Struggles and Symphonies: Does Money Affect Creativity in the History of Western Classical Music?*

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November 19, 2025

Abstract

How do financial constraints affect individual creativity, the fundamental source of innovation? We address this question using evidence from Western classical composers, a uniquely well-documented group of creative producers. Drawing on a new annual panel dataset of 172 composers spanning 1750–2005, we link text-based indicators of financial circumstances from *Grove Music Online* to measures of creative output. We find that composers produce about 16 percent less output in low-income years, and the works they compose are roughly 50 percent less popular on Spotify and generate 14 percent fewer Google search results. These effects are stronger among composers from less affluent backgrounds and among those who relied on teaching to support themselves, consistent with access to financial resources buffering creative effort against income shocks. We also show that composers who spent more of their lives in low income exhibit lower stylistic originality, suggesting that chronic financial constraint discourages risk-taking. Together, the results highlight the importance of financial stability in sustaining creativity and innovation at the individual level.

Keywords: creativity, innovation, income, financial constraints, music history
JEL Codes: D31, G50, J24, L26, N30, O31, Z11

*We are grateful to Joshua Angrist, Emily Beam, Lee Benham, Roger Myerson, Antoinette Schoar, Richard Sicotte, Xuan Tian, participants at the 8th Lindau Nobel Meeting in Economic Sciences, the University of Galway Workshop on Quantitative Approaches to Creativity, the 2025 Association for Cultural Economics International conference in Rotterdam, the 2024 European Workshop on Applied Cultural Economics in Segovia, as well as seminar participants at Tsinghua University, Fudan University, Renmin University, Nottingham University Business School, and University of Limerick for helpful comments on earlier versions of this paper.

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When bankers get together for dinner, they discuss art; when artists get together for dinner, they discuss money.

Oscar Wilde

I pray to God every day to (...) enable me to prosper and make plenty of money, that I may extricate you from your present emergencies, and also to permit us to meet soon, and to live together happily and contentedly.

Wolfgang Amadeus Mozart, 1778

I understand no currency but Vienna ducats (...) for really I am a very bad man of business and accountant.

Ludwig van Beethoven, 1801

If such be the case I would take suitable measures for the success of this work, on occasion of which I should naturally have to make a considerable outlay of time and money, so that I should not be disposed to run any risk without the guarantee of proportionate receipts from the sale of the work (...)

Franz Liszt, 1850

1 Introduction

Does money matter for innovation and creativity? A large literature finds that access to finance is positively related to innovation activities—such as research and development investment and patenting—when examined at the firm and regional levels (e.g., Amore et al., 2013; Hsu et al., 2014; Kortum and Lerner, 2000). Prior work also documents that people from wealthier backgrounds are more likely to pursue careers demanding high levels of creativity and innovation (e.g., Akcigit et al., 2017; Aghion et al., 2017; Bell et al., 2019; Borowiecki and Dahl, 2021).[1] However, we know remarkably little about how finance (especially financial constraints) shape

[1] A related literature finds that scientists, especially successful ones, are disproportionately drawn from high socioeconomic backgrounds. See Airoldi and Moser (2024) and Novosad et al. (2024).

individual creativity, a foundational input into innovative activity. Two obstacles help explain this gap. First, most innovation measures, especially patents, blend individual creativity with firm R&D resources, organizational priorities, and institutional factors, making it difficult to isolate how personal financial conditions affect creativity.[2] Second, individual-level data linking creator's financial circumstances to their output are rarely available, limiting our ability to study how income fluctuations affect creative effort. This lack of evidence is important because creative work is time-intensive and risky—especially when it departs from established conventions—so financial constraints may meaningfully distort the allocation of effort toward safer, more commercially predictable activities.

We explore this question by examining a historically important but relatively under-studied group of innovators: Western classical composers.[3] As figures who pushed the boundaries of musical form, orchestration, tonality, and emotional expression, composers like Wolfgang Amadeus Mozart, Ludwig van Beethoven, Richard Wagner, and Arnold Schoenberg stand as some of the most celebrated creative minds in Western civilization. Yet, despite their lasting cultural legacy, many composers (e.g., Franz Schubert) struggled financially, facing periods of low income that may have influenced their creative output. Musical composition, like other forms of creative production, required substantial investments of time and money—copying parts, hiring musicians for trial performances, and securing access to instruments or performance venues—as well as a willingness to take risks. Financial shortfalls could therefore directly constrain creative activity by limiting opportunities to experiment, complete new works, or stage performances. Conversely, steady income or access to finance, defined here as the availability of financial support through savings, family wealth, or informal borrowing, likely enabled greater

[2] In the innovation literature, patent citations are frequently used to capture the importance and quality of new inventions, but this metric has widely recognized limitations, including the strategic use of the patent system, differences in citation patterns across industries, the truncation issues, and systematic differences across applicants in the search for and disclosure of prior art (see, for instance, Hall et al., 2005; Sampat, 2010; Abrams et al., 2013; Kuhn et al., 2020; Lerner and Seru, 2022).

[3] In economics, *creativity* usually refers to the generation of novel ideas, while *innovation* is the practical application of these ideas in ways that drive change, add value, and stimulate economic growth (for instance, see Schumpeter, 1942; Nelson and Winter, 1982; Mokyr, 1992; Baumol, 2002). By this definition, composers might more accurately be described as creatives, given their primary role in conceiving original music rather than directly applying it within commercial or technological contexts. However, creativity and innovation frequently overlap: the act of composition often involves adapting existing forms, experimenting with new techniques, and responding to changes in tastes or economic conditions, activities that blur the line between generating ideas and implementing them. Furthermore, creatives and innovators face similar incentives and constraints, such as the need for financial support, recognition, and the ability to navigate between originality and accessibility. In addition, the production of new ideas by individuals (i.e., creativity) is by nature the source of all innovation. Accordingly, we will refer to composers as both creatives and innovators, and suggest that the insights gained from their experiences apply to both roles.

freedom to experiment and take artistic risks.[4] Because composers lived in an era with limited credit, insurance, and welfare systems, variation in income provides a natural lens through which to study how financial conditions shape creativity at the individual level.

To formalize these ideas, we develop a simple conceptual framework in which composers allocate limited financial resources between consumption and creativity. In this setting, income matters not only for consumption but also because composing music entails financial outlays (such as copying parts, renting rehearsal venues, hiring musicians for read-throughs, and sacrificing opportunities for paid work). When income falls and financial constraints bind, composers may reallocate time toward more reliable income-generating activities such as teaching, leaving less time for composing and thereby limiting the quantity and quality of creative output. Alternative sources of finance, through savings or family support, relaxes these constraints, allowing creative activity to be smoothed across time. The model yields two key predictions. First, creative output should fall in the short run during periods of low income, as temporary shortfalls constrain resources for artistic production. Second, the effect of income fluctuations should be larger for the composers who lack sufficient savings or alternative sources of support. This framework provides an empirical roadmap for the analyses that follow, linking observable financial circumstances to measurable dimensions of creativity.

To test these predictions, we assemble a novel annual panel dataset of 172 Western classical composers who lived between 1750 and 2005, combining rich biographical information from *Grove Music Online* with detailed and complete records of their compositions. The final dataset is a 10,842 composer-year panel that allows us to track annual fluctuations in both financial circumstances and creative output. Because the data follow composers over time, we can exploit within-composer variation, ensuring that our estimates are not confounded by unobserved, time-invariant characteristics such as innate ability, background, or talent. While precise monetary measures of income and wealth are unavailable for most composers, we infer composers' annual financial circumstances—and, by extension, access to finance—from detailed biographies

[4]In the literature, "access to finance" for firms typically refers to the availability of funding sources such as internal resources (e.g., retained earnings) and external finance (e.g., bank credit, equity financing, or venture capital). For individuals, it denotes income ("internal resources"), access to financial institutions (e.g., banks), or informal borrowing from family or community networks. In our historical context, banking markets were underdeveloped, and other formal financial services, such as insurance, were largely unavailable. As a result, the primary source of finance for composers came from their own income, family wealth or inheritance, with supplemental support occasionally provided by patrons or friends. Family resources could function both as liquidity—through direct transfers or inheritances—and as informal credit—through temporary loans or advances—underscoring the critical role of socioeconomic background in shaping composers' financial stability and creative opportunities.

compiled in *Grove Music Online*. These entries typically divide a composer's life into short periods (usually two to six years) and describe the composer's financial situation in each one (e.g., "prosperous," "struggling," or "in debt"). We use this information to classify each period as either *Low income* (financially struggling) or *High income* (financially prosperous); the omitted category consists of the "financially normal" years in which the biographies report no unusual financial conditions.[5] We also collect cross-sectional information on family background, such as fathers' occupations and indications of childhood poverty, which serve as proxies for access to finance through family wealth.

In the spirit of the innovation literature, which treats patents as observable manifestations of inventive activity, we view each musical composition as the tangible expression of individual creative effort—undertaken without firm-level R&D support—and measure creativity along three observable dimensions: the quantity of output, the perceived significance (or "quality") of that output, and its stylistic originality. The quantitative dimension captures how much creative work an individual produces, measured by the number or total duration of compositions completed in a year. The qualitative dimension—Spotify popularity scores and Google search results for the works produced in a given year—reflects the subsequent reception and visibility of that output. A third dimension, originality, reflects stylistic novelty, or the extent to which a composer's musical language diverges from prevailing conventions. Because each dimension of creativity requires time, skill, and material resources, financial constraints can limit not only how much an individual produces but also the refinement and stylistic ambition of the work.

Our empirical setting offers several advantages for studying how financial conditions shape creativity. First, music historians and biographers have meticulously documented composers' lives, providing detailed information on employment histories, patronage relationships, and socioeconomic backgrounds—detail that is rarely available for modern innovators or artists.

[5]For each period, we classify a composer's financial situation using two independent approaches. The first is an AI-based method in which a large language model assigns financial-status labels based on the composer's biography. The second is a human-based method carried out by a team of research assistants. We cross-check the classifications generated by the AI model and by each assistant. In the human-based coding, we rely on a dictionary of financial descriptors and assign income categories only when the language clearly refers to financial conditions, rather than unrelated circumstances such as "struggling with poor health" or "a poor relationship." See Section 3 and Appendix A. While these biographical sources provide unusually rich contextual detail, any text-based measure inevitably contains measurement error, which likely biases our estimated effects toward zero. For a subset of composers, we also draw on supplementary sources that offer time-varying evidence on financial circumstances, including a rare monetary income series for Mozart and text-based indicators of financial concerns derived from the correspondence of Mozart, Beethoven, and Liszt. These provide alternative measures of financial constraint that complement our qualitative coding of income and access to finance.

These sources allow us, for the first time, to quantify historical variation in both income and access to finance. Second, because most composers lived before the advent of social insurance systems, financial shocks would have been felt more acutely, permitting a cleaner observation of how income fluctuations affected personal finances and, in turn, creative activity. Third, unlike many other kinds of innovators, composers' creative output is exceptionally well documented: we can observe the number of works completed each year as well as indicators of their quality and enduring appeal, such as Google search visibility and Spotify popularity. Fourth, the stylistic features of compositions can be analyzed to assess originality, capturing how distinct a work is relative to prior compositions. Finally, because all composers in our sample are long deceased, their output has had sufficient time to be performed, recorded, and evaluated, helping to avoid the truncation problem common in patent-based measures, where the ultimate significance of recent work is not yet known (Lerner and Seru, 2022). Taken together, this combination of biographical, financial, and output data provides an unusually comprehensive foundation for examining how financial constraints shaped creative effort over time.

We begin by estimating linear models on our composer–year panel that regress the creativity measures on indicators for low- and high-income periods, including individual and year fixed effects. These specifications compare a composer's creativity in low-income years to that in financially normal years. To avoid confounding income effects with natural career progression—given that income fluctuations may coincide with life-cycle patterns in artistic development—we control for career stage (age and age squared, with robustness checks using age dummies). We find a robust negative correlation between periods of low income and the quantity and quality of a composer's creative work. Relative to the sample mean, composers produce 15.7 percent less output in low income years; additionally, the work they produce in low income years is associated with substantially fewer Google search results and lower values on Spotify's popularity score, indicating that it is less appealing and of lower overall significance. These patterns are consistent with the first prediction of our conceptual framework: when income declines and financial constraints bind, composers reallocate limited resources away from creative investment, leading to reductions in the quantity and quality of output. Our main findings remain robust to alternative variable definitions, alternative model specifications, and subsamples.

Although the baseline results suggest a negative relationship between personal financial

struggle and creative output, income is not strictly exogenous: higher musical output could increase earnings, and unobserved advantages—such as patronage relationships, residence in a musical hub, or access to publishers—might affect both creativity and income. Several considerations and identification strategies, however, help mitigate these endogeneity concerns. First, historically, composers were rarely paid contemporaneously for new works. Payments from publishers or performances often arrived months or even years later, meaning that income in a given year largely reflects broader financial circumstances rather than the immediate success of recent compositions.[6] These temporal lags between creative effort and remuneration make reverse causality unlikely. To directly test this concern, we estimate an event-study specification around the start of low-income spells and find no pre-trend in creative output, reinforcing the interpretation that the primary direction of causality runs from income to creativity.

Second, to address concerns about omitted variables, we include a range of additional controls and fixed effects—patronage and freelance status, the number of composers in a composer's resident city (capturing the scale of the professional network), city fixed effects, city–half-century fixed effects, and country–year fixed effects—and re-estimate the baseline specifications. The results remain largely unchanged. Third, we implement an instrumental-variables approach to address remaining identification concerns. The instrument exploits plausibly exogenous variation arising from the staggered introduction of publication protection at the country–year level and pre-policy differences in patronage status across composers. Using this instrument, we again find negative and statistically significant effects of financial struggle on creative output.

In summary, these complementary pieces of evidence consistently indicate that low-income circumstances depress a composer's creativity. Although each test may be open to alternative interpretations, the overall pattern is difficult to reconcile with specific competing explanations, suggesting that our baseline findings are unlikely to be driven by endogeneity.

The second prediction of our conceptual framework is that the creative impact of financial constraints should be weaker for individuals with greater access to financial resources. We test this by examining the cross-sectional heterogeneity in the effect of financial constraints on creativity. Consistent with the framework, the negative effect is substantially weaker among

[6]For instance, Mozart routinely earned income from performances of his works long after their composition, while Beethoven and Liszt typically received publication or performance fees only after their works were completed and circulated. Similarly, Tchaikovsky's regular support from Nadezhda von Meck provided financial stability largely independent of his annual output.

composers from more affluent backgrounds, who could smooth resources over time, highlighting the intensive-margin implication that financial constraints amplify the impact of income fluctuations on creativity. We also find that composers who relied on teaching to supplement their earnings—indicating fewer alternative financial resources—experience larger declines in creative output during low-income years, strengthening the evidence for this channel. These findings underscore the importance of access to finance in sustaining creativity and support the view that financial stability enables the continued pursuit of high-quality work. If low income merely reflected persistent differences in ability or career opportunity, such differential sensitivity would not arise. Combined with the event-study evidence showing no decline in creativity prior to the onset of low-income periods, these heterogeneity patterns help alleviate concerns about omitted variables and strengthen the interpretation that financial constraints reduce creative output.

Having established that low income depresses creative output, we next examine plausible mechanisms underlying the baseline results. Our theoretical framework highlights two empirically testable channels linking financial constraints to creativity. The first concerns time allocation in creative production. When income is low and composers must devote more hours to income-earning activities such as teaching, the time available for composition becomes more limited. Under these conditions, composers are expected both to scale down their creative projects and to experience larger reductions in output when teaching obligations are greater. Consistent with these predictions, we show that works composed during low-income years tend to be smaller in scale, and that the negative effects of low income are substantially larger in years when composers teach or teach more intensively.

The second mechanism concerns how income shortfalls interact with the riskiness of a composer's creative portfolio. Composers differ substantially in the extent to which their music explores broad emotional and expressive ranges. Creative strategies that push into extreme contrasts of mood or intensity often involve more iterative experimentation, higher uncertainty about eventual audience reception, and longer development horizons, making them financially riskier to pursue.[7] Because the commercial payoff of such exploratory work is uncertain and can be slow to materialize, composers who favor these more variable creative approaches are more exposed to the adverse consequences of income fluctuations. To evaluate this idea, we proxy

[7] On uncertainty in creative demand, see Caves (2000). On long gestation and the volatility of success in creative careers, see Menger (1999).

a composer's propensity for risk taking (or expressive experimentation) using audio-analysis metrics provided by Spotify. Consistent with this mechanism, we find that the negative effects of low income on creative output are significantly larger among composers whose music exhibits greater lifetime variability in expressive characteristics.

Finally, we analyze how the share of a composer's career spent in low income years relates to stylistic originality—the distinctiveness of a composer's musical language relative to contemporaries. This test captures a different dimension of creativity: not temporary adjustments in scale or form, but cumulative experimentation and risk-taking over a career. Consistent with the dynamic logic of our framework, we find that composers who spent a larger proportion of their lives in low-income produced music that was, on average, less stylistically original. To further probe this relationship and address concerns that cross-sectional differences in talent or opportunity might drive the results, we complement this analysis with within-composer case studies of Mozart, Beethoven, and Liszt, linking stylistic originality to independently observed time-varying fluctuations in their financial circumstances, including a rare monetary income series for Mozart (Baumol and Baumol, 1994) and text-based indicators of financial concerns derived from their correspondence (Borowiecki, 2017). Together, these results suggest that adverse financial conditions constrain not only the quantity and quality of creative output, but also sustained creative experimentation and originality.

Although our setting is historical, the economic forces we study are not. Like today's writers, performing artists, designers, and inventors, classical composers worked in an environment marked by volatile earnings, delayed and uncertain payoffs, and limited opportunities to secure financial support. Creative work in any field requires substantial training and sustained intellectual effort, and these common features imply that the empirical relationship we document between financial security and creativity speaks to a broader class of creative and innovative workers. At the same time, we recognize important differences in institutional conditions: historical composers operated in an era with underdeveloped credit markets and virtually no social insurance, and the processes that generate innovative ideas in science or technology differ in important ways from artistic production. Our findings should therefore be interpreted as illustrating how financial conditions can shape individual creativity, while acknowledging that the magnitude of such effects may vary across contexts.

The remainder of the paper is structured as follows. Section 2.1 reviews related literature. Section 2.2 presents the conceptual framework that motivates the empirical analysis. Section 3 describes the data and variable construction. Section 4 reports the main panel results on how income fluctuations affect the quantity and quality of creative output, along with robustness checks, event study evidence, instrumental-variable estimates, and heterogeneity analysis. Section 5 examines potential mechanisms through which financial constraints operates, focusing on time allocation and risk taking. Section 6 analyzes the relationship between financial constraints and stylistic originality using both cross-sectional evidence and case studies of Mozart, Beethoven, and Liszt. Section 7 concludes with broader implications for understanding how financial stability supports creativity and innovation.

2 Related literature and conceptual framework

2.1 Related literature

Our study contributes to three strands of literature. First, we build on the broad literautre linking finance to innovation. Much of this literature focuses on how firm- or country-level financial conditions shape corporate innovation typically measured by research and development (R&D) investment or patent outputs (He and Tian, 2018). A well established body of work demonstrates that greater access to finance—including banking credit (Amore et al., 2013), venture capital (Lerner and Nanda, 2023), stock markets (Bernstein, 2015; Cong and Howell, 2021; Hsu et al., 2014; Moshirian et al., 2021), and even shadow banking finance (Tian et al., 2024)—enhances firms' innovative activities and improves patent quality. However, while firms carry out most innovation and patenting activities, capital alone cannot generate generation. At its core, innovation begins with individuals—their ideas and the creative sparks that occur within the human mind. As noted by Bloom et al. (2020), while firms can leverage substantial capital investments to support innovation, they increasingly rely on teams of researchers to generate new ideas. Despite extensive work on the finance–innovation nexus at the firm level, far less is known about how personal financial conditions influence the creativity of individuals—the foundational input into all innovative activity.

Building on this firm- and country-level work, researchers have also examined—primarily using cross-sectional evidence—how personal financial circumstances shape individual innova-

tion and creativity. Several studies document that inventors are disproportionately drawn from wealthier, higher–socioeconomic status families (Akcigit et al., 2017; Bell et al., 2019; Celik, 2023). At a broader level, Aghion et al. (2017) explore the connection between social mobility and innovation, showing that financial background affects whether individuals pursue inventive and risk-taking careers. However, directly assessing the impact of personal financial conditions on innovation and creativity remains challenging due to limited data on individual, time-varying financial circumstances for inventors, and the difficulty of isolating an individual's creative contribution from the influence of firm resources in patent data, where innovation results from a blend of personal creativity, financial support, and commercial efforts.

Our study broadens this literature by examining creativity within the context of Western classical music composers, a field rarely analyzed in innovation research. We introduce novel, time-varying, text-based measures that capture individual composers' financial circumstances over several centuries, enabling us to provide direct micro-level evidence on how personal financial conditions influence creative output over time. Additionally, we draw on alternative data sources to develop unique metrics for assessing the quantity and quality of creativity, including the number of compositions, Spotify streams, Google search results, and originality indices based on musical themes. A distinct advantage of our setting is that creativity measures for classical music are not subject to the "truncation problem" often encountered in innovation measurement, where limited time for recognition can hinder the full assessment of newer works (Lerner and Seru, 2022). Since all the composers in our sample are deceased, and their works have been extensively analyzed, performed, and documented—often over centuries—the quantity and "quality" of their output are well established. We can therefore evaluate their creative achievements using more comprehensive measures of quantity and quality than are typically available in studies of contemporary innovation.

Second, our research also adds to the literature on financial constraints and entrepreneurship. Prior work shops that limited access to finance discourages risk-taking and reduces the likelihood of individuals becoming entrepreneurs (e.g., Evans and Jovanovic, 1989; Hurst and Lusardi, 2004, among others). As summarized by Kerr and Nanda (2011), financial resources not only increases entrepreneurial activity but also enable larger-scale operations and fosters greater innovation within new ventures. Composing innovative music, much like starting a new

business, involves substantial risk. New compositions could be rejected by audiences, leaving composers without financial reward. Additionally, to bring their works to the public, composers functioned much like entrepreneurs, taking on various tasks to ensure the success of their ventures (Scherer, 2004). This included negotiating fees with publishers, managing musicians, and organizing concerts to develop an audience.[8] Composers also cultivated relationships with patrons, similar to entrepreneurs seeking investment, and carefully managed their public image, or "brand," to sustain support and recognition.[9] As pointed out by Cowen (1998), commercial incentives play a broad and important role in fostering creativity by providing the resources and audiences necessary for innovation to thrive. By studying the relationship between composers' financial constraints and their creative output, we therefore gain valuable insights into the broader dynamics of entrepreneurship and the challenges posed by financial insecurity.

Third, we contribute to the cultural economics literature, which examines how financial conditions and economic incentives shape creative production. Baumol and Bowen (1966) highlight the economic constraints facing the performing arts, arguing that rising costs driven by stagnant productivity (the so-called "cost disease") create financial pressures that challenge the sustainability of artistic activity. Subsequent work shows that creative productivity responds to economic incentives: for example, financial rewards and competitive pressures influence the output of composers (Scherer, 2004) and novelists (Wu and Zhu, 2022). In a related study, Giorcelli and Moser (2020) demonstrate that stronger copyright laws in nineteenth-century Italy provided incentives for opera composers to produce more innovative work. Other research emphasizes the role of personal circumstances and life-cycle dynamics in shaping artistic productivity, including the negative effect of mourning on painting quality (Graddy and Lieberman, 2018) and the positive influence of early financial support (Galenson, 2006) and higher socioeconomic background (Borowiecki and Dahl, 2021) on the development of creativity.

We build on this literature by providing long-run empirical evidence on how financial insecurity impacts the creativity of classical composers. Unlike previous studies, we utilize individual-level, time-varying measures of composers' financial conditions, allowing us to directly observe

[8] When he first arrived in Vienna in the 1780s, Mozart organized a series of subscription concerts to promote his work. Beethoven and Brahms, meanwhile, were famously skilled at negotiating favorable terms from publishers. See Scherer (2004).

[9] Tchaikovsky actively nurtured his relationship with his patron Nadezhda von Meck, maintaining a steady correspondence, dedicating works to her, and expressing gratitude, which helped ensure her financial support for over a decade. Liszt, meanwhile, exemplified brand management, building a public persona that drew audiences with his virtuosic performances and carefully curated image. See Kearney (1998); Gibbs and Gooley (2010).

how fluctuations in financial security shape both the quantity and quality of their creative output. Additionally, because most composers in our dataset lived before the advent of the social welfare state, our setting enables us to capture the effects of financial instability more directly than would be possible in modern contexts. By combining detailed biographical data with novel metrics of creative quality, we offer fresh insights into the relationship between financial circumstances and creativity—insights that extend beyond classical music to inform our understanding of other creative industries as well.

2.2 Conceptual framework

To motivate our empirical analysis, we outline a simple conceptual framework in which composers allocate their time and resources to maximize lifetime utility, which depends on both consumption and the quality and quantity of their creative output. To conserve space, we present the full model in Appendix B and summarize only the key elements here.

Creative production requires investment, not only in the form of time and effort, but also in goods and services that entail financial expenditure, such as copying parts, hiring musicians for trial performances, and, in some cases, securing access to instruments or rehearsal venues. These inputs enable composers to produce work of a given quality, experiment with new ideas, and complete pieces in a timely manner. The extent to which a composer can make these investments depends on current and expected future income, as well as on any accumulated wealth or access to external financial support. The framework builds on the standard intertemporal consumption–savings model with liquidity constraints (e.g., Deaton, 1991), extended to include costly investment in creative output that generates future income—an adaptation of the logic of human-capital investment models such as Ben-Porath (1967).

We define a composer as financially constrained if their current resources—including income, savings, or access to external financial support—are insufficient to fund their desired combination of consumption and creative investment, and if they have limited or no ability to borrow against future income.[10] In a multi-period setting, an unconstrained composer can draw on savings or borrow to smooth resources across time, adjusting consumption and creative

[10]In this framework, "access to finance" encompasses all mechanisms that enable resource smoothly across time, such as personal income and savings, family wealth, or informal support from patrons or friends. Family resources could function either as liquidity (readily available funds) or as informal credit (temporary loans or advances) but our data do not allow us to distinguish between these channels.

investment in response to temporary income fluctuations. By contrast, a constrained composer must reduce spending immediately when income falls, which may affect creative investment along several margins—reducing the number or quality of works, or increasing time devoted to income-generating activities outside of composition.

The framework yields two key empirical predictions. First, periods of low income should reduce creative output, since they diminish the resources available for production and may induce reallocation of effort away from composing. Second, the magnitude of this effect should be greater for those who lack a financial safety net, that is, composers whose current resources are insufficient to fund desired consumption and creative investment, and who have limited ability to borrow against future income. The multi-period logic here is similar in spirit to the permanent income hypothesis: if a composer is unconstrained, temporary income shocks should have little effect on the allocation of resources across time. In our context, this implies that an unconstrained composer could maintain output by drawing on savings during low-income periods, keeping both consumption and creative investment near their long-run optimal levels. Financially insecure composers, by contrast, cannot offset temporary income shortfalls in this way, so their creative investment and output are more sensitive to contemporaneous income.

The two predictions above concern short-run responses to temporary income shocks. The framework also implies longer-run effects: persistent financial constraint may cumulatively depress experimentation and stylistic originality over a composer's career by limiting opportunities to develop novel ideas and absorb creative risk. Our empirical analysis reflects this distinction: panel regressions exploit within-composer variation to test short-run predictions on output quantity and quality, while cross-composer comparisons assess the longer-run implication that chronic constraint reduces stylistic originality.

Although simplified, our framework accommodates several mechanisms through which financial constraints may depress creative output. A time-allocation mechanism arises when income shortfalls induce substitution away from composing toward teaching, performing, or other income-earning activities (Becker, 1965), thereby reducing the hours available for composition and encouraging projects that can be completed more quickly or with fewer resource requirements. Likewise, low income may limit access to performers, rehearsal opportunities, copyists, or other inputs needed to complete ambitious compositions, constraining the feasible

set of projects independent of available compositional time (Evans and Jovanovic, 1989).[11] A risk-taking mechanism emphasizes that composers whose creative portfolios involve broader expressive experimentation face longer development horizons and greater uncertainty about eventual success; financial constraints therefore expose these high-variance creators more acutely to income fluctuations (e.g. Manso, 2011; Tian and Wang, 2014).[12] Although our data allow us to test only the two primary mechanisms discussed above, the historical record provides qualitative evidence consistent with these channels as well as with the operation of additional mechanisms.[13]

3 Data, sample, and variable construction

3.1 Composers and their backgrounds

Our data come from a multiple sources, including *Grove*, Google, and Spotify. We begin with an initial sample of 350 composers who are among the most influential in history taken from Barlow and Morgenstern (1975) and Barlow and Morgenstern (1976). By focusing on these prominent figures, whose lives have generated substantial scholarly interest, we ensure a richer availability of published information on their financial circumstances. Because composers active before Mozart's era (1756–1791) typically held salaried positions with aristocratic patrons, royal courts, or the church—and therefore operated in a fundamentally different financial and professional environment—we restrict our analysis to those born after 1750. This yields a final sample of 172 composers.[14]

Our primary data source on composers is *Grove*, one of the most widely used and highly

[11] Time and purchased inputs are partial substitutes; income can relax constraints on both margins by reducing the need to teach and by financing rehearsal, copying, and performers.

[12] In addition, a psychological mechanism reflects the cognitive burden associated with financial strain, which may reduce the effective productivity of compositional work (Borowiecki and Law, 2025). A return-on-output mechanism captures the possibility that financial constraint diminishes access to publishers, patrons, or performance networks, weakening the dynamic link between past creative success and future remuneration (Azoulay et al., 2010). These mechanisms are not mutually exclusive and may reinforce one another in practice.

[13] Historical examples illustrating these mechanisms include Liszt's reliance on extensive concert touring early in his career, which limited compositional time (time-allocation); composers such as Mahler facing difficulty mounting resource-intensive symphonic works (risk-taking and resource-based constraints); Beethoven's challenges in paying copyists and performers during periods of financial strain (resource-based); Schumann's creative decline amid combined financial and psychological pressures (psychological); and Bruckner's limited early access to influential performance networks, which constrained recognition and delayed returns (return-on-output).

[14] The earliest composers in our sample are Muzio Clementi (1752–1832), Giovanni Battista Viotti (1755–1824) and Mozart (1756–1791). The latest, in terms of year of death, are Aaron Copland (1900–1990), Leonard Bernstein (1918–1990) and David Diamond (1915–2005). Our results are robust to including all composers in the original list.

regarded dictionaries of classical music and classical musicians. *Grove* entries are written by music historians who are well established experts on the lives and works of their subjects.[15] From *Grove*, we gather data on composers' nationalities, birth and death dates, places of residence, and family backgrounds, specifically their social class, whether they grew up in poverty, and whether their fathers had stable income or employment. Historically, families were an important source of financial support in times of economic hardship. Composers from upper class families, or who had fathers with stable sources of income (for instance, from employment with decent salaries), may have been able to drawn down on family wealth or accumulated savings. In contrast, composers who grew up in poverty are unlikely to have had this advantage. We classify a composer as "upper class" if *Grove* describes their family as coming from the "aristocracy," "nobility," "gentry" or as having significant property ownership. Composers are categorized as having grown up in poverty if this is mentioned in *Grove*. Finally, we examine the occupations of composers' fathers to determine whether their families had stable sources of income. Composers with fathers who are described in *Grove* as having been an aristocrat, businessman, banker, doctor, professor, proprietor, land owner, civil servant, school master, or station master, are categorized as having had family backgrounds with stable income sources.

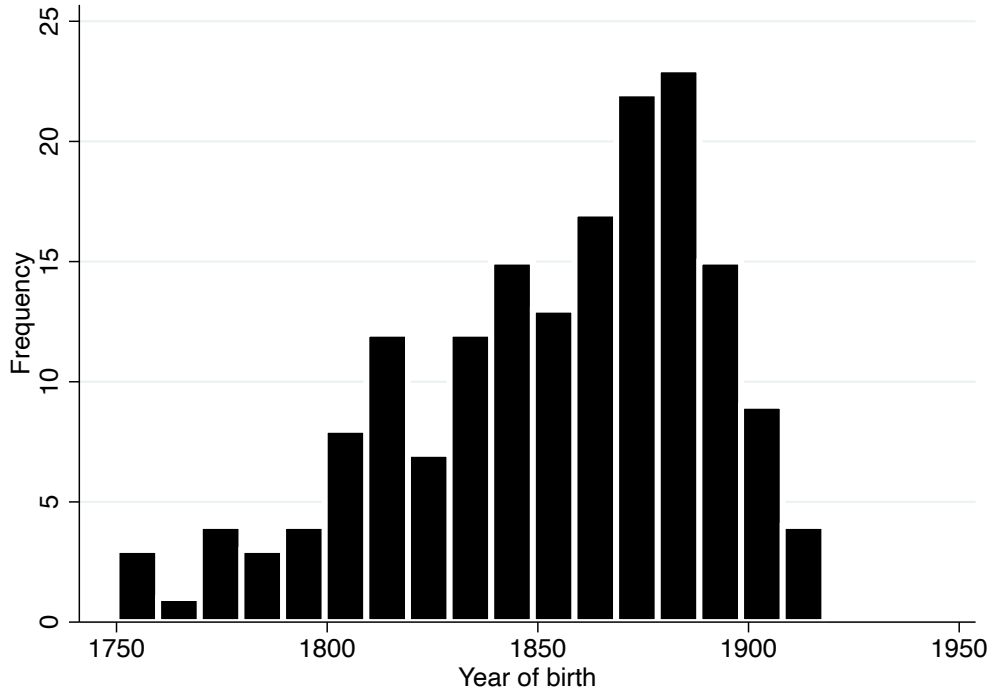
Figure 1 shows the distribution of the 172 composers in our sample according to their decade of birth. While composers from the Classical to the Modernist eras are included, composers of the late Romantic period—born during the mid to late nineteenth century—are most heavily represented. This distribution is ideal for our purposes, as it provides a sample of composers from the golden age of classical music, encompassing a period when most composers were unlikely to have benefited from government social safety nets.

3.2 Measuring composers' incomes

We infer composers' annual financial circumstances from *Grove Music Online*, whose biographical entries document employment histories, patronage, and references to economic conditions. We classify each composer-year into one of two binary income categories—"low income" or "high income" (with "middle income" omitted)—according to biographical descriptions such as "poor," "in debt," or "struggling financially" versus "wealthy," "prosperous," or "financially

[15] Other recent studies in economics that have used *Grove* as a data source include Borowiecki (2022), Borowiecki et al. (2023), and Borowiecki et al. (2025).

Figure 1: Distribution of composers by decade of birth

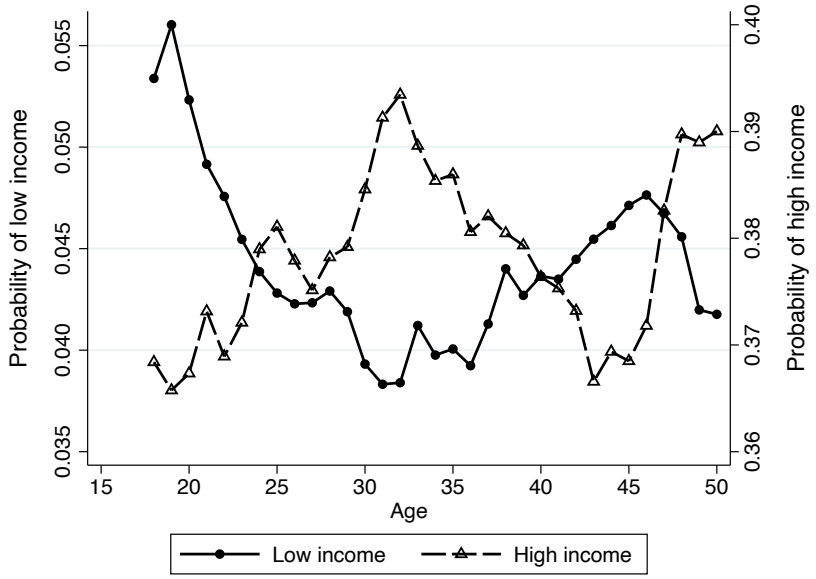


Notes: The figure shows the number of composers in our sample by decade of birth. Birth years are taken from *Grove*.

independent." Composer-years without any such descriptors are treated as belonging to the omitted middle category, which is reasonable given that *Grove* biographers typically highlight notable aspects of a composer's circumstances, including financial ones. The coding procedure, detailed in Appendix A, combined close reading guided by a standardized dictionary of income-related keywords, which is also reproduced there. Each biography was independently reviewed by three research assistants, and a large language model (ChatGPT) was prompted with the same classification rules to provide an automated benchmark. We adopt the classification when the benchmark and at least two coders agree (98.2 percent of cases). If all three coders agreed with each other but not with the benchmark, we adopt the coders' consensus (1.6 percent of cases). The remaining cases were resolved manually after reviewing the underlying text. This hybrid human–AI approach ensured consistency while preserving contextual judgment. Although coarse, these classifications provide the most systematic available proxy for annual income.

As a test of the validity of our measures of composers' income, we examine the relationship between composers' age and their likelihood of being coded as experiencing a spell of low or

Figure 2: Likelihood of "low" or "high" income over the lifecycle



Notes: The figure shows the fraction of composers at each age coded as experiencing "high" or "low" income, based on their biographical entries within *Grove*.

high income. Over the life cycle, it seems reasonable to expect that composers are more likely to experience low income during the early and late phases of their career, while higher income tends to be more common during middle age. Figure 2 plots these relationships. The fraction of composers experiencing low income reaches a high of almost six percent when composers are in their early 20s, falls to around four percent when composers are in their 30s, and rises again when composers are in their 40s and 50s. In contrast, the fraction experiencing high income is lowest (around 37 percent) when composers are in their 20s, rises gradually during their 20s to reach a high of 39.5 percent when they are in their mid 30s, falls back again to around 37 percent in their mid 40s, and then rises again. Accordingly, while the overall patterns are somewhat noisy (possibly due to the fact that we only have 172 composers in our sample), and the absolute changes in the likelihood of low or high income are small, they are roughly consistent with our expectations.

We also obtain from *Grove* data on composers' employment histories, which may have implications for their personal financial situations. Composers sometimes held salaried appointments. We classify composers as "freelance" if they were not employed by a church, court, conservatory, school, or other institute in a given year. Composers also occasionally had patrons. We code composer-years as "patron" if *Grove* reports that a composer enjoyed the support of a patron that year.

As additional evidence in support of our income classification, Appendix Table A2 reports correlations between low- and high-income years and observable indicators of financial resources. Low-income years are more frequent when composers are young, still student, or lack patronage. High-income years correlate positively with patronage and having institutional positions (i.e., not being freelance). These patterns are consistent with expectations and support our interpretation of the income measures.

3.3 Measuring creative output

For the composers in our sample, *Grove* entries also include a "works" section that lists all of a composer's known compositions as well as the years in which they were completed. This allows us to match specific compositions to composer-years and measure the quantity of composers' annual output (based on the year a work is completed). We cross-reference this information with data from the International Music Score Library Project (IMSLP), which provides information on compositions and the years in which they were completed.[16]

For each composition in our dataset, we use Spotify to obtain the work's duration (in minutes) and its popularity score—a 0–100 index, where higher values indicate greater popularity, based on how frequently a piece is streamed, shared, and not skipped relative to other tracks on the platform.[17] Duration provides us with an alternative measure of the quantity of a composer's creative output while the Spotify popularity index is a measure of a work's importance or appeal, as viewed from the perspective of the present day. To minimize any idiosyncrasies from individual artists' interpretations, composition-level information from Spotify is obtained by averaging values across the three most-followed recordings of each work. Additionally, to account for seasonal fluctuations in listening patterns (e.g., heightened interest in December for Christmas-related music, like Handel's "Messiah" or Tchaikovsky's "Nutcracker"), we record each composition's Spotify popularity score three times per year, avoiding major holidays and cultural events, and use the average value in our analysis.

[16]For each composition, *Grove* and IMSLP document the year it is composed, which we use as its year of completion. When this information is missing, we use the earlier of its premiere date or publication date. If none of this information is available, we drop the composition. In addition, we exclude posthumous compositions (i.e., works published after a composer's death, for which the date of composition or premier is unknown). The earliest composition in our sample is by Mozart and was written in 1761.

[17]Spotify is widely recognized as one of the most popular music streaming platforms globally. Recent studies in financial economics have used country-level data on song popularity from this platform (see Edmans et al., 2022).

Appendix Figures A1 through A12 show rankings of the top 20 composers in terms of output, duration, Google search results, Spotify popularity, Google search results per work, and Spotify popularity per work. For each outcome, we show the top 20 composers within our sample of 172 along with the top 20 composers of all time taken from our initial list of 350 composers. Across all metrics, the top 20 composers in our sample generally correspond to the top 20 of all time, suggesting that our sample adequately represents historically important composers. This alignment mitigates concerns about sample bias, reassuring us that a focus on post-1750 composers does not diminish the relevance or generalizability of our findings. Indeed, the overlap between our sample and widely acknowledged "greats" implies that our findings are likely to be reflective of broader historical trends in compositional achievement and not artifacts of period-specific factors.

Quality measures based on Google search results and the Spotify popularity index reveal some overlap but also important distinctions that highlight the different dimensions captured by each metric. Composers like Beethoven, Brahms, Mozart, Schubert, and Tchaikovsky rank highly on both Spotify and Google, reflecting their broad appeal across contemporary listeners and the enduring interest captured in online searches. However, some composers perform better on Spotify than on Google, suggesting a strong listener presence without the same level of educational or cultural interest captured in Google searches. For instance, Antonin Dvořák and Erik Satie appear prominently on Spotify but do not reach the top ranks in Google search results, likely due to the streaming popularity of specific pieces that resonate with today's audiences.[18] In contrast, John Ireland, Victor Herbert, and Carl Maria von Weber achieve high Google search rankings but fall short on Spotify. This pattern likely reflects their enduring relevance in cultural and academic discussions more than in modern streaming preferences.[19] Such distinctions emphasize how composers' popularity may be driven by either scholarly interest or current listener trends, with each metric offering different insights into what sustains a composer's legacy.[20]

[18] For instance, the slow movement from Dvořák's *Symphony No. 9 in E minor*, Op. 85 ("From the New World") and Satie's *Trois Gymnopédies* are perennial favorites among listeners.

[19] John Ireland, Victor Herbert, and Carl Maria von Weber attract scholarly interest for their respective roles in shaping English musical style in the twentieth century, founding the American Society of Composers, Authors, and Publishers (ASCAP) and advancing American operetta, and pioneering German Romantic opera, each significantly contributing to national musical identity and influencing future generations of composers.

[20] Comparing rankings of popularity per work and Google search results per work further highlights differences in composer legacies. Composers who achieve high cumulative popularity often do not rank as highly per work, and vice versa. For example, Aram Khachaturian, celebrated for *Sabre Dance*, ranks first in Spotify popularity per

A natural concern is that our quality measures primarily capture modern tastes rather than the reception of a work at the time it was composed. While tastes do evolve, sustained popularity over long periods provides a meaningful indicator of a composition's enduring significance. Classical music audiences—and even professional critics—tend to be conservative, and many works now regarded as masterpieces were not initially well received. Bach's *Matthäuspassion*, Bizet's *Carmen*, and Prokofiev's *Piano Concerto No. 3* all illustrate pieces that were greeted with indifference or hostility at their premieres but came to be recognized over time for their artistic value. Persistent popularity therefore reflects an accumulated evaluation based on repeated listening, performance, and critical reassessment. This pattern is consistent with the innovation literature, in which the significance of certain patents emerges only after a long temporal horizon, whereas established classical works typically remain part of the repertoire rather than becoming obsolete.

To formally address both this concern and the distinction between our two quality measures, Appendix Figure A13 shows that both Spotify popularity and Google search results align closely with established indicators of enduring prominence at the composer level. The Murray index is a standardized composite measure of historical significance for 522 composers, constructed from coverage in authoritative reference works and expert assessments, and scaled to a common 0–100 metric (see Murray (2003)). The two *Grove* measures capture distinct aspects of scholarly attention: the biography word count reflects the depth of narrative treatment a composer receives in *Grove Music Online*, while the bibliography word count reflects the breadth of scholarly engagement with that composer's work. In the figure, composers with higher Murray scores and more extensive *Grove* coverage also tend to have greater streaming popularity and higher Google search results. Appendix Table A3 corroborates these associations quantitatively. Taken together, the evidence suggests that while Spotify popularity reflects modern listening behavior and Google search results reflect contemporary cultural visibility, both measures are strongly linked to historical and scholarly assessments of importance. This is consistent with the well-documented fact that recognition in classical music tends to stabilize only after considerable time has passed: works of genuinely high creative value are those that continue to attract

work but falls outside the top 20 in overall Spotify popularity. This pattern suggests that while some composers gain recognition through a few iconic pieces, others like Beethoven and Mozart sustain their influence through consistently popular output across many works. These distinctions highlight the varied paths to "greatness," whether through a legacy built on prolific productivity or on a few universally recognized works. See Borowiecki and Law (2026) for a fuller discussion of the multidimensional nature of composer "greatness."

attention across generations.

Our main analysis, at the composer-year level, relies on four measures on creativity: (1) *Output*, the number of new works completed; (2) *Duration*, the total length of those works (in minutes); (3) *Popularity*, the average Spotify popularity index of works completed in a given year; and (4) *Google Results*, the number of Google search results per work completed in a given year. The first two metrics measure the total quantity of output produced in a year, capturing productivity on the extensive margin. The other two metrics assess the enduring appeal and importance of each work completed within the year, representing quality on the intensive margin. [21]

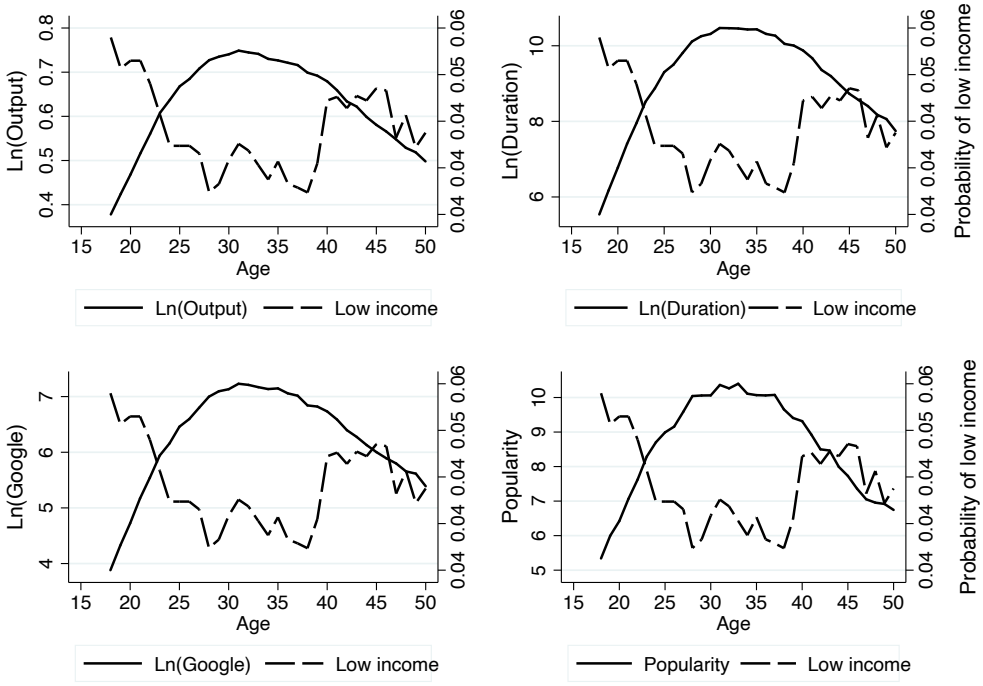
Figure 3 plots the relationship between composers' age and four measures of creativity: the number of works, duration of works, Spotify popularity per work, and Google search results per work, along with the likelihood of low income. All four creativity measures follow an inverted U-shaped pattern: creativity begins at low levels, peaks in the mid-30s, and then declines with age. This hump-shaped pattern between age and creativity aligns with findings from studies of visual artists (e.g. Galenson, 2000; Galenson and Weinberg, 2000; Hodgson, 2011). In contrast, the likelihood of experiencing low income has a U-shaped relationship with age. The figures suggest a likely negative relationship between low income and creativity (i.e., low income years will be correlated with lower creativity). To avoid confounding effects from life-cycle factors, we will control for the non-monotonic relationship between age and creativity.

3.4 Other composition characteristics

Beyond duration, popularity and the number of Google research results, we also gather other Spotify generated audio-analysis metrics of composition-level characteristics, including beats, tempo, valence, energy, and "instrumentalness." *Beats* is the total number of beats in a work (yet another measure of duration). *Tempo* is beats per minute and is a measure of speed. *Valence* is a measure of mood and has a value between zero and one, with values closer to one (zero) indicating a more (less) positive or happy mood. *Energy* is a measure of how energetic music is. It also takes values between zero and one, with values closer to one (zero) indicating more (less) energetic music. Finally, *Instrumentalness* measures the absence of vocal elements

[21] To address potential biases arising from extreme values and skewness in these distributions, we transform measures (1), (2), and (4) by taking the natural log of one plus the variable. For measure (3), we retain the raw index value as the dependent variable because it is a bounded score between 0 and 100.

Figure 3: Creativity over the life-cycle and likelihood of low income



Notes: The figure shows composers' creativity over the life-cycle and the fraction of composers in low income at each age. Creativity is measured in terms of output, duration, Google search results, and Spotify's popularity index. Low income years are based on composers' biographical entries within *Grove*. The lines are smoothed with 5-year windows.

in music, and takes values between zero and one, with values closer to one (zero) indicating less (more) vocal elements.

3.5 Descriptive statistics

Panel A of Table 1 shows the composer-level descriptive statistics. On average, composers lived 67 years and produced almost 76 unique pieces, amounting to between one and two new works per year. The average composer experienced 2.65 years in low income (four percent of their lifespan), and 24.5 years in high income (35 percent of their lifespan). The nearly tenfold predominance of high-income years over low-income years likely reflects the fact that our sample includes many of history's most celebrated composers. In terms of socioeconomic background, eight percent of composers came from the upper class, seven percent were raised in poverty, and 15 percent likely grew up in households with stable family incomes. While the composers in our sample may have enjoyed many years of high income, the majority were unlikely to have had access to family wealth as a financial safety net.

For our primary regression analysis, we aggregate composition-level data to the composer-

Table 1: Descriptive statistics

Panel A: Composer-level descriptive statistics

Variable	Mean	Std. Dev.	Min	Max	Obs.
Age at death	67.06	15.47	31	93	172
Output	75.45	113.99	1	946	172
Output per year	1.36	3.00	0.01	30.52	172
Low income years	2.65	7.65	0	45.	172
Low income proportion	0.04	0.12	0	0.63	172
High income years	24.52	21.87	0	89	172
High income proportion	0.35	0.29	0	0.96	172
Upper class	0.08	0.27	0	1	172
Grew up in poverty	0.07	0.26	0	1	172
Stable family income	0.15	0.35	0	1	172

Panel B: Composer-year-level descriptive statistics

Variable	Mean	Std. Dev.	Min	Max	Obs.
Output	1.11	2.33	0	17	10,842
Ln(Output)	0.45	0.66	0	2.89	10,842
Duration (in minutes)	46.37	94.73	0	527.07	10,842
Ln(Duration)	6.77	8.60	0	19.57	10,842
Google Results (in thousand)	328.29	1,242.89	0	20,560.60	10,842
Ln(Google Results)	4.68	6.09	0	15.40	10,842
Popularity per work	5.18	7.77	0	35.83	10,842
Low income	0.04	0.20	0	1	10,842
High income	0.39	0.49	0	1	10,842
Age	37.90	20.90	5	93	10,842

Panel C: Composition-level descriptive statistics

Variable	Mean	Std. Dev.	Min	Max	Obs.
Duration (in minutes)	4.95	3.40	0.79	17.44	12,186
Beats	491.87	348.85	64	1741.50	12,185
Tempo	103.30	23.54	62.52	173.81	11,927
Popularity	6.49	10.57	0	46	12,186
Valence	0.21	0.18	0.03	0.85	11,927
Energy	0.12	0.10	0.00	0.56	11,927
Instrumentalness	0.53	0.38	0	0.95	11,927

Notes: Panel A shows composer-level summary statistics on 172 composers who lived between 1752 and 2005. See text for a description of the variables. Panel B shows summary statistics on 10,482 composer-year observations, representing the same 172 composers. Ln(Output) is the log of one plus the quantity (number) of a composer's output completed in a given year. Ln(Duration) is the log of one plus the total duration of all the compositions by a composer in completed in a given year. Ln(Google Results) is the log of one plus the average number of Google search results of a composer's work written in a given year. Popularity is the average Spotify popularity score across each of a composer's works completed in a given year. High (Low) income equals one if a composer's biographical entry within *Grove* indicates that the composer is likely to have a significantly higher (lower) income than average, and zero otherwise. Age is a composer's age (in years). Panel C shows the summary statistics of 12,186 classical music compositions by these 172 composers. See the text for a description of each of these variables. For each composition, we obtain the first three tracks with the most followers; and we repeat the data collection on all the tracks for three times randomly within a year, none of which is a holiday of any major culture event. Sample sizes for tempo, loudness, valence, energy, and instrumentalness are lower due to missing observations.

year. Panel B of Table 1 displays composer-year-level summary statistics. In the average composer-year, 1.1 new works were written, amounting to 46.37 minutes of music. While some composers completed no new work in some years, others composed as many as 17 new works in a year, summing up to as many as 527 minutes (8.89 hours) of music. While this may seem like an implausibly large quantity of music, it is a result of the fact that composers' output is lumpy, with some lengthy works (operas and symphonies, for instance) taking many years to complete. Each work composed in an average composer-year has an average Spotify popularity score of 5.18 and generates 328,000 Google search results.

Composition-level summary statistics of 12,186 works by these 172 composers are shown in Panel C of Table 1. The average composition is just under five minutes in duration, and has a score on Spotify's popularity index of 6.5. Additionally, the average composition in the sample has a valence (positiveness) score of 0.21 and an instrumentalness score of 0.53.

4 Main results

4.1 Baseline results

In this section, we test the key prediction of the conceptual framework—that creative output declines during periods of low income. When income falls, financially constrained composers must reallocate resources toward immediate consumption needs, which may lower the quantity or quality of creative output. To examine this relationship, we estimate a baseline panel regression relating annual creative output to income fluctuations:

$$Y_{it} = \beta_0 + \beta_1(Low\ income_{it}) + \beta_2(High\ income_{it}) + \beta_3(Age_{it}) + \beta_4(Age_{it}^2) + \gamma_i + \delta_t + \epsilon_{it} \quad (1)$$

In this regression, Y_{it} is a measure of composer i's creativity in year t; $low\ income_{it}$ is an indicator equal to one if composer i is classified as low income in year t and zero otherwise; $high\ income_{it}$ is an indicator equal to 1 if composer i is classified as enjoying high income in year t; γ_i and δ_t denote composer and half century fixed effects, respectively. The composer fixed effect holds constant time-invariant unobservable differences among composers in terms of overall talent or creativity. Additionally, because each composer has a single *Grove* biography,

it also absorbs any biographer-specific writing tendencies—such as differences in narrative tone or consistency in using terms like "struggling" or "prosperous"—that could otherwise introduce systematic differences in how income conditions are described. The half-century fixed effect holds constant factors related to a composer's era that may influence a composers' creativity. To capture the hump-shaped relationship between age and creativity, we also control for age as a second order polynomial.[22] We cluster standard errors by composer.

The coefficient of interest is β_1, which tells us the within-composer association between low income years and our four measures (number of works, duration, Spotify popularity, Google search results) of a composer's annual creative output. Under the hypothesis that financial constraints depress creativity activity, we therefore expect β_1 to be negative.

Table 2 displays the regression results from our baseline model. We find that all four measures of creativity have a negative and statistically significant relationship with low income, while they have a positive but statistically insignificant relationship with high income. Accordingly, we have consistent evidence that periods of low income are associated with a lower quantity of creative work (either in terms of the number of works written, or the total duration of the works written) and less popular and potentially less important work (in terms of the number of Google search results or the Spotify popularity score). In terms of magnitudes, periods of low income are associated with approximately 15.7 percent ($= 0.071/0.45$) fewer new compositions per year and a 17.7 percent ($= 1.195/6.77$) reduction in the total duration of compositions written each year, relative to the sample mean at the composer-year level. Additionally, compositions written during periods of low income generate 13.9 percent ($= 0.65/4.68$) fewer Google searches relative to sample mean and have a Spotify popularity score that is 2.5 points lower, which represents a decrease of almost 50 percent relative to the composer-year average. Our baseline findings therefore provide suggestive evidence that low income reduces both the quantity and quality of composers' creative output, while episodes of notably high income have relatively limited—though positive—associations with creativity.

Table 2: Income and creativity: baseline panel regression

Variable	(1) *Ln(Output)*	(2) *Ln(Duration)*	(3) *Ln(Google Results)*	(4) *Popularity*
Low Income	-0.071***	-1.195***	-0.650***	-2.556**
	(0.01)	(0.11)	(0.08)	(0.86)
High Income	0.008	0.179	0.121	0.311
	(0.01)	(0.12)	(0.09)	(0.24)
Ln(Age)	1.728***	22.357**	15.470***	21.013**
	(0.34)	(5.71)	(3.55)	(6.27)
$[Ln(Age)]^2$	-0.254**	-3.283**	-2.261**	-3.001*
	(0.07)	(1.18)	(0.75)	(1.26)
Composer FE	Yes	Yes	Yes	Yes
Half-century FE	Yes	Yes	Yes	Yes
Observations	10,842	10,842	10,842	10,842
R-squared	0.481	0.385	0.374	0.457

Notes: The sample contains 10,482 composer-year observations, corresponding to 172 classical music composers who lived between 1752 and 2005. Variables are defined in the notes of Table 1. Ln(Output) is the log of one plus the number of a composer's works in a specific year. Ln(Duration) is the log of one plus the total duration of all the compositions by a composer in a specific year. Ln(Google Results) is the log of one plus the average number of Google search results for each of a composer's works composed in a given year. Popularity is the average Spotify popularity index across each of a composer's works written in a given year. All regressions include composer fixed effects and half-century fixed effects. Standard errors, clustered at the composer level, are reported in parentheses. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

4.2 Robustness checks

To assess the robustness of our baseline results, we re-estimate the model under a variety of alternative specifications and sub-samples. For clarity and brevity, Table 3 reports only the coefficients relevant to each robustness check; unless otherwise noted, all specifications follow the baseline model.

First, our primary productivity measure is the count of compositions completed annually (i.e., *Output*), which may follow a Poisson distribution instead of a normal distribution. Given that the sample mean of *Output* (1.11) is relatively small (i.e., close to one), applying a natural log transformation (i.e., log of one plus the output measure) could introduce bias and complicate interpretation. Following Cohn et al. (2022), we instead estimate a Poisson regression within the same empirical framework, treating *Output* directly as the dependent variable. Coefficient estimates shown in Column (1) of Table 3 Panel A, indicate that our baseline findings are not a result of the bias highlighted by Cohn et al. (2022). Specifically, the estimated coefficient for *Low Income* implies an effect size of 12.31 percent (= 0.137/1.11) relative to the sample

[22] Our findings are not sensitive to whether we log age and its square or include dummy variables for each age. To conserve space, we therefore only present results using the log of age and its square.

Table 3: Robustness checks for alternative specifications and samples

Panel A: Alternative model specifications (N=10,842)				
	(1)	(2)	(3)	(4)
Variable	*Output*	*Output*	*Creative dummy*	*Ln(Output)*
Low Income	-0.137***	-0.125***	-0.069***	-0.071***
	(0.04)	(0.04)	(0.01)	(0.01)
High Income	0.015	0.043**	0.008	0.008
	(0.03)	(0.02)	(0.01)	(0.01)
Ln(Age)	9.429***	7.542***	1.208***	1.728***
	(0.96)	(0.62)	(0.30)	(0.34)
[Ln(Age)]2	-1.387***	-1.158***	-0.176**	-0.254**
	(0.18)	(0.13)	(0.06)	(0.07)
Estimation method	Poisson	Zero-inflated	Linear	Two-way cluster
Composer & half century FEs	Yes	Yes	Yes	Yes
Panel B: Including composers born between 1600 and 1750 (N=12,778)				
	(1)	(2)	(3)	(4)
Variable	*Ln(Output)*	*Ln(Duration)*	*Ln(Google Results)*	*Popularity*
Low Income	-0.062***	-0.829**	-0.407**	-2.270**
	(0.02)	(0.28)	(0.17)	(0.77)
Controls and FEs	Yes	Yes	Yes	Yes
Panel C: Restricting age range to 20-50 years old (N=5,082)				
Variable	*Ln(Output)*	*Ln(Duration)*	*Ln(Google Results)*	*Popularity*
Low Income	-0.080*	-1.090**	-0.594**	-3.593**
	(0.04)	(0.32)	(0.18)	(1.28)
Controls and FEs	Yes	Yes	Yes	Yes
Panel D: Including productive composers only (N=5,043)				
Variable	*Ln(Output)*	*Ln(Duration)*	*Ln(Google Results)*	*Popularity*
Low Income	-0.103***	-1.590***	-0.970***	-4.290**
	(0.01)	(0.19)	(0.18)	(1.12)
Controls and FEs	Yes	Yes	Yes	Yes
Panel E: Excluding composers based in musical cluster cities (N=7,547)				
Variable	*Ln(Output)*	*Ln(Duration)*	*Ln(Google Results)*	*Popularity*
Low Income	-0.061***	-1.466***	-0.749***	-0.929
	(0.01)	(0.11)	(0.14)	(1.23)
Controls and FEs	Yes	Yes	Yes	Yes
Panel F: Excluding 1914-1945 (N=8,175)				
Variable	*Ln(Output)*	*Ln(Duration)*	*Ln(Google Results)*	*Popularity*
Low Income	-0.096***	-1.313***	-0.705***	-3.263***
	(0.02)	(0.07)	(0.08)	(0.64)
Controls and FEs	Yes	Yes	Yes	Yes

Notes: The primary sample contains up to 10,482 composer-year observations, representing 172 classical music composers who lived between 1752 and 2005. In Panel B the sample includes 31 additional composers born between 1600 and 1750. Variables are defined in the caption of Table 1 and of Table 2. Each panel assesses the robustness of our baseline findings using alternative model specifications or different sample restrictions. Specifically: Panel A uses alternative estimation methods (Poisson, zero-inflated, and linear models). Panel B extends the sample backward in time to include earlier-born composers. Panel C restricts the sample to composers aged 20-50, focusing on prime creative years. Panel D limits the sample to productive composers only (those with above-median output). Panel E excludes composers based in major musical cluster cities. Panel F excludes the turbulent years 1914-1945. All regressions include the baseline controls (age, age-squared, and high income), composer fixed effects, and half-century fixed effects. Standard errors, clustered at the composer level, are reported in parentheses. For Panel A Column (4), we re-estimate the baseline regression and cluster standard errors by composer and half-century. For the two Poisson regressions in Panel A, we cluster the standard errors by half century only, due to limitations of the algorithm. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

mean of *Output*, which is of comparable magnitude to our baseline effect size (15.7 percent). In addition, to mitigate the potential bias that could arise from an excessive number of zero values in the dependent variable, we use a zero-inflated Poisson model in Column (2), which provides further confidence in the robustness of our results.

Second, to address concerns that extreme values may influence our results, we construct a new dependent variable, *Creative dummy*, which equals one if a composer completed at least one new work in a given year and zero otherwise. We then re-estimate our baseline regression using this modified dependent variable. In Column (3) of Table 3 Panel A, the coefficient estimate on *low income* is negative and statistically significant at the one percent level, suggesting that our baseline findings are unlikely to be driven by extreme values of the dependent variable.

Third, one might worry that our within-composer estimates could be affected by serial correlation in the error term. To address this, we re-estimate the baseline specification using two-way clustered standard errors (clustering by composer and by period). For brevity, Column (4) of Panel A reports the results for *Ln(Output)* as a representative case; the corresponding estimates for the other creativity measures are very similar to the baseline results, indicating that serial persistence in the errors does not drive our inference

Fourth, our main analysis focuses on composers born after 1750, during the Classical period and beyond, as these composers were more likely to experience income fluctuations due to the gradual decline of stable, salaried positions within royal and aristocratic courts or the church. However, including Baroque era (circa 1600–1750) composers allows us to test the robustness of our results across a broader historical sample, ensuring that our findings are not driven by the specific economic conditions of the Classical and Romantic periods. Although Baroque composers were typically salaried, they nonetheless faced creative demands and expectations that could serve as a proxy for economic pressures, allowing us to verify whether our results hold across differing economic contexts. We therefore re-run the baseline regressions with an expanded sample that includes Baroque era composers.[23] As shown in Panel B of Table 3, our findings are robust to including these additional composers; however, the coefficients are slightly smaller in magnitude and less precisely estimated, consistent with our argument that

[23] We were able to add 31 composers born between 1600 and 1750, selected from our initial list of the 350 greatest composers of all time. The earliest of these is Giacomo Carissimi (born in 1605), and the latest is Domenico Cimarosa (born in 1749). This group includes Johann Sebastian Bach, George Frederic Handel, Antonio Vivaldi, Arcangelo Corelli, as well as Joseph Haydn and Carl Philipp Emanuel Bach, who, while technically not Baroque composers, were born before 1750.

Baroque composers, due to their salaried roles with aristocratic patrons, royal courts, or the church, were less exposed to financial instability.

Fifth, a potential concern is that composers with longer lifespans contribute more observations, which could introduce truncation bias and affect our results. Specifically, longer-lived composers might skew our findings simply by virtue of having more years of productivity recorded. To address this, we limit our sample to include only the creative activities of composers between the ages of 20 and 50, reducing the influence of variations in lifespan. As shown in Panel C of Table 3 our findings remain consistent, indicating that differences in composers' lifespans are not biasing our baseline results.

Sixth, following the approach of Lerner and Seru (2022), we focus on composers with high productivity (defined as those who composed at least 50 works over their lifetime) and re-estimate the baseline regressions on this subsample.[24] Focusing on highly productive composers allows us to test whether our findings hold among individuals with sustained creative output, who may be less vulnerable to short-term economic pressures due to their established productivity. Coefficient estimates displayed in Panel D of Table 3 indicate that our findings remain robust among these highly productive composers.

Finally, we consider two alternative sub-samples to test the robustness of our results. First, we exclude composers based in Vienna, London, or Paris—the cities where composers were most heavily clustered—to ensure that our findings are not driven by dynamics unique to these major musical centers. Second, we exclude the years from the outbreak of World War I through the end of World War II (1914–1945), as the extraordinary social and economic disruptions of this period likely introduced shocks to income and productivity that are not representative of normal historical conditions.[25] The results remain broadly consistent across these tests.[26]

Taken together, the results in Table 3 provide strong evidence for the robustness of our baseline findings across various model specifications and sample adjustments.

[24] While the average composer in our sample has a lifetime productivity of 75.45 works, the median lifetime productivity is 44.5 works. Eighty one composers (47 percent) have a lifetime productivity of at least 50 works.

[25] Our findings are unchanged if we retain the interwar years and exclude only the war years (1914–1918 and 1939–1945), or if we instead exclude the years of the Napoleonic Wars.

[26] The main exception is the coefficient for *Popularity* in Panel E, which becomes less precisely estimated, though the point estimate remains negative.

4.3 Reverse causality and omitted variables

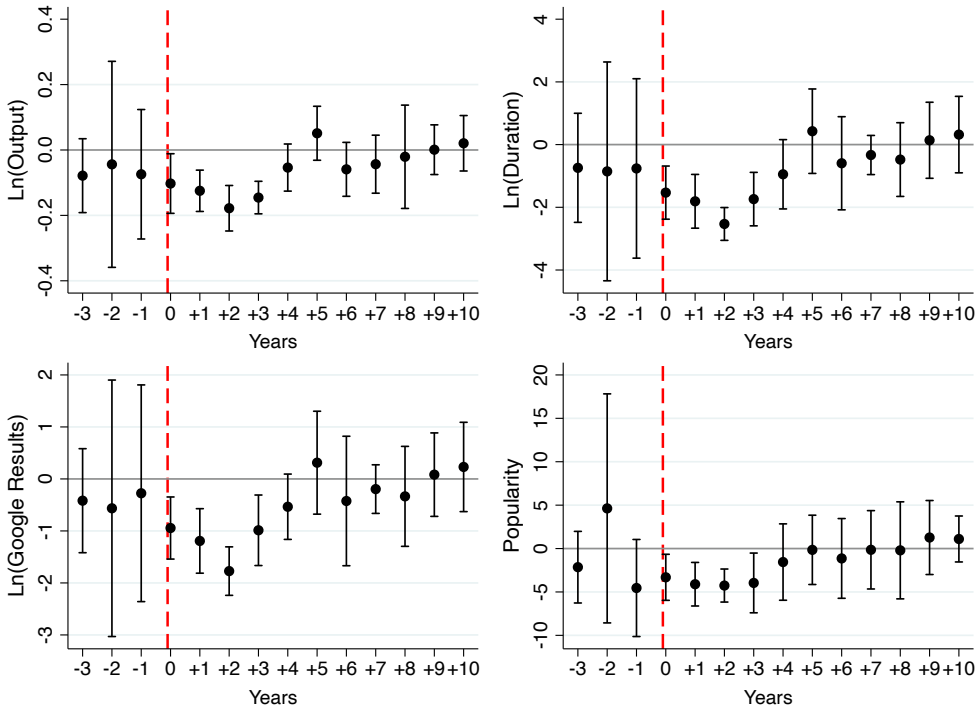
Of course, our findings so far are merely correlations. A composer's income is unlikely to be fully exogenous. One could easily argue that causation runs in the opposite direction, with periods of low creativity causing low income rather than the other way around. To examine the potential for reverse causation, we estimate a dynamic event study model to analyze changes in our four measures of creativity in the years leading up to a low income period. Specifically, following equation 1, we decompose the key variable of interest, *Low income*, into a series of binary variables indicating the number of years relative to a composer entering a low income period.[27] As shown in Figure 4, the coefficient estimates for the years prior to a low income spell are generally insignificant and close to zero, indicating no clear pre-trends in the four measures of creativity. Furthermore, creativity declines slightly in the years following a low-income spell for three of the four measures, a pattern consistent with low income "causing" lower creativity. The event study thus provides suggestive evidence that reverse causality is unlikely to be driving our findings.

Income may also be endogenous because of omitted variables. There are many factors that could affect composers' income but also independently impact their creativity. Having a patron might reduce the risk of low income, but if patrons also impose restrictions on what composers create, this could affect their creativity. Composers who are freelance may be at greater risk of low income; however, the risk of low income may independently affect creativity if these composers are induced to change the type of music they write in order to make ends meet. Living in a city with many other composers could reduce income because the market is more competitive but also have independent impacts on creativity. The same is true of many other factors including living under a regime with copyright protections for music, or residing in a thriving music hub.

Table 4 reports the results when we sequentially control for potential omitted variables. In panel A we include indicator variables for whether a composer has a patron in a given year and whether he or she worked as a freelancer. In panel B we control for the number of other composers living in the same city in a given year. Panel C introduces city-by-year fixed effects,

[27] We recognize that composers may re-enter a low income period after several years of recovery. To avoid capturing the lagged effects of previous low income spells, we set the "before" indicators to zero if the year falls within five years of a prior low income year.

Figure 4: Event studies of the relationship between low income and creativity



Notes: The figure shows event study coefficient estimates of the dynamic impact of low income on four measures of creativity. In each panel, "0" denotes the year a composer enters a low income period; $+j$ $(-j)$ denotes j year(s) after (before) year 0, where j =1, 2, 3, etc.

allowing us to absorb time-varying city characteristics—such as the size or prominence of a musical center—that might independently influence creativity. Panel D adds country-by-year fixed effects, capturing national policy changes (including copyright reforms) and broader economic conditions that could affect creative output.[28] Panel E examines whether past financial circumstances have cumulative effects by adding controls for the cumulative number of low-income and high-income years (scaled by age) up to each year. Across all specifications, low income remains negatively and significantly associated with each creativity measure, and the magnitude of the coefficient is remarkably stable. We exclude these controls and fixed effects from the baseline model because several of them may themselves be shaped by a composer's financial circumstances—introducing "bad-control" bias by conditioning on post-treatment variables—and because including numerous fixed effects can create multicollinearity and substantially reduce the usable sample. The robustness checks nonetheless show that our findings are not driven by omitted-variable concerns and that the core results hold across a wide range of alternative specifications.

[28]Country-by-year fixed effects also absorb changes in social support systems, which may matter for the twentieth-century composers in the sample.

Table 4: Tests of omitted variables

	(1) *Ln(Output)*	(2) *Ln(Duration)*	(3) *Ln(Google Results)*	(4) *Popularity*
Panel A: Controlling for having a patron or being freelance (N=10,842)				
Low Income	-0.071***	-1.229***	-0.692***	-2.731**
	(0.01)	(0.13)	(0.09)	(0.92)
Patron	-0.001	-0.043	-0.067	-0.406*
	(0.02)	(0.13)	(0.08)	(0.17)
Freelance	0.002	0.202	0.189	0.147
	(0.02)	(0.30)	(0.23)	(0.77)
Controls	Yes	Yes	Yes	Yes
Composer & Half century FE	Yes	Yes	Yes	Yes
Panel B: Controlling for the number of other composers in a city (N=10,842)				
Low Income	-0.070***	-1.173***	-0.637***	-2.546**
	(0.01)	(0.09)	(0.06)	(0.91)
No. of composers	0.005**	0.139***	0.085**	0.062
	(0.00)	(0.03)	(0.03)	(0.03)
Controls	Yes	Yes	Yes	Yes
Composer & Half century FE	Yes	Yes	Yes	Yes
Panel C: Including city-by-half century fixed effects (N=8,807)				
Low Income	-0.067***	-1.014***	-0.591**	-2.496*
	(0.01)	(0.22)	(0.18)	(1.09)
Controls	Yes	Yes	Yes	Yes
Composer FE	Yes	Yes	Yes	Yes
City-Half century FE	Yes	Yes	Yes	Yes
Panel D: Including country-by-year fixed effects (N=8,807)				
Low Income	-0.073**	-0.920***	-0.582***	-3.780**
	(0.02)	(0.12)	(0.09)	(1.31)
Controls	Yes	Yes	Yes	Yes
Composer FE	Yes	Yes	Yes	Yes
Country-year FE	Yes	Yes	Yes	Yes
Panel E: Including past low-/high-income years (N=10,842)				
Low Income	-0.086**	-1.246***	-0.689**	-3.257**
	(0.04)	(0.45)	(0.32)	(1.60)
High Income	0.019	0.300	0.208	0.463
	(0.01)	(0.19)	(0.13)	(0.36)
Past low-income years	0.580	2.724	2.027	24.070
	(0.39)	(5.38)	(3.69)	(15.22)
Past high-income years	-0.358**	-3.831**	-2.751**	-5.061
	(0.16)	(1.93)	(1.36)	(3.65)
Controls	Yes	Yes	Yes	Yes
Composer & Half century FE	Yes	Yes	Yes	Yes

Notes: The sample covers 172 classical music composers who lived between 1752 and 2005. Variables are defined in the caption of Table 1 and Table 2. Each panel tests the robustness of our baseline results to potential omitted variable bias by introducing additional controls or stricter fixed effects. Panel A controls for whether a composer had a patron or was freelance. Panel B controls for the number of other composers residing in the same city, capturing local competition or agglomeration effects. Panel C introduces city-by-half century fixed effects. Panel D includes country-by-year fixed effects. Panel E adds controls for the cumulative number of low-income and high-income years a composer has experienced up to each year (scaled by age). All regressions include the baseline controls (age, age-squared, and high income), as well as composer fixed effects and half-century fixed effects unless replaced by stricter fixed effects as indicated. Standard errors, clustered at the composer level, are reported in parentheses. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

4.4 Instrumental variable approach

As a final step in addressing potential endogeneity in our key explanatory variable, we employ an instrumental-variable strategy that uses the interaction between a composer's patronage status and the presence of publication rights (a form of copyright protection) as an instrument for low-income years.[29] Historically, composers with the support of patrons benefited from a degree of financial stability, as patrons provided regular stipends, commissions, or even salaried employment. This support insulated composers from fluctuations in market demand, reducing the likelihood of experiencing low income. Publication rights, a key form of copyright protection, further supported composers by securing their entitlement to royalties from published works. In regions with publication rights, composers could earn a residual income stream each time their music was printed and sold.

The combined presence of patronage and publication rights generates both cross-sectional and time-series variation in financial security. Composers who had a patron received stable support, while publication rights provided a more dependable stream of revenue through royalties; together, these sources substantially reduced the likelihood of experiencing low-income years. For this reason, the interaction between patronage status and the existence of publication rights offers a plausible source of exogenous variation and serves as our instrument for low-income years.

Table 5 Column (1) presents the first stage regression results. As anticipated, the interaction between having a patron and publication right protection has a large, negative, and statistically significant correlation with low income years. The first stage F-statistic is highly significant, indicating that the instrument satisfies the relevance condition. Columns (2) through (5) show the second stage results for the four measures of creativity. Consistent with our earlier findings, low income has a negative and statistically significant relationship with all measures of creativity.

4.5 Heterogeneity in responses to access to finance

Our conceptual framework yields a second prediction: the impact of low income on creative output should be stronger for composers who are less able to buffer financial "shocks". Those with access to savings or other financial support can smooth resources over time, while those

[29] We are grateful to Alexander Cuntz of the World Intellectual Property Organization, for providing us with data on publication rights at the country-year level.

Table 5: Instrumental variable approach: low income and creativity

Variable	(1) *Low Income*	(2) *Ln(Output)*	(3) *Ln(Duration)*	(4) *Ln(Google Results)*	(5) *Popularity*
Publication right × *Patron*	-0.945***				
	(0.02)				
$\widehat{Low Income}$		-0.321**	-5.698***	-3.230**	-7.843**
		(0.12)	(1.99)	(1.51)	(2.94)
First-stage F-stat	317.12***				
Age controls	Yes	Yes	Yes	Yes	Yes
Composer FE	Yes	Yes	Yes	Yes	Yes
Half-century FE	Yes	Yes	Yes	Yes	Yes
Observations	7,774	7,774	7,774	7,774	7,774

Notes: The sample covers 172 classical music composers who lived between 1752 and 2005. Variables are defined in the caption of Table 1. Column (1) displays the first stage regression. Columns (2) through (5) present the coefficients from the second stage regression, using *Publication right* × *Patron* as the instrument for low income. Ln(Output) is the log of one plus the number of a composer's works in a specific year. *Publication right* is an indicator variable equal to one in country-years where publication rights are protected. Ln(Duration) is the log of one plus the total duration of all the compositions by a composer in a specific year. Ln(Google Results) is the log of one plus the average number of Google search results for each of a composer's works composed in a given year. Popularity is the average Spotify popularity index of each of a composer's works completed in a given year. All regressions include age, age-squared, composer fixed effects and half-century fixed effects. Standard errors, clustered at the composer level, are reported in parentheses. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

without such slack experience sharper reductions in creative activity when income falls. We operationalize this idea using two complementary approaches. First, we use family background as an *ex-ante* proxy for access to finance. Second, we exploit reliance on teaching as an *ex-post* indicator of limited resources during a composer's career.

4.5.1 Family background as an indicator of access to finance

Family wealth influenced whether a composer could draw on savings or informal support when income declined. Those from affluent backgrounds faced looser financial constraints and should be less affected by low-income years. We consider three indicators of family background: social class (whether a composer was from the upper class), the stability of the father's income, and whether the composer grew up in poverty. Composers from the upper class, with stable parental incomes, or who did not experience poverty in childhood are more likely to have had access to family resources that could buffer temporary income shocks. By contrast, those from lower social classes, unstable family backgrounds, or impoverished childhoods were more likely to face binding financial constraints. In an environment with limited formal credit and insurance markets, such differences would have strongly influenced how a low-income episode constrained a composer's ability to maintain creative productivity.

To test this prediction, we re-estimate the baseline regression separately for composers whose family background suggests they were not likely financially constrained and those who were. We expect the negative association between low income and creative output to be concentrated among the financially constrained—that is, those not from the upper class, whose fathers lacked stable employment, or who experienced poverty in childhood.

Regression results are reported in Table 6. Panel A measures access to finance using family social class. For each creativity measure, the coefficient on low income is more negative for composers outside the upper class, and the differences between the two groups are statistically significant. Panel B classifies composers by childhood poverty status. Although the low-income coefficients are negative in both subsamples, the differences are negative and statistically significant across all outcomes, indicating that low-income composers who grew up in poverty are particularly affected by financial shortfalls. Panel C uses the stability of the father's occupation to proxy for financial security. Again, the effects are larger in magnitude for the financially less secure group, and the differences are statistically significant for most outcomes. Taken together, Panels A through C show that composers with weaker access to finance exhibit significantly larger declines in creative output during low-income years, consistent with the hypothesis that financial slack mitigates the consequences of income shocks.

Table 6: Access to finance by family background, low income, and creativity

Panel A: Access to finance measured by family's social class								
	Ln(Output)		*Ln(Duration)*		*Ln(Google)*		*Popularity*	
	Not Upper Class	Upper Class	Not Upper Class	Upper Class	Not Upper Class	Upper Class	Not Upper Class	Upper class
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Low Income	-0.086***	0.051	-1.286***	-0.639	-0.703***	-0.293	-2.838**	-0.335
	(0.01)	(0.08)	(0.19)	(1.57)	(0.12)	(1.01)	(0.92)	(1.44)
Differences [left - right]	-0.137***		-0.647***		-0.410***		-2.504***	
Controls and fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,046	796	10,046	796	10,046	796	10,046	796
R-squared	0.489	0.380	0.387	0.357	0.375	0.345	0.470	0.254
Panel B: Access to finance measured by family's poverty status								
	Poor	Not Poor	Poor	Not Poor	Poor	Not Poor	Poor	Not Poor
Low Income	-0.096***	-0.067*	-1.599	-1.130***	-1.225	-0.555***	-3.105	-2.702**
	(0.03)	(0.01)	(0.84)	(0.26)	(0.74)	(0.19)	(2.09)	(1.03)
Differences [left - right]	-0.031***		-0.469***		-0.670***		-0.403**	
Controls and fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,051	791	10,051	791	10,051	791	10,051	791
R-squared	0.470	0.588	0.374	0.527	0.364	0.496	0.470	0.302

Table 6 continued

Panel C: Access to finance measured by stability of family income

	Ln(Output)		*Ln(Duration)*		*Ln(Google)*		*Popularity*	
	Unstable	Stable	Unstable	Stable	Unstable	Stable	Unstable	Stable
Low Income	-0.085***	0.068	-1.253***	-0.898	-0.694***	-0.511	-2.725**	-1.149
	(0.01)	(0.09)	(0.14)	(0.69)	(0.08)	(0.36)	(0.83)	(1.63)
Differences [left - right]	-0.153***		-0.355**		-0.183*		-1.576***	
Controls and fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,312	1,530	9,312	1,530	9,312	1,530	9,312	1,530
R-squared	0.494	0.397	0.388	0.367	0.377	0.354	0.487	0.259

Panel D: Access to finance proxied by whether a composer taught

	Teaching	*Non-teaching*	*Teaching*	*Non-teaching*	*Teaching*	*Non-teaching*	*Teaching*	*Non-teaching*
Low Income	-0.102	-0.062**	-1.597	-1.087**	-1.080	-0.534*	-3.078	-2.457
	(0.05)	(0.02)	(0.81)	(0.31)	(0.64)	(0.22)	(2.01)	(1.20)
Differences [left - right]	-0.040*		-0.510*		-0.545**		-0.622	
Controls and fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,856	6,986	3,856	6,986	3,856	6,986	3,856	6,986
R-squared	0.530	0.443	0.387	0.382	0.374	0.372	0.551	0.371

Notes: The sample covers 172 classical music composers who lived between 1752 and 2005. Family background is based in composers' entries within *Grove*. We classify a composer as upper class if they are described as coming from the aristocracy, gentry, nobility, or if their families had significant property ownership. Composers are classified as having grown up in poverty if this is mentioned in *Grove*. We use the father's occupations to determine whether their family had stable income. Stable income occupations include aristocrats, businessmen, bankers, doctors, professors, proprietors, land owners, civil servants, school masters, and station masters. Information on composer's teaching is taken from *Grove Music Online* biographies. A composer is classified as not relying on teaching (*No teach*) if they have no recorded students; otherwise, the composer is classified as relying on teaching (*Ever teach*). *Ln(Output)* is the log of one plus the number of a composer's works in a specific year. *Ln(Duration)* is the log of one plus the total duration of all the compositions by a composer in a specific year. *Ln(Google Results)* is the log of one plus the average number of Google search results for each of a composer's works composed in a given year. *Popularity* is the average Spotify popularity index of each of a composer's works completed in a given year. All regressions include high income, age, age-squared, composer fixed effects, and half-century fixed effects as in the baseline regressions. Standard errors, clustered at the composer level, are reported in parentheses. ***, **, and * indicate significance at the 1% , 5%, and 10% levels, respectively.

4.5.2 Reliance on teaching as an indicator of financial slack

Composers who lacked access to financial resources that could cushion income shortfalls often had to teach to support themselves. Reliance on teaching thus serves as another indicator of limited financial buffers. In this setting, we expect that low-income years should have a more negative effect on creative output for composers who relied on teaching.

To test this prediction, we divide the sample based on whether a composer is documented in *Grove* as having ever taught students, which we treat as an indicator of reliance on teaching income. Panel D of Table 6 reports the results. Across all four creativity measures, the coefficient on low income is more negative for composers who relied on teaching than for those who did not, and the differences are statistically significant for three of the four outcomes. This pattern is consistent with the interpretation that teaching is indicative of reduced financial slack, such that composers with limited financial buffers experience more severe creative downturns when income falls.

5 Plausible underlying mechanisms

5.1 Financial constraints and time allocation in creative production

Having documented that creative output declines during financially constrained years, we now examine the mechanisms that can account for this relationship. While the theoretical framework admits several possible channels, we focus here on two that are both directly testable in our data and historically salient. The first operates through changes in time allocation in creative production. When income falls short, the marginal utility of consumption rises, and substitution into paid work becomes more attractive (Becker, 1965). For classical composers, teaching was the most common supplementary occupation, especially in the nineteenth century as patronage declined and conservatory systems expanded. As teaching and performing commitments absorb time, the hours available for composition fall, leading composers to favor projects that can be completed more quickly and with lower resource requirements. This mechanism generates two testable implications. First, in low-income years, when compositional time is scarce, composers should produce smaller scale works requiring fewer performers or rehearsals. Second, the negative effects of low income on creative output should be most pronounced in

years when competing time demands are especially high.

Panel A of Table 7 provides evidence consistent with the first implication. During low-income years, composers wrote works that were smaller in scale, reflected in shorter duration, fewer beats, and lower instrumentalness.[30] In contrast, we find no systematic association between low income and tempo—a faster piece does not require more composition time or rehearsal resources than a slower one of comparable length. The absence of a tempo effect is consistent with the idea that financial constraints primarily influence the scope of projects rather than musical features unrelated to production demands. These patterns are consistent with the view that limited time encourages composers to select projects that can be completed more efficiently and with fewer required resources. In other words, when compositional time is constrained, composers respond by scaling down the scope of their creative output.

Historical evidence from the lives of major composers reinforces the plausibility of these adjustments. During periods of low income, Schubert increasingly concentrated on lieder (German art song), which could be composed rapidly, performed in intimate venues, and sold into a growing domestic market.[31] Antonín Dvořák likewise relied on smaller-scale salon pieces and dances early in his career, before the security of patronage and institutional appointments enabled him to undertake larger and more time-intensive works.[32] These cases illustrate that financially constrained composers often adapted their creative choices to the available time and resources, consistent with the empirical patterns observed in Panel A.

Panels B and C examine the second implication by exploiting year-to-year variation in teaching activity as a measure of how binding a composer's time constraints were, proxied by whether a composer had students in a given year and the number of students taught in a given year. Consistent with our conjecture, the adverse effects of low income on both the quantity and quality of creative output are substantially larger in years when teaching obligations are present or more intensive, suggesting that time allocation is likely a plausible channel that underlies our baseline results. Specifically, when these obligations increase, the time available for composition falls, resulting in fewer completed works and pieces that are smaller in scope and less visible in

[30] Beats measure the total amount of notated musical material in a composition; fewer beats indicate a smaller overall scope of writing. Instrumentalness is a Spotify audio-analysis metric that classifies recordings based on the presence or absence of vocals; vocal-keyboard works were historically cheaper to produce and perform than fully instrumental pieces, which often required larger forces and more rehearsal coordination.

[31] See Rosen (1998), Newbould (1992) and Deutsch (1958) on Schubert's commercial strategies and periods of financial difficulty.

[32] See Clapham (1979) and Beckerman (1993) on Dvořák's early income volatility and output choices.

Table 7: Financial constraints and time allocation in creative production

Panel A: Financial constraints and the scale of creative work				
	(1)	(2)	(3)	(4)
Variable	*Ln(Duration)*	*Ln(Beats)*	*Tempo*	*Instrumental*
Low Income	-0.087**	-0.092**	0.049	-0.075***
	(0.03)	(0.03)	(1.18)	(0.01)
High Income	-0.004	-0.011	-0.944**	0.008
	(0.01)	(0.01)	(0.24)	(0.01)
Ln(Age)	0.028	0.041	-1.984	-0.180***
	(0.08)	(0.04)	(5.94)	(0.04)
[Ln(Age)]2	0.001	-0.003	0.087	0.027**
	(0.02)	(0.01)	(0.92)	(0.01)
Composer & half-century FEs	Yes	Yes	Yes	Yes
Observations	9,061	9,060	9,061	9,061
R-squared	0.122	0.122	0.081	0.202
Panel B: Creativity when time constrained: teaching				
	(1)	(2)	(3)	(4)
Variable	*Ln(Output)*	*Ln(Duration)*	*Ln(Google Results)*	*Popularity*
Low Income × Teaching	-0.297**	-3.547**	-2.676**	-2.607
	(0.14)	(1.71)	(1.29)	(6.68)
Low Income	-0.057	-1.039**	-0.536*	-2.471*
	(0.04)	(0.42)	(0.29)	(1.31)
High Income ×Teaching	-0.035	0.422	0.247	1.568
	(0.05)	(0.69)	(0.48)	(1.12)
High Income	0.011	0.128	0.090	0.150
	(0.01)	(0.21)	(0.14)	(0.41)
Teaching	-6.266	-33.805	-26.285	-121.534
	(4.18)	(32.22)	(22.78)	(141.35)
Age controls and interactions	Yes	Yes	Yes	Yes
Composer & half-century FEs	Yes	Yes	Yes	Yes
Observations	10,842	10,842	10,842	10,842
R-squared	0.483	0.387	0.375	0.458

Panel C: Creativity when time constrained: intensity of teaching

Variable	(1) *Ln(Output)*	(2) *Ln(Duration)*	(3) *Ln(Google Results)*	(4) *Popularity*
Low Income × Ln(Students)	-0.372**	-4.064**	-3.154**	-8.067
	(0.18)	(1.92)	(1.36)	(9.79)
Low Income	-0.057	-1.046**	-0.539*	-2.319*
	(0.04)	(0.43)	(0.29)	(1.31)
High Income × Ln(Students)	-0.023	0.481	0.349	1.170
	(0.04)	(0.58)	(0.42)	(1.07)
High Income	0.010	0.113	0.073	0.185
	(0.01)	(0.21)	(0.14)	(0.42)
Ln(Students)	-4.430	-9.693	-11.338	-111.303
	(4.26)	(21.93)	(15.50)	(140.91)
Age controls and interactions	Yes	Yes	Yes	Yes
Composer & half-century FEs	Yes	Yes	Yes	Yes
Observations	10,842	10,842	10,842	10,842
R-squared	0.483	0.388	0.376	0.458

Notes: The sample contains 10,482 composer-year observations for 172 classical music composers (born after 1750) covering the years 1750-2001. *Low Income* (*High Income*) equals one if a composer's biographical entry in *Grove* indicates that the composer is likely to have a lower (higher) income than average, and zero otherwise. In Panel A (composition-level regressions), *Ln(Duration)* is the log of a composition's length (in minutes); *Ln(Beats)* is the log of the total number of beats of a composition; *Tempo* is the number of beats per minute and measures the speed of a composition; and *Instrumental* denotes the proportion of instrumental (versus vocal) sounds in a composition; standard errors are clustered by composition scale. In Panels B and C, all the regressions include the log of a composer's age in year t and its square as controls, along with their interactions with the variables of interest; standard errors are clustered by composer. In Panel B, *Teaching* equals one if a composer had any students in year t, and zero otherwise. In Panel C, *Ln(Students)* is the log of one plus the number of students that a composer had in year t. All the regressions include composer and half-century fixed effects. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

the long run. More broadly, the results show that income shortfalls are especially detrimental when they coincide with competing demands on a composer's time, reinforcing the view that financial constraints operate in part through their impact on time allocation.

5.2 Financial constraints and risk taking in creative activity

A second mechanism concerns how income shortfalls interact with a composer's willingness to undertake creative risk. Composers differ substantially in the extent to which their music explores broad emotional and expressive ranges. Works that push into extreme contrasts of mood or intensity, or that involve large-scale formal ambition, often require long periods of development, substantial production resources, and carry uncertain or delayed audience reception. For example, Mahler's symphonies and Wagner's music dramas exemplify such high-variance creative endeavors: they required long periods of drafting and revision, large and costly performing forces, and often generated financial returns only after long delays. Because the commercial payoff from such ambitious projects is uncertain and slow to materialize, composers who gravitate toward this type of expressive experimentation are more exposed to the adverse consequences of income fluctuations. We therefore conjecture that financial constraints may affect creativity through a risk-taking channel: the negative effect of low income should be more pronounced for composers with a greater propensity to undertake high-variance creative work. This mechanism parallels theories in innovation economics showing that financial constraints discourage long-horizon, high-variance projects (e.g. Manso, 2011; Tian and Wang, 2014).

To evaluate this idea, we proxy a composer's propensity for expressive experimentation using Spotify's audio-analysis metrics. Specifically, we measure each composer's lifetime standard deviation in valence (emotional positiveness) and energy (perceived intensity or drive) as indicators of how widely their music varies in expressive space. Because we cannot reliably measure year-to-year fluctuations in risk-taking, we classify a composer as "high risk-taking"' if their lifetime variance in either valence or energy falls in the top quartile of the distribution, and zero otherwise. The prediction is that low-income years should have a disproportionately negative impact on the creative output of composers whose portfolios exhibit greater dispersion in expressive character.

As shown in Table 8, the interaction terms between *Low income* and the *High risk-taking*

indicators are negative across all four creative output measures. The interaction is statistically significant for two outcomes when high risk-taking is defined using variability in valence, and for three outcomes when based on variability in energy. There is little corresponding evidence of differential responses in high-income years. These results indicate that income shortfalls disproportionately depress the quality and quantity of creative output of composers whose portfolios generally span a wider expressive range, consistent with the idea that creators engaged in more variable, exploratory forms of composition are more exposed to the adverse consequences of financial constraints.

Table 8: Financial constraints and risk taking in creative production

	(1) *Ln(Output)*	(2) *Ln(Duration)*	(3) *Ln(Google Results)*	(4) *Popularity*
Panel A: Risk-taking based on variability in valence				
Low Income × High risk-taking (valence)	−0.159**	−0.835	−0.709	−7.443*
	(0.07)	(0.89)	(0.56)	(4.36)
Low Income	−0.045	−1.084**	−0.550*	−1.342
	(0.04)	(0.44)	(0.31)	(1.06)
High Income × High risk-taking (valence)	0.016	0.750*	0.446	0.652
	(0.03)	(0.42)	(0.31)	(0.72)
High Income	0.003	−0.032	−0.005	0.115
	(0.01)	(0.22)	(0.15)	(0.46)
Controls and interactions	Yes	Yes	Yes	Yes
Composer & half-century FE	Yes	Yes	Yes	Yes
Observations	10,842	10,842	10,842	10,842
R-squared	0.483	0.387	0.375	0.458
Panel B: Risk-taking based on variability in energy				
Low Income × High risk-taking (energy)	−0.160**	−1.750*	−0.955*	−2.448
	(0.07)	(0.94)	(0.57)	(2.09)
Low Income	−0.043	−0.917**	−0.503*	−2.134
	(0.04)	(0.40)	(0.30)	(1.50)
High Income × High risk-taking (energy)	0.006	0.568	0.407	0.181
	(0.03)	(0.45)	(0.33)	(0.62)
High Income	0.004	−0.014	−0.016	0.209
	(0.01)	(0.21)	(0.14)	(0.51)
Controls and interactions	Yes	Yes	Yes	Yes
Composer & half-century FE	Yes	Yes	Yes	Yes
Observations	10,842	10,842	10,842	10,842
R-squared	0.483	0.387	0.375	0.458

Notes: The sample comprises 10,842 composer-year observations for 172 composers (born after 1750), 1750–2001. Dependent variables measure quantity and quality of works completed in year t. *High risk-taking (valence/energy)* equals one if the composer's lifetime standard deviation of composition-level valence (energy), measured from Spotify track features, lies in the top quartile. All regressions include composer and half-century fixed effects and controls for age and age squared. Standard errors (in parentheses) are clustered by composer. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

6 Further analysis: Financial constraints and originality

In the final part of the study, we examine implications of financial constraint for stylistic originality, namely the extent to which a composer's musical language diverges from prevailing norms.[33] The question here is whether sustained or recurrent financial constraint discourages experimentation and risk-taking over a career, resulting in an overall musical oeuvre that is less stylistically distinctive relative to their predecessors or contemporaries.

To measure stylistic originality, we follow Borowiecki (2022) and Borowiecki and Mauri (2024), drawing on the thematic catalogues of Barlow and Morgenstern (1975, 1976), which contain 18,074 melodic themes from 6,352 works by 769 composers. Each theme is encoded as a standardized sequence of notes (transposed to a common key) with associated key and time signatures. We analyze the frequency of two-, three-, and four-note n-grams and compare each composer's distribution of these musical features with that of earlier composers. From these data, we compute eight indices that quantify stylistic divergence—specifically, the percentage of unique n-grams and the cosine distance of n-gram distributions, key, and time signatures—so that higher values consistently indicate greater originality, meaning that a composer's music differs more from that of their predecessors or contemporaries.[34]

Our focus on stylistic originality at the composer level is motivated by both conceptual and data-related considerations. Conceptually, originality reflects the cumulative evolution of a composer's musical language—arising from experimentation, learning, and synthesis over time rather than from isolated works—making it inherently a long-run characteristic. Empirically, the thematic catalogues of Barlow and Morgenstern (1975, 1976) provide no coverage for nearly 75 percent of composer-years in our sample, making annual measurement unreliable. Aggregating to the composer level therefore improves measurement by averaging over a larger body of work within each career and by preserving a broader cross-section of composers. A limitation of this

[33] Originality and popularity need not coincide. A piece may be widely known because it is accessible or conventional rather than innovative. One of our measures of quality—the number of Google search results—may partly capture originality, since innovative or distinctive works can attract attention, analysis, and discussion. However, this metric may conflate stylistic novelty with popularity or cultural visibility. For instance, Charles Ives's *Piano Sonata No. 2* ("Concord Sonata")—one of the most original American compositions of the early twentieth century—features experimental harmonies and transcendentalist references, yet its avant-garde style has limited its popular appeal (its Spotify popularity score is just one, less than one-sixth of the sample average). To identify originality more directly, we therefore rely on stylistic measures based on musical structure rather than audience response.

[34] The original similarity measures are transformed so that higher values correspond to greater stylistic divergence (i.e., originality). For percentage-based metrics, we take the complement (1 – similarity); cosine distances already increase with dissimilarity and thus require no transformation.

approach, however, is that composer-level originality may be correlated with omitted factors such as innate ability, quality of training, career duration, or genre specialization. To address this concern, we supplement the cross-sectional analysis with composition-level evidence for composers who are well represented in the thematic data and for whom additional information on financial conditions is available, specifically Mozart, Beethoven, and Liszt. These case studies draw on distinct sources of within-composer variation: one links Mozart's annual income to the originality of his works, and the other relates financial concerns expressed in the correspondence of Mozart, Beethoven, and Liszt to composition-level measures of stylistic divergence.

6.1 Composer-level evidence

We begin by examining whether sustained financial constraint is associated with lower stylistic originality at the composer-level. To test whether prolonged exposure to income shortfalls discourage stylistic experimentation and risk-taking, we regress measures of each composer's stylistic originality on the fraction of their lifespan spent in low-income and high-income periods. A negative relationship between originality and time spent in low income would indicate that chronic financial constraint reduces long-run creative innovation.[35]

Table 9 reports the results. Each column presents a separate regression using one of eight originality metrics as the dependent variable, where higher values indicate greater stylistic divergence from earlier music. The key explanatory variables are the shares of a composer's life spent in low or high income, with controls for birthplace (Europe vs. elsewhere), country-of-birth, and half-century-of-birth. We find that the fraction of life spent in low income is negatively and significantly associated with seven of the eight originality measures.[36] These results are consistent with the prediction that persistent financial constraint hinders experimentation and the development of novel musical styles.

[35] Originality indices cannot be constructed for 14 of the 172 composers in our main sample, as they lack themes in the BM dataset. The regression sample therefore includes 158 composers.

[36] Results are robust to alternative definitions of low income, including the number of low-income years and indicators for spending more than five or ten years in low income.

Table 9: Income and composers' originality

	Pct. Unique			Cosine Distance				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Low income years	-0.106*	-0.214***	-0.134***	-0.110*	-0.322***	-0.430***	-0.087*	0.005
	(0.05)	(0.06)	(0.03)	(0.06)	(0.06)	(0.06)	(0.05)	(0.03)
High income years	0.031	0.032**	0.009	0.006	0.019	-0.004	-0.035	-0.019
	(0.02)	(0.01)	(0.01)	(0.01)	(0.03)	(0.04)	(0.03)	(0.01)
Born in Europe?	-0.036	-0.006	0.004	0.012	0.084*	0.118*	-0.038***	0.001
	(0.03)	(0.03)	(0.02)	(0.02)	(0.04)	(0.06)	(0.01)	(0.01)
Nationality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Half-century FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	158	158	158	158	158	158	158	158
R-squared	0.145	0.210	0.259	0.148	0.195	0.203	0.104	0.279

Notes: The sample contains 158 classical composers with no missing information on originality. Originality is measured by the degree of uniqueness of a creator's work relative to past works, with higher originality indicating greater deviation from the styles of previous creators (see Borowiecki and Mauri, 2024). Specifically, the dependent variable is a standardized originality coefficient that measures the pct. of unique 2-/3-/4-grams (columns 1-3, respectively) or cosine distance of 2-/3-/4-grams, key and time signature (columns 4-8, respectively). *Low income years* and *high income years* are the fraction of a composer's lifespan spent in periods of low or high income, respectively, adjusted for their age at death. All regressions include composer nationality fixed effects and fixed effects for half-century. Standard errors are clustered at the country (nationality) level and reported in parentheses. ***, **, and * indicate significance at the 1 percent 5 percent, and 10 percent levels, respectively.

6.2 Complementary evidence of case studies

We now turn to composition-level analyses that complement the composer-level results. Using detailed data on individual works, we examine whether within-composer variation in financial conditions is associated with stylistic originality. Two case studies—one based on Mozart's annual income and another on the financial concerns expressed in the letters of Mozart, Beethoven, and Liszt—allow us to explore this relationship using independent data sources and more detailed year-by-year evidence.

6.2.1 Case study 1: The relationship between Mozart's income and originality

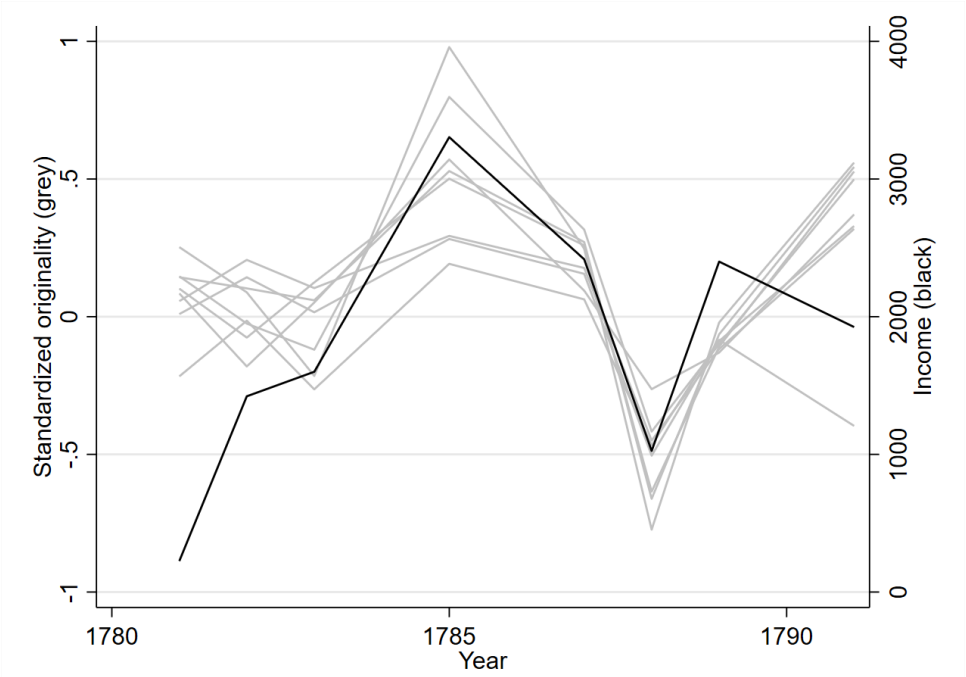
We use a rare data series on Mozart's real annual income from 1781 to 1791 (Baumol and Baumol, 1994).[37] His income, measured in florins, has a mean of 1,629.7 (s.d. 901.4). We correlate Mozart's annual income with the stylistic originality of works composed in the same year, calculated as the percentage of unique note sequences (2-, 3-, and 4-grams) or the cosine distance of 2-/3-/4-grams, key, and time signatures. Both time series are shown in Figure 5. The correlation coefficients between income and the eight originality metrics range from 0.49 to 0.65 and are statistically significant at the five percent level, indicating that Mozart's stylistic originality tended to rise in periods of higher income.

6.2.2 Case study 2: The impact of financial concerns on the originality of Mozart, Beethoven, and Liszt

The second case study examines how money-related concerns expressed in the correspondence of Mozart, Beethoven, and Liszt relate to the stylistic originality of their music, using data from Borowiecki (2017). The Linguistic Inquiry and Word Count (LIWC) software was applied to 1,432 letters to quantify the frequency of words and expressions associated with financial hardship, uncertainty, or distress, yielding an annual measure of financial stress. This measure serves as a proxy for years in which composers faced tighter financial constraints. We then correlate it with composition-level stylistic originality for the corresponding years, resulting in 39 composer-year observations. The regression results with composer-fixed effects, shown in Table 10, reveal negative and largely significant coefficients: In years when composers expressed less

[37] Baumol and Baumol (1994) estimates of Mozart's real annual income are based on archival work by Moore (1989).

Figure 5: Standardized originality and income of Mozart, 1781-1791



Notes: The figure shows standardized originality coefficient that measures the pct. of unique 2-/3-/4-grams or cosine distance of 2-/3-/4-grams, key and time signature (grey lines), and Mozart's real income in florins (black line). The originality measures are calculated following Borowiecki (2022). Mozart's income data are obtained from Baumol and Baumol (1994).

financial stress, their works were more stylistically original. These findings reinforce the results from Mozart's income data and provide additional within-composer evidence that financial constraints were associated with reduced stylistic originality.

Taken together, the composer-level results and the two case studies—which provide complementary time-varying evidence—consistently indicate that financial constraints reduce stylistic originality, the third dimension of creativity considered in this study. Moreover, the finding that financially constrained years are associated with less stylistic divergence is consistent with the operation of the risk-taking mechanism: when income is low and financial pressure is high, composers appear less willing or able to undertake high-variance, exploratory projects

Table 10: Impact of financial concerns on the originality of Mozart, Beethoven, and Liszt

	Pct. Unique			Cosine Distance				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Financial concerns	-0.465*	-0.454**	-0.348***	-0.411*	-0.387**	-0.282**	-0.229**	-0.117
	(0.247)	(0.181)	(0.126)	(0.212)	(0.163)	(0.111)	(0.094)	(0.152)
Composer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	39	39	39	39	39	39	39	39
R-squared	0.09	0.15	0.17	0.09	0.13	0.15	0.14	0.02

Notes: The dependent variable is a standardized originality coefficient that measures the pct. of unique 2-/3-/4-grams (columns 1-3, respectively) or cosine distance of 2-/3-/4-grams, key and time signature (columns 4-8, respectively). Financial concerns measures the intensity of financial (money-related) concerns expressed in written correspondence by the three composers and is obtained from Borowiecki (2017). The originality measures are calculated following Borowiecki (2022). ***, **, and * denote statistical significance at the 1 percent, five percent, and 10 percent levels, respectively.

7 Conclusion

A central question in the economics and management of innovation literature is how financial constraints affect creativity. Does financial hardship spur ingenuity, as the image of the "starving artist" suggests, or does financial stability provide the foundation for sustained creative investment? Systematic evidence has been scarce, largely because individual-level data on creative workers' financial circumstances are rarely available.

Drawing on the case of Western classical composers, a uniquely well-documented group of historical innovators, we find empirical support for the view that financial constraints depress creativity. Periods of low income are associated with lower output and reduced long-run visibility, with particularly pronounced effects for composers from less privileged backgrounds. A wide array of robustness checks, event-study estimates, and identification strategies suggests that these patterns are not driven by endogeneity. We also present evidence consistent with two mechanisms. Finally, composer-level results and two complementary case studies indicate that financial constraints also diminish the stylistic originality of creative work. Taken together, these findings support the interpretation that financial constraints constitute a key channel linking income and creativity.

At the same time, an important qualification is warranted. Although composers offer an empirically advantageous setting, their experience does not map mechanically onto that of modern scientists, technologists, or entrepreneurs. Innovation in those fields may draw on different cognitive skills, take place under different institutional and market conditions, and face distinct financial environments and risk structures. Our results should therefore be interpreted as illustrating how financial conditions can shape creativity in one historically salient artistic context, without assuming that the magnitude of such effects will generalize to contemporary scientific or entrepreneurial innovation.

Although our analysis is rooted in a historical setting, the economic logic it highlights remains pertinent. Many creative professionals—including those working in the arts, design, science, and technology—face income volatility and limited access to credit or social protection. Recent policy experiments—such as Ireland's *Basic Income for the Arts* pilot, which provided randomly selected artists with stable weekly stipends, and the *Guaranteed Income for Artists* program in New York, which offered monthly unconditional payments to several

thousand artists—show that predictable income mitigates financial strain and allows greater focus on creative work (Teppo and Mc Quaid, 2025; Creatives Rebuild New York, 2024). Our results offer a historical complement to this evidence, indicating that economic stability facilitates sustained creativity and innovation. In doing so, they challenge the enduring notion of the "starving artist," suggesting instead that reliable financial support—not deprivation—creates the conditions most conducive to creative achievement.

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Appendix

A Construction of Income Indicators

The income indicators were derived from *Grove Music Online* biographies, which provide detailed accounts of composers' employment, patronage, commissions, property, and living conditions. Coders relied on a structured list of keywords and short phrases (the *income keyword dictionary*) grouped into thematic clusters. Low-income clusters included poverty, debt, reliance on patronage, and the need to supplement income through teaching or performing. High-income clusters included references to wealth, stable salaries, financial independence, commissions, property ownership, and professional success. These expressions served as interpretive guides rather than mechanical triggers.

Each biography was independently reviewed by three coders, who worked under the authors' supervision and recorded whether evidence of low or high income appeared in each life period. The coding was conducted between fall 2023 and spring 2024. Coders applied contextual judgment—for instance, the term "struggling" was not automatically treated as a financial indicator if it referred to personal difficulties. In parallel, a large language model (ChatGPT) was prompted with the same dictionary and classification rules to produce independent classifications. Final classifications reconciled these sources: if the model and at least two human coders agreed, that classification was adopted (98.2% of cases); if all three coders agreed but differed from the model, the human consensus was used (1.6% of cases); remaining discrepancies were resolved manually. This hybrid human–AI approach ensured both consistency and contextual nuance.

Some high-income indicators, such as property ownership or investment income, may capture accumulated wealth rather than contemporaneous earnings. These were coded contextually: references to steady rental, interest, or patronage income were classified as high income, whereas inherited or unsustainable holdings were not automatically treated as such. The high-income variable therefore reflects broader financial stability and access to resources, representing an upper bound on the prevalence of genuinely high-income years.

The coding identified, for each composer in each year, whether the available biographical evidence indicated either financial hardship or prosperity. A year was classified as *Low Income* when such evidence pointed to economic difficulty, and as *High Income* when it suggested financial stability or affluence. Years without any such references were treated as *financially neutral*, meaning that no clear information about the composer's economic situation was available for that year. The complete keyword dictionary used for this classification is provided below.

Table A1: Keyword Dictionary Used to Code Income Indicators from Composer Biographies

Category	Cluster / Theme	Illustrative Keywords and Phrases
Low Income	Poverty / Destitution	poverty; destitute; poor; penniless; subsistence; lived in poverty; poverty-stricken; died in poverty; barely survived; subsistence level; lived modestly; lived frugally; had little means; limited means; meagre resources
	Debt / Financial Distress	debt; financial difficulty; hardship; distress; in debt; fell into debt; financial distress; economic hardship; struggled financially; suffered from lack of income; unable to make a living; no steady income; unpaid; without regular employment
	Dependence / Patronage Reliance	dependent; patron; charity; support; relied on charity; relied on friends for support; dependent on patrons; patronage was his main source of income; dependent on family support; helped by acquaintances
	Employment Instability	struggled to find employment; lacked steady patronage or employment; took minor teaching positions
	Supplementary / Survival Work	supplement; survive; teaching; lesson; worked as a teacher to supplement his income; gave piano lessons to survive; accepted small jobs; teaching to make ends meet
	Limited Recognition and Opportunity	obscure; recognition; few; limited; limited recognition during his lifetime; few performances; few pupils; unable to afford publication/performance; restricted career opportunities
High Income	Wealth / Fortune	wealthy; fortune; prosperous; rich; became wealthy; considerable fortune; prosperous period; financially successful; financial independence; independent means; enjoyed fame and wealth; lived comfortably; lived in comfort
	Salary / Income Source	salary; income; pension; stipend; secured a lucrative position; received a pension; patronage from the court; court appointment with salary; profitable concerts; substantial income from publication; prestigious post with high salary; financially secure livelihood
	Patronage / Court Support	patronage; royal; court; favour; royal patronage; received royal favour; court stipend; support from aristocratic patrons; commissioned by the court; close relationship with royalty or nobility
	Professional Demand and Market Success	demand; success; commission; fame; demand for his works increased; profitable tours; successful performances; received generous commissions; contract with a publisher; highly sought after as a teacher; international fame and fortune
	Generosity / Philanthropy	donate; philanthropy; charity; donated to charity; philanthropic acts; supported others financially

Notes: Keywords and phrases served as interpretive guides rather than mechanical triggers; coders considered context when assigning income status. The dictionary was applied during coding conducted from fall 2023 to spring 2024.

B A Simple Theoretical Framework of Financial Constraints and Creative Output

Dynamic setup

We assume that the composer maximizes lifetime utility over consumption and creative output. In each period t, preferences are represented by $U(C_t, Q_t)$, where C_t denotes consumption and Q_t is a composite measure of creative output that reflects both the quantity and the quality of work produced. Utility is increasing and concave in both arguments.

Producing Q_t requires monetary expenditure $m(Q_t)$, which covers the financial inputs necessary for creation, such as copying parts, hiring musicians for try-outs, or securing access to appropriate instruments or venues. We assume $m'(Q_t) > 0$ and $m''(Q_t) \geq 0$ (i.e., creative production is subject to diminishing returns). These costs are paid out of available resources in each period.

The composer's budget constraint in period t is

$$C_t + m(Q_t) + S_t = Y_t^E + Y_t^P + W_t,$$

where S_t denotes savings carried forward to the next period, Y_t^E is exogenous current income (e.g., from teaching or patronage), Y_t^P is income derived from past creative work (e.g., royalties or repeat performances), and W_t is wealth. Wealth evolves according to

$$W_{t+1} = (1 + r)S_t.$$

We do not initially restrict S_t to be nonnegative, allowing for borrowing; financial constraints are introduced later.

The composer's problem is therefore:

$$\max_{\{C_t, Q_t, S_t\}} \sum_{t=0}^{T} \beta^t U(C_t, Q_t)$$

subject to the budget constraint in each period and the law of motion for wealth.

First-order conditions and intraperiod margin

Let λ_t denote the Lagrange multiplier on the period-t budget constraint. The first-order conditions are:

$$\beta^t U_C(C_t, Q_t) = \lambda_t \quad \text{(F1)}$$

$$\beta^t U_Q(C_t, Q_t) = \lambda_t \, m'(Q_t) \quad \text{(F2)}$$

$$\lambda_{t-1} = \beta(1 + r)\lambda_t \quad \text{(F3)}.$$

From (F1) and (F2), the intraperiod optimality condition can be written as

$$\frac{U_Q(C_t, Q_t)}{U_C(C_t, Q_t)} = m'(Q_t) \quad \text{(F4)},$$

which states that the marginal rate of substitution between creative output and consumption equals the marginal cost of producing an additional unit of Q_t.

Static benchmark

For intuition, consider the special case of a single period in which $U(C, Q) = C^{\alpha}Q^{1-\alpha}$ and the budget constraint is $C + m(Q) = I$, where $I = Y^E + Y^P + W$. The first-order conditions imply:

$$\frac{1-\alpha}{\alpha} \cdot \frac{I - m(Q)}{Q} = m'(Q).$$

Given $m'(Q) > 0$ and $m''(Q) \geq 0$, the implicit function theorem yields $\partial Q^{\star}/\partial I > 0$. Thus, an increase in current resources raises optimal creative output for everyone, with diminishing sensitivity at higher levels of I. This benchmark highlights the basic mechanism: lower current income reduces Q for all composers, but the proportional effect is larger when income is low. We return to the dynamic setting to capture intertemporal smoothing.

Constrained and unconstrained regimes

In the unconstrained case, the composer can borrow or save freely, and S_t can take positive or negative values. A temporary fall in Y_t^E is then smoothed by adjusting S_t so that λ_t and the intraperiod condition (F4) change little; Q_t is only weakly affected by transitory income shocks.

If financial constraint bind, so that $S_t \geq 0$, then the budget constraint reduces to $C_t + m(Q_t) = Y_t^E + Y_t^P + W_t$. A fall in Y_t^E now directly reduces the resources available for both C_t and Q_t, increasing λ_t and lowering Q_t according to (F4). In this case, the contemporaneous impact $\partial Q_t/\partial Y_t^E > 0$ is larger, reflecting the inability to smooth.

Empirical Predictions

This setup yields two short-run and one long-run prediction, corresponding to the conceptual framework in the main text.

Short-run Prediction 1 (income shock):
A temporary decline in Y_t^E reduces Q_t on average. When borrowing and saving are unconstrained, the composer smooths the shock by adjusting S_t, so that Q_t changes little. When financial constraints bind, however, the shock tightens the budget constraint and increases λ_t (the shadow value of relaxing the constraint), leading to a sharper fall in Q_t.

Short-run Prediction 2 (heterogeneity):
The effect of a decline in Y_t^E is stronger when financial constraints are more likely or more severe. Thus, creative output falls more among financially constrained composers, consistent with the empirical finding that low-income years depress productivity most strongly for those with limited access to external finance.

Long-run Prediction (persistence and feedback):
Persistent low income increases the frequency of binding periods, keeping Q_t depressed on average. Because Y_{t+1}^P depends on past Q_t, this creates a dynamic feedback loop: lower output today reduces future income from past works, perpetuating low output and discouraging experimentation. Empirically, composers who spent a larger share of their lives in low-income conditions produced less original work, consistent with this long-run mechanism.

Interpretation and Mechanisms

The model is intentionally parsimonious, but its structure can accommodate several complementary mechanisms through which income affects creative output. While our empirical analysis primarily identifies the overall relationship between income and creative output, these channels help interpret the observed patterns and clarify the model's broader implications.

Time-allocation mechanism. In an extended setting, the composer allocates time between composing and income-earning activities. A fall in exogenous income (Y_t^E) raises the marginal utility of income, inducing substitution toward paid work and away from composition. This reduces the effective time available for producing creative output and lowers Q_t.

Resource-based mechanism. When the non-negativity condition on savings binds ($S_t \geq 0$), current income limits the composer's ability to acquire purchased inputs such as rehearsal opportunities, performers, or copying, which are needed to complete ambitious works. This constrains the feasible set of creative investments independent of the time margin and directly lowers Q_t.

Risk-taking mechanism (heterogeneous vulnerability). Creative investment decisions differ in uncertainty, gestation length, and payoff dispersion. Creators with a preference or comparative advantage for exploratory work (high-variance projects) face a greater risk that delayed or uncertain returns will conflict with current consumption needs if financial constraints tighten. Formally, when the payoff distribution for Q_t has higher variance, binding financing constraints generate larger reductions in optimal creative investment.

Psychological mechanism. Persistent financial strain may lower effective creative productivity or reduce the utility derived from creative activity. Formally, this can be represented as an upward shift in the marginal cost function $m(Q_t)$ or a downward shift in the marginal utility of creation $U_Q(C_t, Q_t)$, both of which decrease optimal Q_t.

Return-on-output mechanism. Financial hardship may impair access to professional networks, patrons, publishers, and performances, weakening the dynamic link between past creative output and current income ($Y_t^P = f(Q_{t-1})$). A reduction in $f'(Q_{t-1})$ lowers expected future returns to creative work and discourages current investment in Q_t.

Together, these channels illustrate how the model accommodates multiple pathways through which low income can reduce creative output.

C Composer Rankings (Based on Attributes of Creative Outputs)

Figure A1: Top Twenty Composers (1750–2005): Output

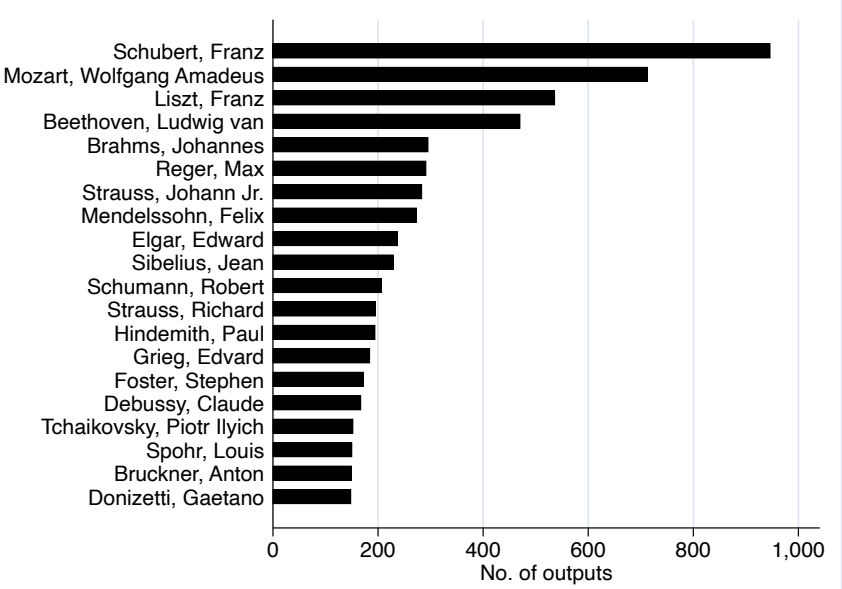


Figure A2: Top Twenty Composers (all time): Output

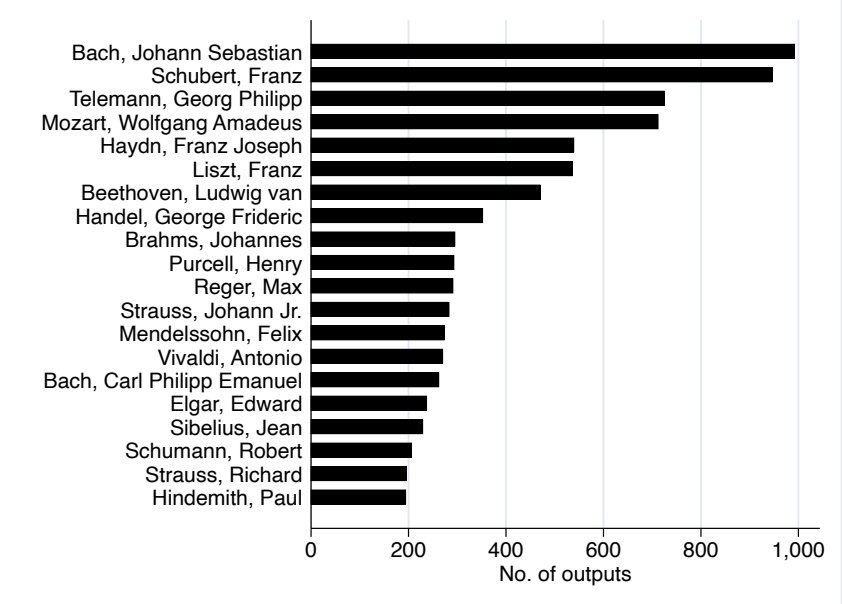


Figure A3: Top Twenty Composers (1750–2005): Duration

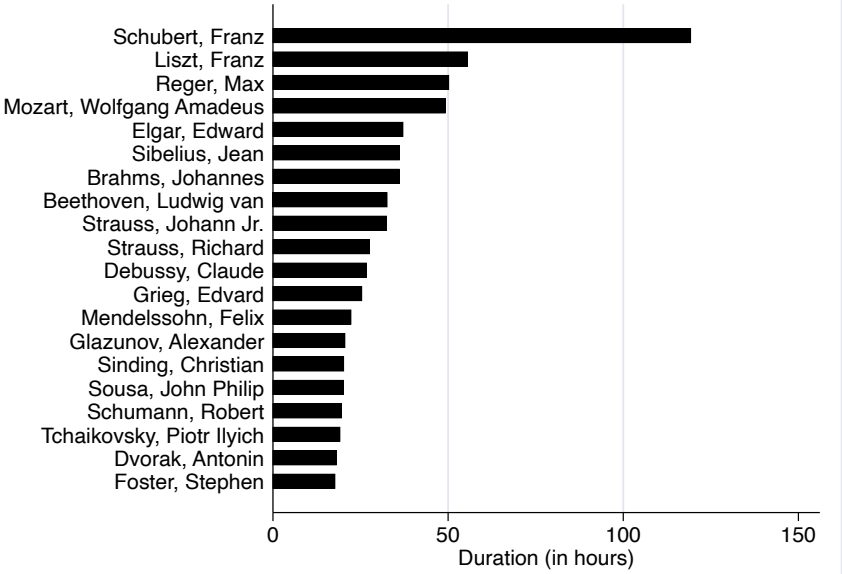


Figure A4: Top Twenty Composers (all time): Duration

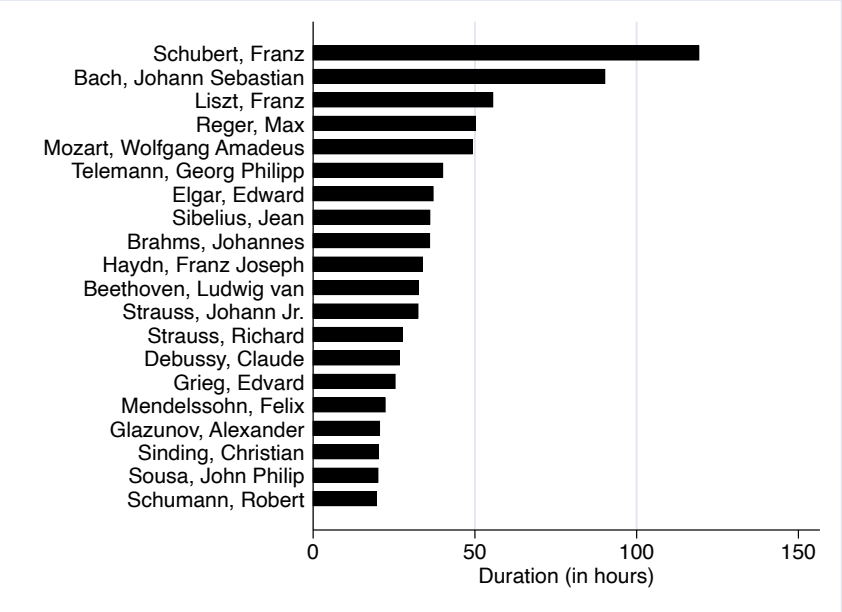


Figure A5: Top Twenty Composers (1750–2005): Google search results

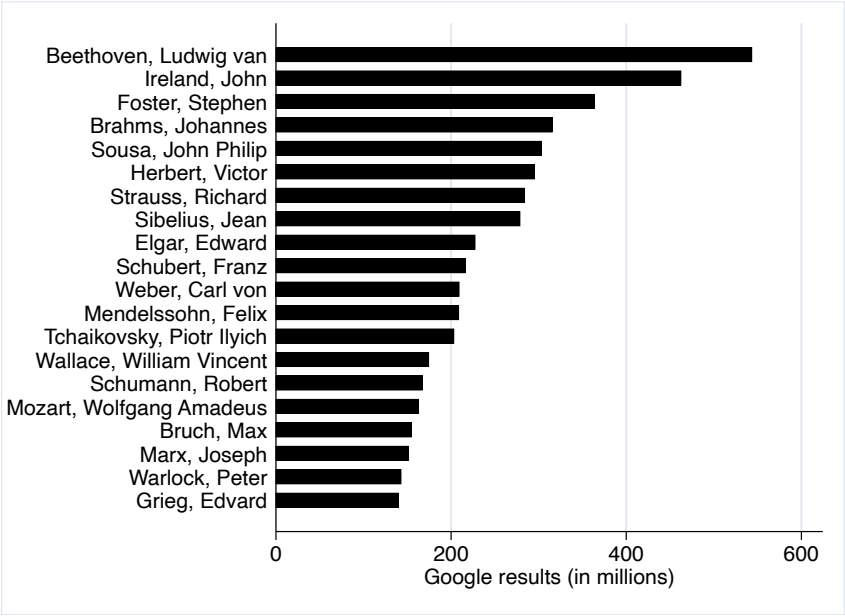


Figure A6: Top Twenty Composers (all time): Google search results

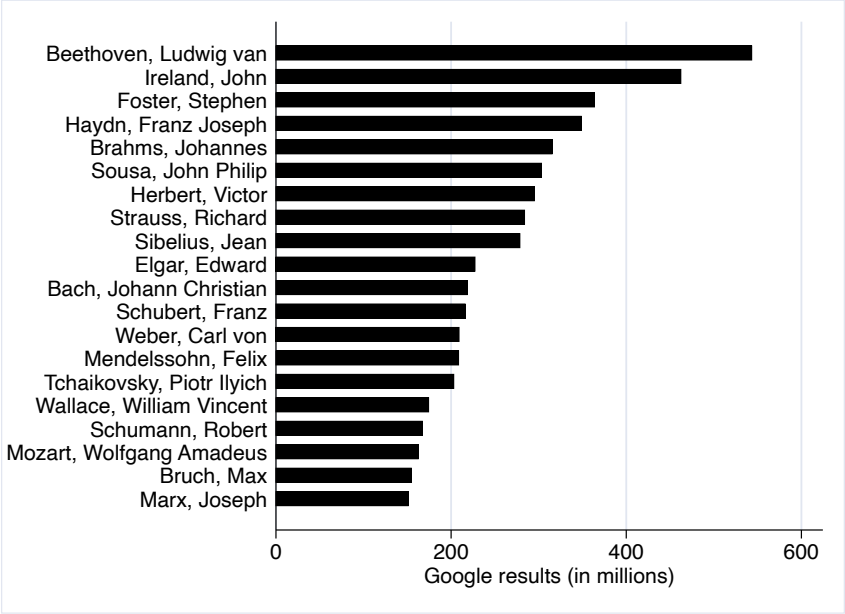


Figure A7: Top Twenty Composers (1750–2005): Spotify popularity

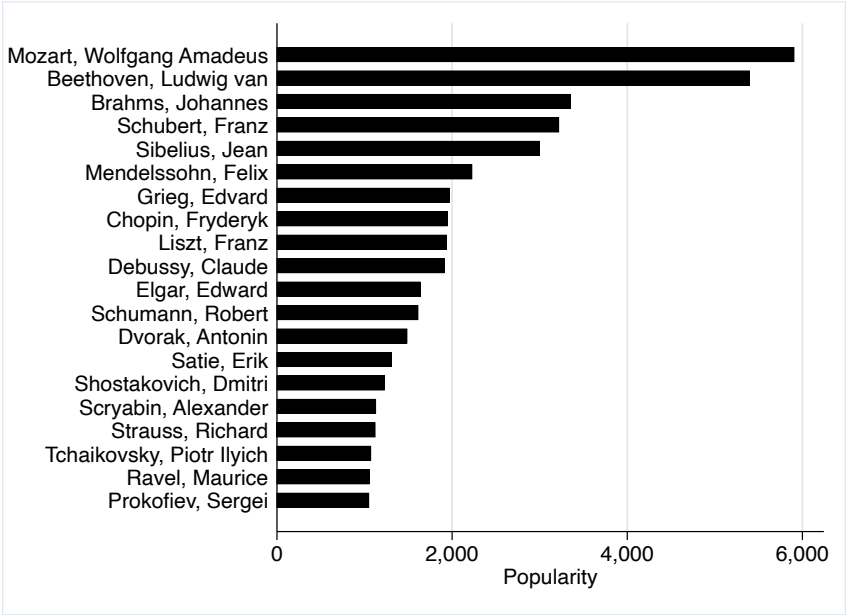


Figure A8: Top Twenty Composers (all time): Spotify popularity

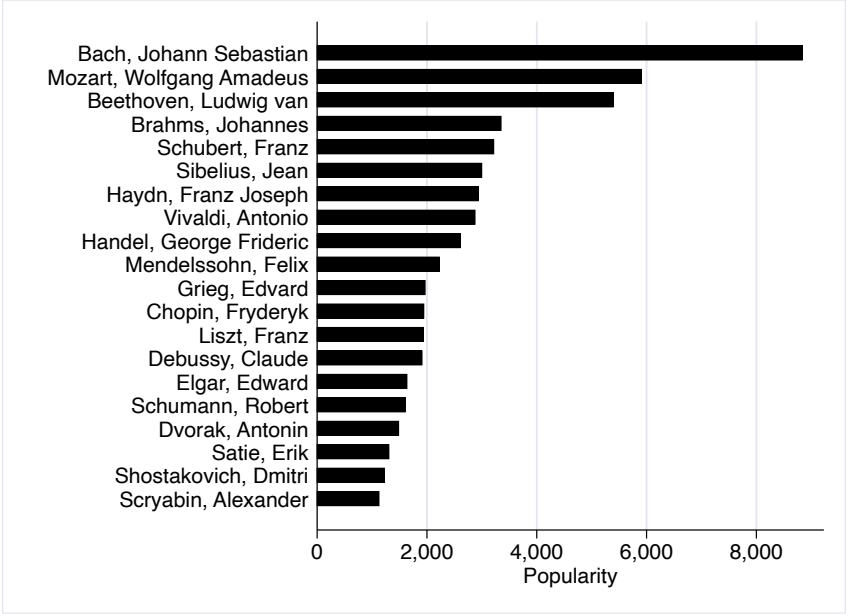


Figure A9: Top Twenty Composers (1750–2005): Google search results per work

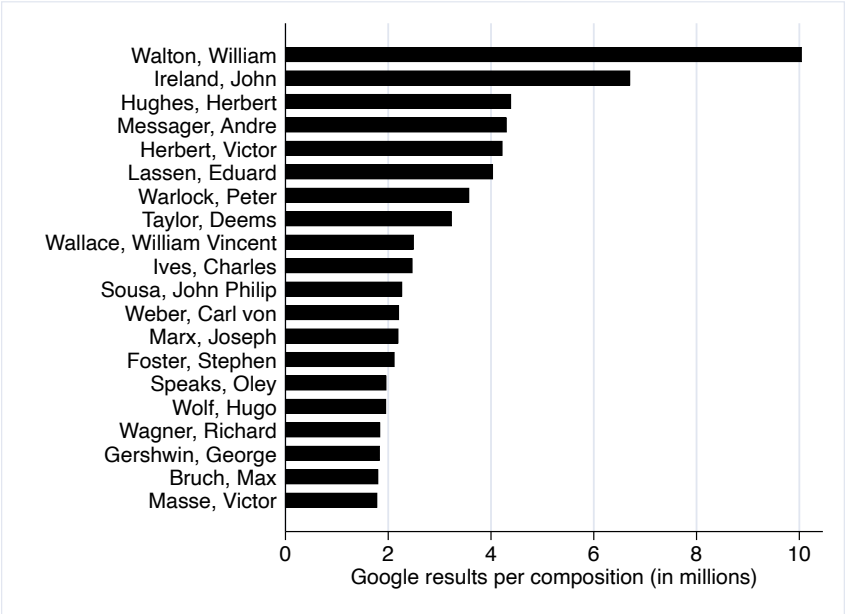


Figure A10: Top Twenty Composers (all time): Google search results per work

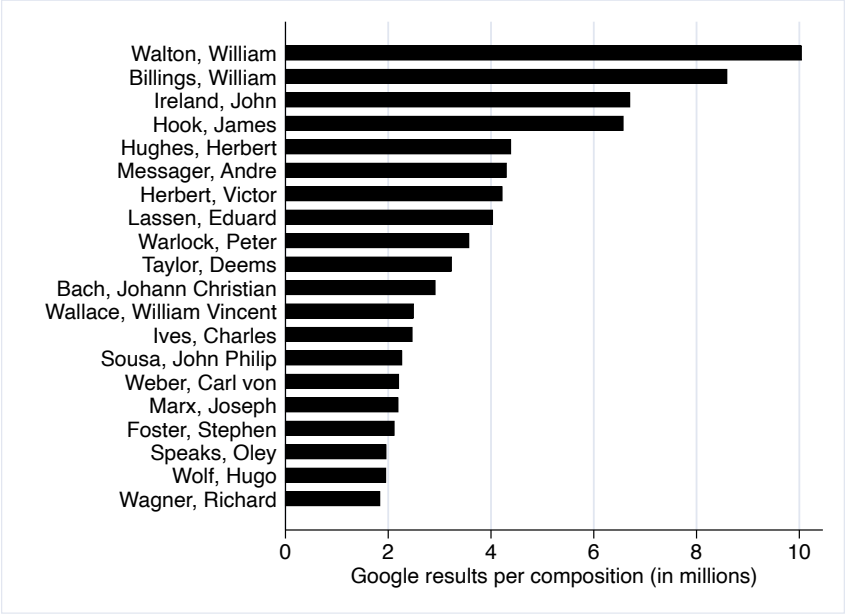


Figure A11: Top Twenty Composers (1750–2005): Spotify popularity per work

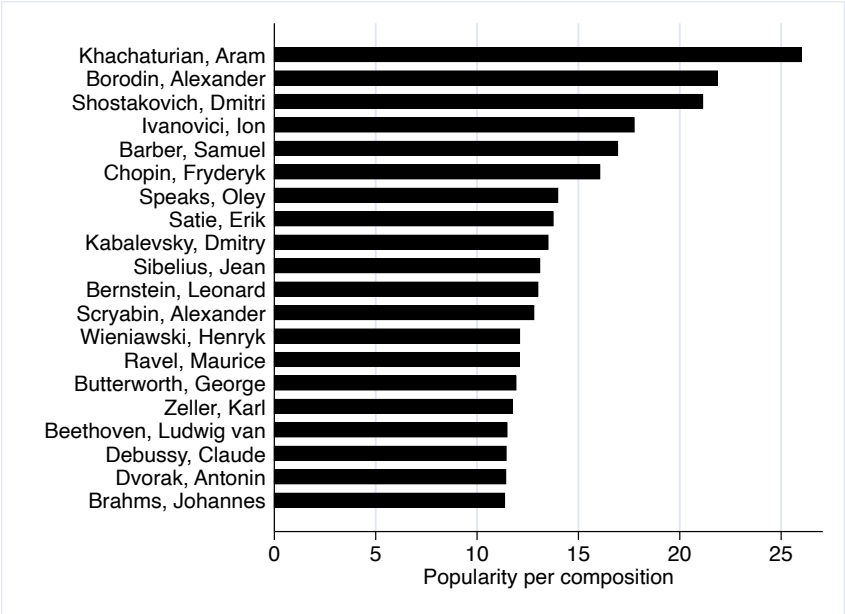
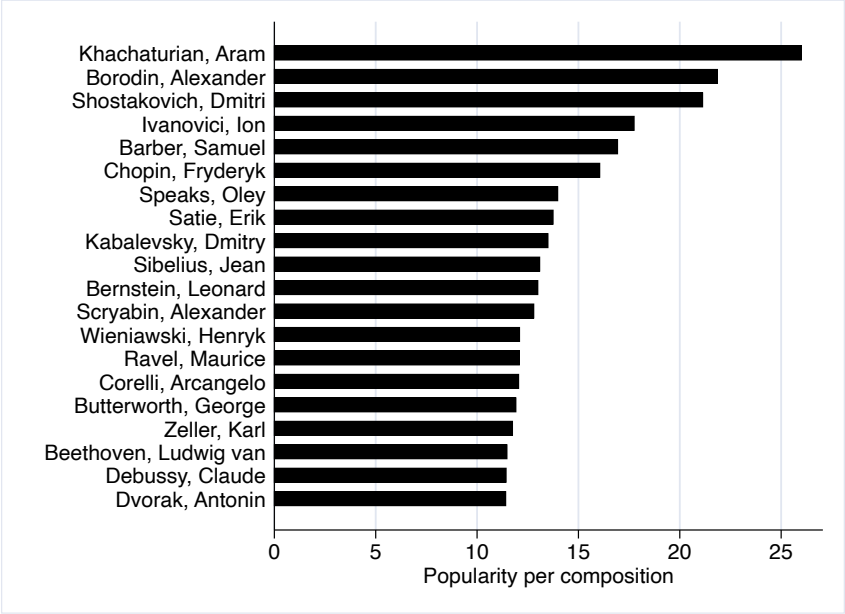


Figure A12: Top Twenty Composers (all time): Spotify popularity per work



D Additional Variable Validation

Table A2: Correlation of Income Classification with Financial Background and Career Characteristics

	Low Income	*High Income*	*Patron*	*Freelance*	*Poor Family*	*Age*
Low Income	1.0000					
High Income	-0.1739***	1.0000				
Patron	-0.1126***	0.2864***	1.0000			
Freelance	-0.0010	-0.1330***	-0.2445***	1.0000		
Poor Family	0.0698***	-0.0285***	-0.0158*	-0.0051	1.0000	
Age	-0.0221**	0.0348***	0.0059	0.0047	0.0055	1.0000
Student	0.0240***	-0.0069	-0.0258***	0.0377***	0.0278***	-0.2320***

Notes: Table reports pairwise correlations among key variables used to classify income years. Low income and high income are binary indicators defined in Section 3. *Patron* equals one if the composer was employed by a court, church, or other institution in a given year; *Freelance* equals one if they lacked a primary institutional employer; *Poor family* indicates low socioeconomic background based on *Grove Music Online*; *Student* indicates if a composer was engaged in formal training in a given year. *** p<0.01, ** p<0.05, * p<0.10.

Table A3: Correlation of Prominence and Visibility Measures (Composer Level)

	Ln(Murray index)	*Ln(Biography* word count)	*Ln(Bibliography* word count)	*Ln(Popularity)*	*Ln(Google* results)
Ln(Murray index)	1.0000				
Ln(Biography word count)	0.8850***	1.0000			
Ln(Bibliography word count)	0.8680***	0.9410***	1.0000		
Ln(Popularity)	0.6300***	0.5310***	0.5120***	1.0000	
Ln(Google results)	0.4620***	0.3450***	0.2780***	0.6400***	1.0000

Notes: Table reports pairwise correlations among composer-level measures. *Murray index* is a composer's score on Murray's index of the top 522 composers of all time. *Biography word count* is the length of the composer's main biographical entry in *Grove Music Online*. *Bibliography word count* is the length of the bibliography section within a composer's *Grove* entry. *Popularity* is the composer's score on Spotify's popularity index. *Google search results* measure the extent of a composer's online presence based on the number of pages referencing their name returned by Google. *** p<0.01, ** p<0.05, * p<0.10.

Figure A13: Relationship Between Prominence and Visibility Measures (Composer Level)

