Measuring Innovation in the Art and Book Markets during the Dutch Golden Age

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During the seventeenth century, Dutch cultural production expanded rapidly, outstripping other countries in terms of scale and scope. Previous studies have demonstrated how favorable circumstances, entrepreneurial ingenuity, and industrial organisation stimulated supply and demand, and how patterns of differentiation and specialization further pushed levels of innovation (Rasterhoff 2016; Montias 1987). But how innovative was cultural production during the Golden Age really?

In this paper we introduce measures for differentiation and specialization and test them on markets for books and paintings between c.1570-1800 relying on two datasets: The Short Title Catalogue of the Netherlands (STCN, the Dutch retrospective bibliography for the period 1540-1800, containing more than 206,000 titles)[1] and the Netherlands Institute for Art History (RKD) dataset, (the online databank of *RKD Images*, which contains more than 150,000 paintings, prints, and drawings dated between 1550-1750).[2] Both datasets contain metadata on individual artworks and publications, including genre and subject labels, as well links to data on producers.

Previous analyses of the STCN dataset have suggested profound levels of product differentiation in Dutch book markets (Rasterhoff 2016). In order to test this, we first use Simpson's Diversity Index (Simpson, 1949), as a measure of diversity.[3] Applying Simpson Diversity to the whole STCN dataset (as well as several subcategories) suggests an increasing diversity in terms of subject labels over time. However, these figures do not show how distinctive the *individual* products were. Besides the metadata in the STCN, we used the shortened and normalized titles themselves to gauge shifts in the markets for books, limiting ourselves to Dutch-language titles totaling 64,706 and excluding state ordonnances and such) (Baron & Rayson 2008).

Subsequently, we trained a topic model--using Latent Dirichlet Allocation (Blei, 2012) on all titles. This yields a per-document-topic distribution for each title. We sum the probabilities per year and normalize the resulting vector. This gives a matrix in which each row-vector capture the

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[1] https://www.kb.nl/en/organisation/research-expertise/for-libraries/short-title-catalogue-netherlands-stcn.
[2] https://rkd.nl/en/explore/images.
[3] $D = N(N-1)/ \Sigma n(n-1)$. Index $= 1-D$.

per-year-topic probabilities. Similarly to Barron et. al. 2017, we score years by their *novelty*, i.e. the extent to which (topic distributions of) publications take an unexpected turn compared to preceding year(s). We measure the level of innovation using the Kullback-Leibler divergence of titles published in year j (represent by a vector $v^{(j)}$) to preceding years ($v^{(j-d)}$ with $1 \leq d \leq w$, with w representing the maximum number of steps we go back in time (formula (1))

$$N_w(j) = \frac{1}{w} \sum_{d=1}^{w} KLD\left(v^{(j)} \mid v^{(j-d)}\right) \ (1)$$

The innovation level patterns correspond to research on cultural markets that places the more radical stylistic and aesthetic innovations in the 1610s and 1620s, followed by a few decades of modest product differentiation, and more conservative trends from the late seventeenth century onwards. But of course novelties only become innovations if they stick. To measure the extent to which innovations *resonated*, i.e. had an impact on the years that followed, we compute *resonance* R score using equation (2):

$$R_w(j) = \frac{1}{w} \sum_{d=1}^{w} \left[KLD\left(v^{(j)} \mid v^{(j-d)}\right) + KLD\left(v^{(j)} \mid v^{(j+d)}\right) \right] \ (2)$$

We find strongly fluctuating levels of resonance (especially during the 17th century) with drops during the politically tumultuous 1670s and 1700s. In the open and competitive Dutch book market, publishers were quick to jump on commercial successes and issue their own reprints or variants.

In addition to high levels of differentiation, Golden Age markets for cultural products were also characterized by increasing specialization. This section on art markets demonstrates how we might measure this. Out of the RKD database, we filtered over 48,000 paintings which are attributed to painters active between 1550-1750. Each painting in *RKD Images* has a title, which often explicitly indicates subject matter (e.g., *Landscape with river scene*) and is also tagged with on average 6 or 7 keywords describing subject matter. The title and keywords allow us to categorize the whole *RKD Image* catalogue into five groups: history paintings, portraits, landscapes, still-lifes, and genre.

With the 48,000 paintings assigned to a specific genre, we quantify genre diversity within the oeuvres of more than 3,000 painters who became active between 1550-1750. To measure the degree of specialization of generations of painters across two hundred years, we use Simpson's diversity measure. A single diversity score is calculated for every artist based on the total number of paintings in his oeuvre (N), and the number of paintings he made for every genre possible n.

We witness an overall trend of decline in genre diversity from 1560 to 1660, with stagnation after c. 1650. An initial decline in the third quarter of the 16th century is also observed, presumably driven by the growing art market in the Southern Netherlands. The rebound of genre diversity in the last decades of the sixteenth century indicates the newly emerging art market in the Northern Netherlands driving up the demand for various genres, especially when immigrants from the South brought pictorial traditions that allured artists to fill the market gap by painting in new fashions (Sluijter 2009). As the market in the Northern Netherlands matured, painters who entered the trade during the first half of the seventeenth century were more specialized than their predecessors.

These exercises provide us with the first systematic quantitative analysis of patterns of differentiation and specialization in the cultural markets of the Dutch Golden Age. The patterns strongly correlate with the by now familiar trends in market development, suggesting close interaction between cultural producers and their markets: in a growing market with an excessive (potential) demand, producers were driven to increase their production, but when facing a mature and saturated market, it was more and more difficult to find a new market niche or a cheaper way of production. Finally, these exercises also suggest that strategies of specialization and differentiation interacted, and that a full-blown comparative analysis of these measures for both (and other) markets would worthwhile for increasing our understanding of surges in cultural production and consumption.

Baron, A. and Rayson, P. "VARD 2: A tool for dealing with spelling variation in historical corpora." Proceedings of the Postgraduate Conference in Corpus Linguistics, Aston University, Birmingham, UK, 22 May 2008.

Barron, Alexander TJ, Jenny Huang, Rebecca L. Spang, and Simon DeDeo. "Individuals, Institutions, and Innovation in the Debates of the French Revolution." arXiv preprint arXiv:1710.06867 (2017).

Blei, David M. "Probabilistic topic models." Communications of the ACM 55, no. 4 (2012): 77-84.

Lincoln, Matthew (2016). If Paintings were Plants: Measuring Genre Diversity in Seventeenth-Century Dutch Painting and Printmaking. In *Digital Humanities 2016: Conference Abstracts*. Jagiellonian University & Pedagogical University, Kraków, pp. 256-259

Montias, J. Michael. "Cost and value in seventeenth-century Dutch art." Art History 10, no. 4 (1987): 455-466.

Rasterhoff, Claartje, *Painting and Publishing as Cultural Industries. The Fabric of Creativity in the Dutch Republic*, Amsterdam 2016.

Simpson, E. H. (1949). "Measurement of diversity". Nature. 163: 688. doi:10.1038/163688a0.

Sluijter, E.J.,'On Brabant Rubbish, Economic Competition, Artistic Rivalry and the Growth of the Market for Paintings in the First Decades of the Seventeenth Century,' *Journal of the Historians of Netherlandish Art* 1 (2009), no.2 http://jhna.org/index.php/past-issues/volume-1-issue-2/109-on-brabant-rubbish