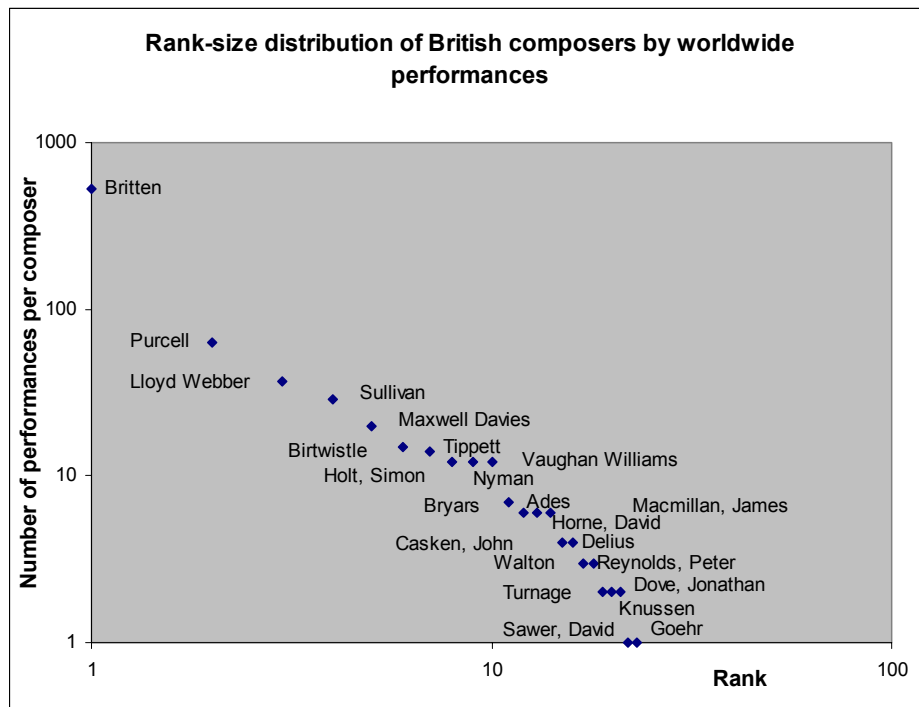


Figure 15: Rank-size distribution of British composers by number of performances of their works.

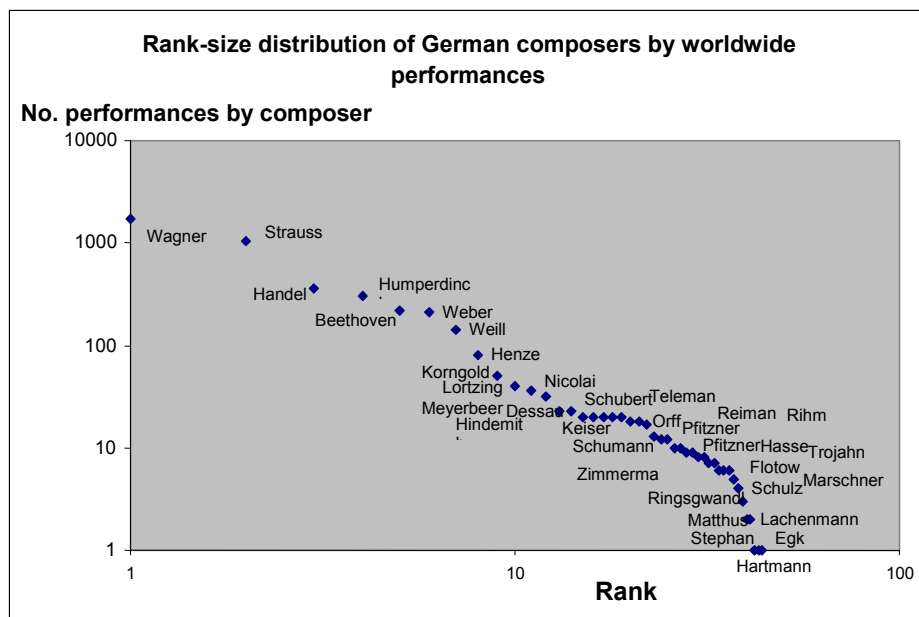


Figure 16: Rank-size distribution of German composers by number of performances of their works.

⁴⁷ Time and space constraints prevent further examples. The associated β coefficients for the inequality between composers, given by the number of performances each achieved between 1997-98 and 2000-01, was -0.626 for Britain and -0.574 for Germany. Again, composers achieving fewer than four performances were omitted, although presented in the graphs below.

Overall, the highest degree of inequality exists for Austrian and Italian operas, where markets for talent were more highly developed. However, a ‘winner takes all’ pattern also appears to exist for German, French and British operas. Inequality is least for America where the degree of skewness is less than the Zipfian distribution. This is slightly surprising; we would have expected that in the US the orientation towards the market encouraged the generation of ‘hits’. There may be two reasons for this counterintuitive result; first, composers who moved to the US as adults are coded by the country where they were born and educated, so that, for example, Kurt Weill’s operas composed for Broadway are considered to be ‘German’. Secondly, a large-scale public subsidy of a musical infrastructure – in terms of subsidising permanent opera companies and prestigious music schools – may be necessary to generate thick markets for talent which foster the competition leading to a ‘winner takes all’ phenomenon.

This leads on to the results in table 1.6 below, which examines the degree of inequality of opera performances by country of performance. All major opera houses will rely on the core repertory to a greater or lesser extent; the results below illustrate this extent. Thus Austria exhibits the lowest degree of inequality and the US the greatest. The top ten operas performed in France and Austria form a smaller proportion of the total (19% and 26% respectively) than the top ten in the UK (31%) or the US (33%).

Table 1.6: Regression analysis of opera performance data selected by location of performance.

Country	Coefficient	Estimate	Standard error	<i>t</i>	
Austria ⁴⁸	α	8.485	0.118	72.069	$n = 99$
	β	-1.69	0.04	-41.956	$R^2 = 0.947$
Czech Republic	α	5.48	0.121	45.193	$n = 48$
	β	-0.964	0.044	-22.131	$R^2 = 0.912$
France	α	7.43	0.067	111.617	$n = 178$
	β	-1.35	0.027	-50.421	$R^2 = 0.935$
Germany	α	6.956	0.066	105.955	$n = 178$
	β	-0.910	0.021	-44.181	$R^2 = 0.917$
Italy	α	7.182	93.303	93.303	$n = 144$
	β	-1.371	-43.063	-43.063	$R^2 = 0.928$
UK	α	6.861	0.085	80.844	$n = 100$
	β	-1.272	0.032	-39.425	$R^2 = 0.94$
US	α	6.721	0.056	120.868	$n = 157$
	β	-0.998	0.020	-50.301	$R^2 = 0.942$

The ‘top ten’ positions are not uniform across countries so that the winner does not take all in each national market. However, while Austria favours Austrian opera, France French and Italy Italian opera, a clutch of operas tend to make the top ten positions in each country, particularly Mozart’s *Figaro*, *Die Zauberflöte* and *Don Giovanni*, and Bizet’s *Carmen*. This is probably the reason for Mozart’s dominance of the world table; while not always the most favoured composer, he is favoured consistently across countries.

A tentative suggestion is that the increased equality of distribution between performances in Austria, France, Italy and Britain may be due to the effects of arts subsidy and in promoting repertory diversity. However, this does not hold for Germany, where it might be thought that relatively lavish funding would lead to higher equality between

⁴⁸ For this regression, the data for operas performed in Austria exhibited a distinctive pattern in that there were too few operas receiving less than 8 performances. Therefore these observations were omitted from the analysis.

performances. It is more understandable why the more market-oriented US opera houses depend more heavily on the core repertory.

The data were finally analysed to investigate the *period* when the ‘winner takes all’ phenomenon was greatest. The operas were sorted into half-century cohorts, and the log of the rank was regressed on performance numbers of operas by date of opera’s composition. The results are given in table 1.7.

Table 1.7: Regression analysis of opera performance data selected by period of composition.

Date composed	Coefficient	Estimate	Standard error	<i>t</i>	
1650-99	α	4.247	-0.187	22.671	$n = 12$
	β	-1.117	0.078	-14.286	$R^2 = 0.949$
1700-49	α	4.736	0.11	43.126	$n = 28$
	β	-0.929	0.042	-22.296	$R^2 = 0.948$
1750-99	α	4.285	0.065	66.109	$n = 33$
	β	-0.533	0.018	-29.292	$R^2 = 0.964$
1800-49	A	5.509	0.08	68.963	$n = 75$
	β	-0.672	0.023	-29.042	$R^2 = 0.919$
1850-99	A	5.974	0.073	51.949	$n = 114$
	β	-0.638	0.02	-32.445	$R^2 = 0.903$
1900-49	A	6.329	0.042	150.299	$n = 142$
	β	-0.807	0.013	-59.93	$R^2 = 0.962$
1950-99	A	7.261	0.036	200.334	$n = 178$
	β	-1.379	0.016	-88.286	$R^2 = 0.978$

The results imply a pattern of increasing inequality followed by decreasing inequality over time, possibly following the growth and decline of opera as a cultural force; contemporary and seventeenth-century works tend to be included in the repertory because they are historically interesting rather than standard works. The ‘winner takes all’ phenomenon appears to be most prevalent in the 1750-99 period, which was when Mozart was active, and when the international market for talent was perhaps most ‘thick’. However, the expected finding that late-nineteenth century compositions would exhibit greater equality due to effects of cultural nationalism does not come through. This may be because the data are not sufficiently disaggregated. It also may be because the 1850-99 period, when national traditions were promoted heavily, generated ‘winner takes all’ type patterns within each country. Examining the data graphically, the inequality for the highest 37 operas is less than that for the following 77. There may be a threshold effect at work, so that operas which reached the top 37 were ‘winners’ in their own national markets, and there is relative equality between these winners; but their winning was generated by strong competition within the national market, thus causing the higher inequality between the operas ranked 38 to 114.

1.7 Conclusion

This paper suggests that applying an evolutionary approach, using insights from the economics of technology, might be enlightening when examining the invention of opera and its diffusion across Europe. Opera was a technology which was generated in a city-state environment, but the standard was refined in the more commercial states of Venice and Milan. Beyond Italy, the absolutist regime of France came closest to challenging Italian dominance and diffused opera most rapidly.⁴⁹ The raw composition data suggests

⁴⁹ Comparison of ‘raw’ composition data with the current repertory illustrates however that the current French repertory is based on operas composed between 1850 and 1899 – the lavish support for French opera before 1850 did not lead to many compositions achieving lasting operatic success. With the

that Austria, Germany and Britain surprisingly exhibited similar trends, with Germany's influence as 'das Land der Musik' due to a surge in composition in the 1875-1924 period, and Austria's leadership of the core repertory resting on the leadership of Mozart. At present, the US has world leadership in opera composition, although Russia has also exhibited notable success; its operas achieved places in the current repertory as soon as its composers began working in the genre. In terms of the current repertoire, even Britain has its period of leadership following a period of cultural catch-up, with performances of British operas leading the 1945-1949 composition period due to the popularity of Benjamin Britten.

In terms of the determinants of operatic popularity, the conditions for lasting success appear to rest on thick markets for talent, whether state-sponsored or deriving from the expansion of middle-class audiences; quality improvements associated with the introduction of copyright; and a measure of 'collective invention'. Inequality in performances for operas by country of composition appear to rest on the quality of musical infrastructure, whereas inequality in performances for operas by country of performance appears to rest on the extent of reliance on the market. Further work remains to shed light on the differences between 'raw' composition rates and the current repertory, and what determined the likelihood of a given work having reached the current repertory.