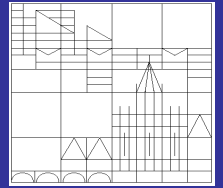




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Measuring the Value of Research: A Generational Accounting Approach

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Abstract

This paper proposes a generational accounting approach to valuating research. Based on the flow of scientific results, a value-added (VA) index is developed that can, in principle, be used to assign a monetary value to any research result and, by aggregation, on entire academic disciplines or sub-disciplines. The VA-index distributes the value of all applications that embody research to the works of research which the applications directly rely on, and further to the works of research of previous generations which the authors of the immediate reference sources have directly or indirectly made use of. The major contribution of the VA-index is to provide a measure of the value of research that is comparable across academic disciplines. To illustrate how the generational accounting approach works, I present a VA-based journal rating and a rating of the most influential recent journal articles in the field of economics.

Keywords: Research evaluation, research accounting, journal ranking, citations.

JEL Classification Numbers: A13, A14, I23.

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1 Introduction

Wilhelm Conrad Röntgen discovered the X-rays (in German referred to as Röntgen rays) on 8 November 1895. He observed that the rays illuminated a fluorescent screen and noted that placing an object between the screen and the source emitting the rays reduced the effect but did not fully stop it. Röntgen published his first results on X-rays in the very last days of 1895. In this publication, Röntgen mentioned that photographic plates are sensitive to X-rays and that he had produced pictures of various objects, including a photograph showing the bones of his wife's hand. This news spread so fast, that the first radiological laboratories opened already in March 1896, only a few months after Röntgen's publication.¹ In 1901 Röntgen received the very first Nobel Prize in physics "in recognition of the extraordinary services he has rendered by the discovery of the remarkable rays subsequently named after him".²

The discovery of the X-rays illustrates how research benefits mankind, namely through applications. The use of X-rays improved the quality of medical treatment. Subsequent research has increased the value of X-rays further, by allowing for higher quality pictures, lower radiation and additional applications such as X-ray computed tomography. Although Röntgen's work constitutes only a small fraction of the research on X-rays that has been carried out ever since, his contribution left its imprint on any subsequent piece of research: X-ray computed tomography and other subsequent applications profess Röntgen's legacy. The value of Röntgen's discovery for mankind thus derives from direct and indirect contributions.

Alfred Nobel wanted his prize to be awarded "to those who, during the preceding year, shall have conferred the greatest benefit on mankind." Awarding committees are therefore obliged to assess the overall impact of a researcher's work on welfare. It is thereby not important whether the honored research generates direct valuable applications, as in the case of the X-rays, or whether such applications are likely to be forthcoming after further research and development as it was the case with regard to Einstein's theory of relativity. What is supposed to count for winning the Nobel Prize is that research will eventually give rise to applications, thereby improving the human condition.

Although the Nobel Prize is the highest distinction in science today, Alfred Nobel's selection criterion plays almost no role when it comes to judging less

¹see Glasser (1995) and the reprint of Röntgen's original publication in Glasser (1995).

²Nobel Prize homepage (http://nobelprize.org/nobel_prizes/physics/laureates/1901/rontgen.html)

outstanding research. Evaluations of researchers nowadays measure a scientist's research performance in terms of citations to his or her work, the number of published papers, the outlets in which he or she has published, or some combination thereof. These criteria, however, provide no information on the intrinsic value of research since they measure only the creation of knowledge per se and not necessarily the direct or indirect creation of social welfare. The informative value of traditional research performance indices is thus limited, i.e. these indices are not helpful in guiding the science system towards an efficient use of research time and funds.

One of the arguably most important issues in research policy is to determine the overall amount invested in basic and applied research and to distribute these funds across the various disciplines and specific fields of investigation. The composition of the public research budget is however in large parts historically determined and, moreover, subject to rent-seeking activities. It would therefore be surprising if the marginal return of research, for example, in quantum physics would be the same as in archeology.

This study proposes a research performance indicator that can, in principle (i.e. if the required information is acquired), provide researchers, managers of research institutions, and politicians in charge of research policy with an instrument that measures how efficiently scarce resources are used in the science system. Before presenting the basic idea of this indicator, I briefly survey the state of the art of research evaluation in order to show why the existing research performance indicators fail to assess the relative contribution of different scientific disciplines towards generating social welfare benefits.

Traditional measures of research production

Citations represent the basic ingredient of all traditional measures of research performance. It is therefore not surprising that the most frequently mentioned obstacle to comparing research productivity across disciplines consists in differences in discipline-specific citation habits. In particular the number of studies referenced in the average research item varies a great deal across disciplines. Standardizing indicators based on citation counts by normalizing discipline averages does of course not solve the problem as it renders all disciplines equally important by definition.

Instead of normalizing research indicators ex post, one can control for reference intensity when calculating an indicator. In practice these two approaches produce

different results, because of cross-citations between fields. Such interdisciplinary citation flows can be used to illustrate how research is influenced by different fields. The invariant method developed by Pinski and Narin (1976), for example, is a method to measuring journal quality that corrects for reference intensity, i.e. it corrects for the average number of references per study across disciplines.³ In addition, the invariant method also weights citations according to the quality of the citing source. Palacios-Huerta and Volij (2004) show that the invariant method is the only method satisfying a set of desirable properties. This axiomatic foundation has certainly greatly contributed to establishing the invariant method as the state-of-the-art method of rating journals.

The quality weights that result from applying the invariant method to a set of journals measure the “intellectual influence” (Palacios-Huerta and Volij, 2004) of a research outlet, i.e. a journal’s quality weight represents the journal’s relative importance for subsequent research. Ritzberger (2008), for example, ranks economics journals using the invariant method. He finds that business-related fields rank significantly lower than other sub-fields of economics. This finding is due to the fact that business-related research is more applied and therefore contributes less input for subsequent research than more theoretical research. Consequently, the invariant method ranks applied journals systematically lower than journals specializing in publishing theoretical results or new research methods. Knowledge and utility are, however, two distinct concepts which do not need to coincide. It is therefore an open question whether the relatively poor performance of downstream journals also holds in terms of utility.

It has repeatedly been stressed that there are many ways of evaluating research and that the selection of a specific evaluation method is often rather arbitrary.⁴ Assessing research in terms of utility restricts this arbitrariness. Utility is, for example, independent of the prevailing citation habits. Invariance to reference intensity is thus not only a nice theoretical concept, it is an indispensable constituent of any utility based research assessment.

The basic idea of the VA-index

I now return to fleshing out the general idea of measuring research productivity by tracing, generation by generation, social welfare gains to their intellectual sources.

³The invariant method is also at the heart of Google’s search algorithm.

⁴see, among others, Palacios-Huerta and Volij (2004), Kóczy and Strobel (2010), and Ravalion and Wagstaff (2010)

The purpose of research is not to have a direct effect on social welfare, but to provide insights to politicians, entrepreneurs and the individual how to achieve higher welfare. Research is thus an investment into future utility. Different research fields will, typically, affect different aspects of utility. Allocating resources in academia is, therefore, a classical investment decision in which preferences play a role. A rational decision maker needs to maximize his or her expected utility, given his or her information. To do so efficiently, a decision maker needs to know how research maps into utility.

Understanding how research affects utility goes beyond knowing in which fields applications emerge and how valuable these applications are. By restricting a discipline's relevance to applications, one ignores, for example, the fundamental contribution of mathematics to almost all disciplines. What one really needs to understand is how applications emerge, i.e. who contributed how much to the creation of a particular application.

Reconsider X-ray computed tomography, which was developed by Allan M. Cormack and Godfrey N. Hounsfield. Cormack and Hounsfield received the Nobel Prize in Physiology or Medicine in 1979. Besides Cormack and Hounsfield, Wilhelm C. Röntgen certainly also has an intellectual share in the creation of X-ray computed tomography. Moreover, Röntgen did not discover X-rays out of the blue: he relied on earlier research. More so, Cormack and Hounsfield relied not only on Röntgen's work, but also on other findings. The intellectual achievement of X-ray computed tomography is, therefore, not one of Cormack and Hounsfield alone, but one of numerous researchers, Röntgen included. The intellectual credit of X-ray computed tomography and all other inventions thus belongs to numerous researchers. Understanding how research maps into utility means to understand how and how much the individual idea has contributed to applications and thus to utility.

In the following I propose a generational accounting approach, that identifies the intellectual sources of research generated welfare. Moreover, this approach measures the intellectual influence of any research result on other research results and assigns the parent result a corresponding share of influence. The accounting feature of this method is that all shares of influence of a research result add up to one. The sources of intellectual contribution are thus exactly identified, measured, and distributed.

The proposed method allows to assess research performance in terms of utility by combining the value of applications with the corresponding shares of research influence. Measuring the value of applications is unfortunately way beyond the

scope of this paper. Nederhof and Meijer (1995) argue that research does not improve living conditions directly, but that research results need to be transferred to users outside the science system to generate useful applications. Transferring knowledge to users outside the science system can therefore be regarded as final product of any scientific endeavor. The *raison d'être* of the VA-index is to identify the sources of value created by scientist for a given valuation of the observed research transfers.

The next section presents the theoretical concept of the VA-index. I also discuss some problems of applying the method to existing data. Section three presents a first implementation for economics, albeit a purely bibliometric one, since we do not have, so far, data on research transfer and a convincing exogenous measure for the value of applications. The bibliometric application ranks economics journals and individual articles published in the 1986-2004 period according to their respective influence on subsequent economic research. Section four concludes.

2 Research accounting

The VA-index is designed to measure the contribution of individual research results to the creation of value, i.e. to the utility accruing to the users of applications that embody these research results. The idea of the VA-index rests on the insight that research production requires research as one of its main production factors and this production process can be investigated and portrayed with standard economic techniques. In this respect the VA-index follows the basic idea of endogenous growth theory (see, for example, Romer, 1990).

Research provides two kinds of services: transfer of knowledge to the applied sector and intellectual input into further research. Transfer of knowledge to the applied sector constitutes the final product of academic research, i.e. the output. Intellectual input into further research, on the other hand, is an intermediate good in the production of knowledge. The value or revenue generated by research results thus depends on the knowledge transferred to the applied sector and on its contribution to subsequent research. The intellectual revenue of a research result is illustrated with the help of the right-hand account in Figure 1.

Research relies on previous research results. Stigler and Friedland (1975), for example, refer to citations as “a form of intellectual collaboration”. Researchers can therefore only claim a fraction δ of the value of their research results as

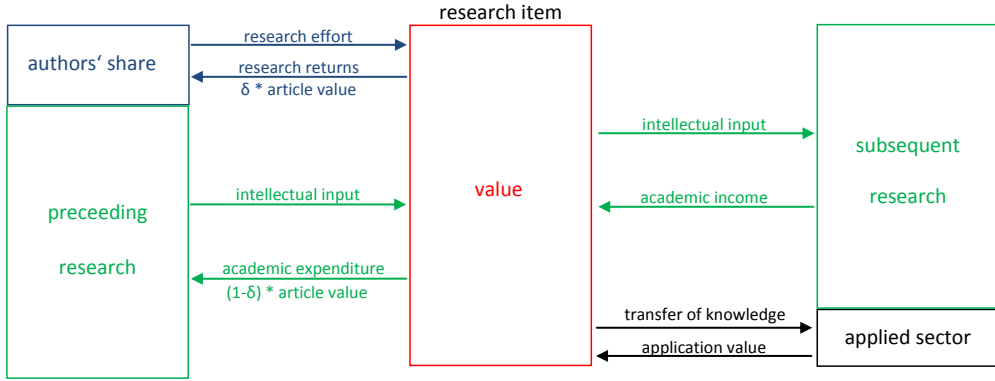


Figure 1: Research accounting at article level

their own intellectual contribution, i.e. their value added, while the remaining value belongs to the preceding literature upon which the results are built. The expenditure part of an article is portrayed by the left-hand account in Figure 1.

The VA-index identifies all direct intellectual sources of the research results and also the relevance of each individual source. It then follows a simple rule: the value of a research item is distributed to all direct intellectual inputs (researchers own input and preceding research), according to their respective influence on the result at hand. Applying this concept for all generations of research allows to identify all *indirect* intellectual sources of any research result because indirect sources are linked to the final research result via a finite chain of direct inputs. Consider a research result of a given value. A fraction of this result’s value remains with the authors while the remaining part is passed on to the research results that provided direct inputs to this study. The value of the direct inputs is then also distributed on the research items that these direct inputs are based on. Thus, any transfer from a research result to its direct inputs will not only affect the direct inputs but also the direct inputs of the direct inputs. By continuing this process, value is mapped from one generation of research to the previous one, and ultimately to all items which provided direct and indirect inputs to a research result at some point of time.

Figure 2 illustrates how the value of research result A is mapped to its intellectual sources. Research results are depicted by two rectangles, a large one representing the value of the item and a smaller shaded one (in the upper left corner of the large rectangle), representing the authors’ contribution. The five items U to Z represent research results whose “ancestors” cannot be traced and therefore constitute starting points of the research production process. Connections between research results indicate intellectual input from the left to the right

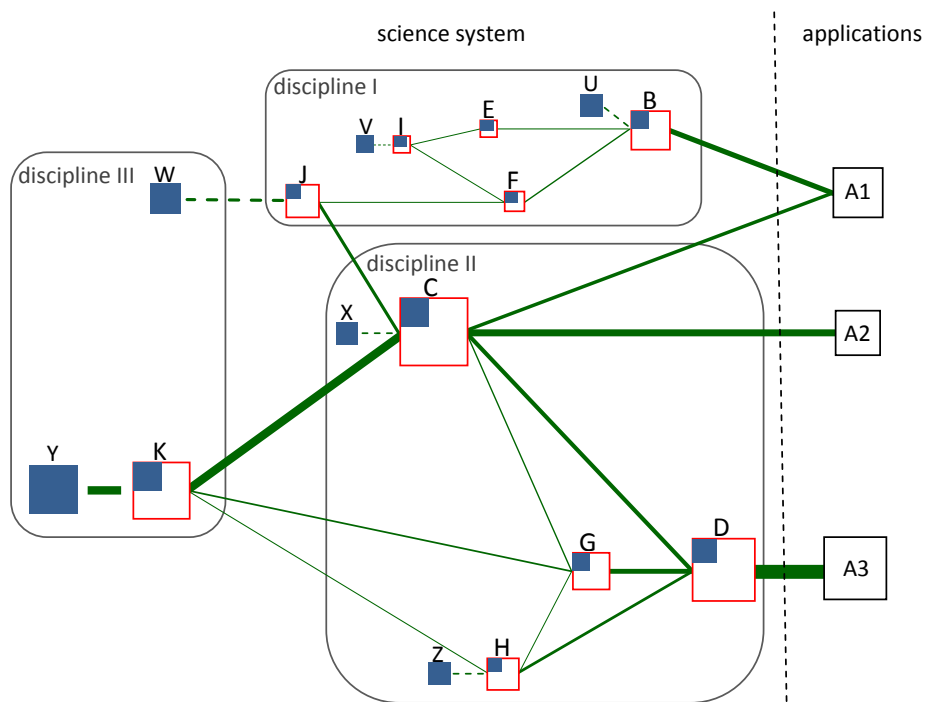


Figure 3: Research accounting from applications to academia

areas) of the individual research results belonging to this discipline. Note that *discipline III* has the largest impact on the creation of welfare, although it does not directly lead to any application.

Transferring knowledge to the applied sector is a dynamic process. Research results are absorbed with time lags and it takes time for applications to emerge. One would therefore expect that the (materialized) research value increases over time. Similarly, if a research study combines two or more results, the dynamics of value realization can change the relative importance of the study's intellectual sources. Consider, for example, a study that introduces a new econometric method and, by applying this method, also provides new insights into the mechanism of money supply. Central bankers are able to use the findings directly, whereas it takes some time for the new econometric method to give rise to other applications. The money supply innovation will, therefore, be most relevant in the beginning.

In the next subsection I outline a formal representation of generational research accounting and the VA-index.

Formal description

Let Γ be the set of intellectual contributions at a given point of time and let Γ comprise a total of N research results (items).

The value v_i of item i is split between the item's own contribution amounting to the fraction δ_i of the value and the contribution to the preceding literature that receives, via transfers, the remaining value in return for its intellectual input.

Let $c_{i \rightarrow j}$ denote the value of the direct intellectual input provided by item j to item i and the corresponding value transfer from i to j ; $c_{i \rightarrow i}$ is zero by definition. The vector $c_i = (c_{i \rightarrow 1} \dots c_{i \rightarrow N})$ collects all direct inputs provided to item i . The transfer matrix $C = (c_1; c_2; \dots; c_N)$ describes all inputs and thus accounts for all inter-generational transfers of value added.

When mapping value transfers across many generations of items, it is convenient to work with transfers in relative terms. The share of total value of item i transferred to item j is given by $d_{i \rightarrow j} \equiv c_{i \rightarrow j}/v_i$. By construction $\sum_{j=1}^N d_{i \rightarrow j} = 1 - \delta_i$, since the authors' contribution δ_i is not passed further on. Moreover, let $d_i = (d_{i \rightarrow 1} \dots d_{i \rightarrow N})$, $D = (d_1; d_2; \dots; d_N)$ and $a_{i \rightarrow j}$ be a dummy variable assuming the value 1 if research result j contributes to research result i ($c_{i \rightarrow j} > 0$) and $a_{i \rightarrow j} = 0$ otherwise.

An indirect link of order q connecting item i to item j is a chain $a_{i \rightarrow k_1} a_{k_1 \rightarrow k_2} \dots a_{k_q \rightarrow j}$, with no zeros.⁵ That is, an indirect link of order q is a link passing through q generations of research results.

Note that research results can be linked through many different chains or paths connecting item i with item j . For example items A and K in Figure 2 are indirectly linked of order 1 via $A \rightarrow C \rightarrow K$, of order 2 via $A \rightarrow D \rightarrow C \rightarrow K$, $A \rightarrow D \rightarrow G \rightarrow K$ and $A \rightarrow D \rightarrow H \rightarrow K$, and of order 3 via $A \rightarrow D \rightarrow G \rightarrow C \rightarrow K$ and $A \rightarrow D \rightarrow G \rightarrow H \rightarrow K$.

Indirect links reveal the channels through which research results affect each other. The order of an indirect link indicates the importance of the link. The higher the order of a link, the smaller is the value passing through this channel, because each generation of items between the two ends keeps a fraction of value.

The share of indirect transfer via a link of order $q \geq 1$ between item i and

⁵Formally, if $i = k_0$ and $j = k_{q+1}$, then an indirect link of order q between i and j via k_1, \dots, k_q exists, if $\prod_{n=0}^q a_{k_n \rightarrow k_{n+1}} = 1$.

item j is given by

$$\begin{aligned} id_{i \rightarrow j, q} &= id_{i \rightarrow 1, q-1} d_{1 \rightarrow j} + \dots + id_{i \rightarrow N, q-1} d_{N \rightarrow j} \\ &= \sum_{k=1}^N id_{i \rightarrow k, q-1} d_{k \rightarrow j}. \end{aligned} \quad (1)$$

Adding over all research results in Γ implies that all potential paths are taken into account. Because a share δ_k of value at level $q - 1$ remains with the contributing research result, only the remaining fraction is passed on. Direct transfers are indirect transfers of order zero, i.e. $id_{i \rightarrow j, 0} \equiv d_{i \rightarrow j}(1 - \delta_i)$. Finally, define $id_{i, q} = (id_{i \rightarrow 1} \dots id_{i \rightarrow N})$ and $ID_q = (id_{1, q}; \dots; id_{N, q})$.

Using the concept of indirect transfers, one can express the transfer of value from applications to their intellectual sources and the resulting measures of value-added in the following manner:

$$\mathbf{va} = \Delta \left[\mathbf{u} + \sum_{q=0}^Q ID_q' \mathbf{u} \right], \quad (2)$$

where \mathbf{va} is the resulting vector of value added, Δ is a diagonal matrix with the individual δ s on the main diagonal, \mathbf{u} is the utility gain deriving from each item's knowledge transfer to the applied sector, and Q is the order of the longest indirect link.

\mathbf{va} is a measure of valuation of individual research results. Based on this measure one can derive (1) valuations of individual scientists, (2) entire research units, (3) evaluations of journal quality, and (4) evaluations of entire disciplines.

The contribution of an arbitrary research entity e is given by:

$$\mathbf{va}_e = \sum_{i \in E} \mathbf{va}_i * s_{i, e}, \quad (3)$$

where E is the set of research projects which entity e was involved in, and $s_{i, e}$ captures the entity's share in result i . If a result has three authors, each of them might be credited by $s = \frac{1}{3}$.

Since the creation of research results and the creation of the utility related to these results are separated in time, the costs and benefits are not directly comparable. One therefore may want to account for time preferences by adding a discount factor to equation 3. Discounting valuations is also appropriate when

comparing different disciplines. Suppose an average result in mathematics has a larger impact on welfare than a result in economics. If the average impact time in mathematics is much longer than in economics, the effective returns from mathematics can actually be smaller than those from economics.⁶

Many theoretical concepts in economics face problems when it comes to implementing those concepts. Generational research accounting makes no exception. First, measuring the contribution u of a research result to the applications is a challenging task. Second, some sources that provided intellectual input to a research result may not be documented, be it because they were forgotten or, as for example in the case of the Nash equilibrium (Nash, 1950), because an explicit reference appears to be redundant. Due to a lack of better alternatives one is, unfortunately, often forced to use citations. In bibliometrics this is common practice, but nevertheless it is a rather crude escape.⁷ The third problem of implementing generational research accounting concerns the relevance of the sources for a research result. Citations only indicate the incidence of intellectual input, not its impact. Even worse, Serrano (2004) points out that citations sometimes refer to bad contributions to a topic. Finally, the share of a research item's value that the authors can claim as their contribution is hard to measure and likely to differ from item to item.

All these problems have to be treated appropriately, if the full potential of the VA-index is to be reached. Yet, even while many tough problems remain, the VA-index can already now provide valuable services to the scientific community. Comparing the performance of different social science disciplines, for example, is less demanding than comparing the value added of the social sciences with the value added of the natural sciences, because all social sciences use similar channels of transferring their output to the applied sector, implying that measurement errors will affect all sub disciplines in the same manner.

One way of circumventing many of these problems is to compile VA-indices that portray only the science system, i.e. indices that do not attempt to measure utility in terms of application values but only the value of research for subsequent research as measured by standard bibliometric data. The next section presents such an indicator which is based on citation flows only. Although the resulting measures cannot be regarded as reliable measures of the value of research for the

⁶Note, that the VA-index allows not only to compare the returns from different areas of research, but also to compare the returns from research to returns from other activities, e.g. from infrastructure projects.

⁷Ritzberger (2008), for example, provides a comprehensive list of shortcomings of relying on citation data.

society at large, one can gain from this exercise first insights into how the VA-index performs as compared to other bibliometric measures of research performance.

3 The intellectual sources of research in economics: applying the VA-index to citation data

In this section I apply the VA-index using only standard citation data and then compare the resulting evaluations of journal quality and article impact with alternative bibliometric measures. Since we are, at the time being, not able to measure the application value of economic research, the presented VA-indices are restricted to identifying the intellectual sources of research in economics conducted between 2006 and 2008.

The data

I use citation data collected from the Social Science Citation Index (SSCI) for the years 1986 to 2008.⁸ The 1986 edition also indexes some journal articles published in 1985. I only consider articles published in journals which were classified by the SSCI as economics journals in 2010. The resulting set of items is limited to items classified as an article, discussion, letter, note, reprint or review. This restriction yields a set of 162,745 research items. Within this set I identify 972,815 citations. For the most recent years almost thirty percent of the references can be identified (the remaining references are not indexed in the considered subsample of the SSCI).

Basic assumptions

I assume that citations indicate direct intellectual input from the cited article to the citing article. Since citations only indicate the incidence of intellectual input between articles, I assume that all sources that an article cites are equally important. Let $a_{i \rightarrow j}$ indicate whether article i cites article j ($a_{i \rightarrow j} = 1$) or not

⁸Ursprung and Zimmer (2007) show that citation data is prone to errors and that such errors can have a significant effect on citation-based ratings. Readers should be aware of the possibility of such errors when it comes to interpreting the results below.

$(a_{i \rightarrow j} = 0)$, i.e.

$$a_{i \rightarrow j} = \begin{cases} 1 & \text{if } c_{i \rightarrow j} > 0 \\ 0 & \text{if } c_{i \rightarrow j} = 0. \end{cases}$$

Given a complete set of literature which covers all citable items, any reference can be matched with the corresponding article. The data I use is, however, incomplete: the SSCI mainly covers journal articles, not all journals are indexed by the SSCI, and the electronic record upon which I rely dates back only to 1985. The last limitation causes older articles to receive a disproportionately higher share of citations: an article published in 2008 can cite articles published between 1985 and 2008, whereas an article published in 1985 can only cite articles published in the same year. Old articles will therefore receive more citations and appear to be more influential than they actually are. To control for this bias one can normalize citations by the number of references instead of the number of citations (identified in the dataset). Normalizing transfers by references causes, however, the fraction of value that an article passes to the previous generation to vary with the share of identified references. I evade this problem by introducing a year dependent correction factor that normalizes the citation to reference ratio to the ratio in 2008.⁹ The fraction of value of article i transferred to article j is then given by:

$$d_{i \rightarrow j} = cf_i a_{i \rightarrow j} / \left(\sum_{k=1}^N a_{i \rightarrow k} \right),$$

where cf_i is the correction factor of the year in which article i was published.

I calculate shares of indirect transfer using $id_{i \rightarrow j}$ as given in equation 1 and assume that the authors' shares are constant across articles, i.e. $\delta_i = \delta \forall i$. Finally, I discount the value of a publication by 3.065 percent a year which corresponds to the average real interest on ten year US treasury bonds between 1986 and 2008.

⁹In 2008 almost 30% of the references can be identified as citations. In 1992 this share is 15%. Thus, I assume that another 15% of references from 1992 articles could be identified if the dataset covered 16 more years. The number of citations would be twice the number reported. Therefore items which are cited by articles published in 1992 will only receive half the transfer they would have obtained if the citing article was published in 2008.

3.1 Rating journal quality

The invariant method

Evaluating journal quality on the basis of citations has been popular among scientists ever since Garfield (1972) proposed the journal impact factor. While the impact factor considers only the number of citations, Liebowitz and Palmer (1984) proposed to take the citing journal's quality into account. The invariant method developed by Pinski and Narin (1976) controls not only for citation quality but also for reference intensity, i.e. the number of items an article refers to. Palacios-Huerta and Volij (2004) establish the invariant method as current the state-of-the-art method to rate journals by showing that the invariant method is the only method that satisfies a set of desirable properties.

I therefore regard the invariant method to represent the natural benchmark for the VA-index. Invariant quality weights of those journals which have had full coverage in the SSCI between 2002 and 2008 are reported in the second column of Table 4 in the appendix. Table 1 below presents a selection of the top-ranked journals. In contrast to most other applications of the invariant method, I control for reference intensity at the article level and not at the aggregate journal level. Palacios-Huerta and Volij (2004) point out that controlling for reference intensity at the article level gives an equal vote to each article in a journal, whereas controlling for reference intensity at the journal level causes articles to receive a disproportional high (low) weight if they have relatively many (few) references. The citing and the cited period are both 2006-2008. I omit self-citations at the level of journals, because some journals, for whatever reasons, show excessive rates of self-citations. The resulting rating with the three year window 2006-2008 is labeled *Inv 3y*. Journal weights are normalized so that the top journal has a score of 100.

The journal rating *Inv 3y* corresponds to the state of the art in bibliometrics, but it is nevertheless not the best rating of the invariant type. In the following I will elaborate on the shortcomings of the standard invariant rating and present a superior invariant rating.

Journal ratings usually rely on rather short cited periods.¹⁰ Limiting the cited period gives, however, editors and thereby researchers an incentive to focus on hot topics which are likely to attract citations quickly. Promising research, which is however not en vogue, is more likely to remain unpublished, since the journal's

¹⁰Palacios-Huerta and Volij (2004) use seven years, Kalaitzidakis, Mamuneas, and Stengos (2003) five years and Ritzberger (2008) three years

rating will not benefit from a paper’s late success. Furthermore, manipulation attempts have a larger effect on the resulting rating if it relies on a small data set: short cited periods thus increase the incentives for strategic manipulations.

Differences in journal coverage are not a big issue when ratings are based on short cited periods because journals with an incomplete citation record are either excluded or treated as if all data were available. For long cited periods, however, differences in journal coverage become more problematic, since more journals are affected and the effects resulting from incomplete coverage become more pronounced. Figure 4 illustrates how a journal’s imputed quality depends on its coverage if journal quality is measured as the total number of citations divided by the total number of articles published in the relevant period. The first panel in Figure 4 shows the distribution of citations in articles published in 2006-2008 of articles published in 1985-2008. The second panel presents the corresponding cumulative density function. The last panel reports citations per article for a fictitious journal with coverage from 2008 back to the year indicated on the x-axis. Citations per article peak for a journal with a track record of 12 years (i.e. a journal whose coverage commences in 1997). Comparing the rating of a journal with twelve years of data coverage to the rating of the same journal with 23 years of coverage suggests that articles of the “older” journal have almost 20% lower quality. These differences do, however, not reflect differences in journal quality, they rather arise because of the specific pattern of the citation life cycle.

To control for variations in journal coverage I weight citations by a year specific weight: all articles published in a year receive a weight proportional to the fraction ϕ of citations to articles published in this year as represented by the first panel of Figure 4. Each individual article then receives a weight equal to ϕ/n , where n is the number of articles published in the respective journal and year. If a journal does not have full coverage, I rescale the journal’s year specific weights to add up to one.

Column three in Table 1 reports the journal rating using the described correction for coverage. It is based on citations by articles published between 2006 and 2008 of articles from all years covered in the data set. The results would be identical to the standard invariant method, (1) if the journal size was constant over time, (2) if all journals had full coverage, and (3) if all years received the same number of citations. The rating is labeled *Inv* 24y*.

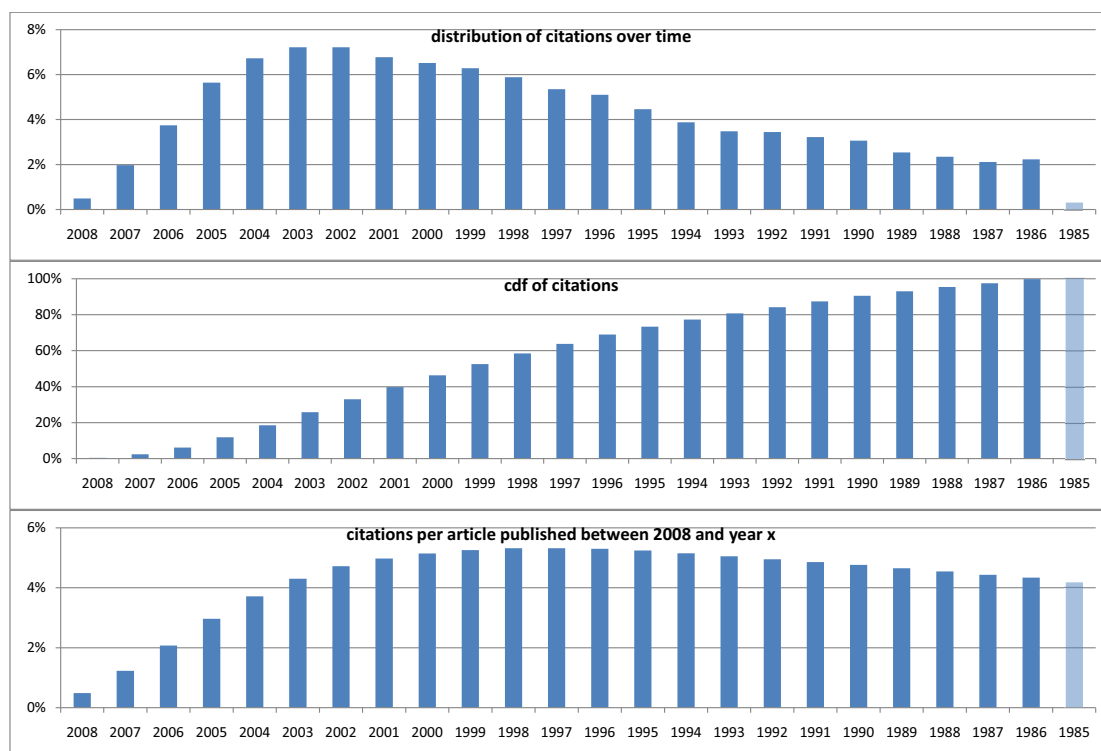


Figure 4: Journal coverage and citation life cycle

Table 1: Comparison of journal ratings

Journal	Inv 3y	Inv* 24y	VA-index w	VA-index u
QUARTERLY JOURNAL OF ECONOMICS	96.37 (2)	100 (1)	100 (1)	100 (1)
JOURNAL OF POLITICAL ECONOMY	86.97 (3)	81.59 (3)	71.78 (2)	69.3 (3)
ECONOMETRICA	100 (1)	85.23 (2)	70.23 (3)	68.65 (4)
JOURNAL OF ECONOMIC LITERATURE	51.13 (6)	73.02 (4)	68.36 (4)	99.87 (2)
AMERICAN ECONOMIC REVIEW	75.23 (5)	59.81 (6)	56.23 (5)	64.35 (5)
REVIEW OF ECONOMIC STUDIES	80.71 (4)	63.5 (5)	53.04 (6)	48.3 (7)
BROOKINGS PAPERS ON ECONOMIC ACTIVITY	7.1 (56)	35.27 (7)	40.31 (7)	52.51 (6)
JOURNAL OF ECONOMIC PERSPECTIVES	34.95 (11)	27.27 (10)	28.19 (8)	39.25 (8)
JOURNAL OF FINANCIAL ECONOMICS	28.74 (15)	27.08 (11)	27.66 (9)	35.6 (11)
JOURNAL OF ECONOMIC GROWTH	24.18 (22)	28.05 (9)	25.64 (10)	37.67 (10)
JOURNAL OF MONETARY ECONOMICS	25.89 (18)	24.7 (13)	25.32 (11)	32.3 (12)
RAND JOURNAL OF ECONOMICS	40 (8)	30.01 (8)	24.68 (12)	30 (13)
JOURNAL OF ECONOMIC THEORY	39.11 (9)	26.61 (12)	21.55 (13)	21.2 (28)
ECONOMIC POLICY	27.26 (16)	18.69 (18)	20.7 (14)	38.74 (9)
JOURNAL OF LABOR ECONOMICS	31.2 (14)	20.6 (14)	20.12 (15)	24.84 (21)
REVIEW OF ECONOMICS AND STATISTICS	40.65 (7)	20.4 (15)	20.07 (16)	29.58 (14)
INTERNATIONAL ECONOMIC REVIEW	35.82 (10)	19.93 (16)	17.86 (17)	20.3 (32)
JOURNAL OF HUMAN RESOURCES	24.26 (21)	16.32 (23)	17.54 (18)	23.82 (22)
JOURNAL OF LAW & ECONOMICS	31.92 (13)	17.53 (20)	16.96 (19)	20.45 (31)
GAMES AND ECONOMIC BEHAVIOR	32.69 (12)	19.16 (17)	16.7 (20)	16.84 (40)
AER Papers & Proceedings	18.12 (30)	15.81 (24)	16.62 (21)	21.59 (25)
JOURNAL OF ECONOMETRICS	23.92 (23)	18.06 (19)	16.2 (22)	26 (18)
JOURNAL OF INTERNATIONAL ECONOMICS	26.48 (17)	14.58 (28)	16.08 (23)	26.7 (17)
REVIEW OF ECONOMIC DYNAMICS	20.86 (26)	16.57 (21)	15.09 (24)	16.13 (44)
ECONOMIC JOURNAL	25.56 (20)	15.26 (25)	14.66 (25)	25.76 (19)
JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS	25.8 (19)	16.43 (22)	14.46 (26)	17.53 (37)
JOURNAL OF ACCOUNTING & ECONOMICS	7.87 (52)	13.85 (29)	13.65 (27)	13.73 (51)
JOURNAL OF BUSINESS & ECONOMIC STATISTICS	22.97 (24)	14.87 (27)	13.41 (28)	21.34 (26)
JOURNAL OF LAW ECONOMICS & ORGANIZATION	8.9 (48)	13.65 (30)	12.62 (29)	17.27 (38)
JOURNAL OF PUBLIC ECONOMICS	19.33 (27)	12.38 (32)	12.39 (30)	19.98 (33)
JOURNAL OF INDUSTRIAL ECONOMICS	21.46 (25)	13.56 (31)	11.93 (31)	21.13 (29)

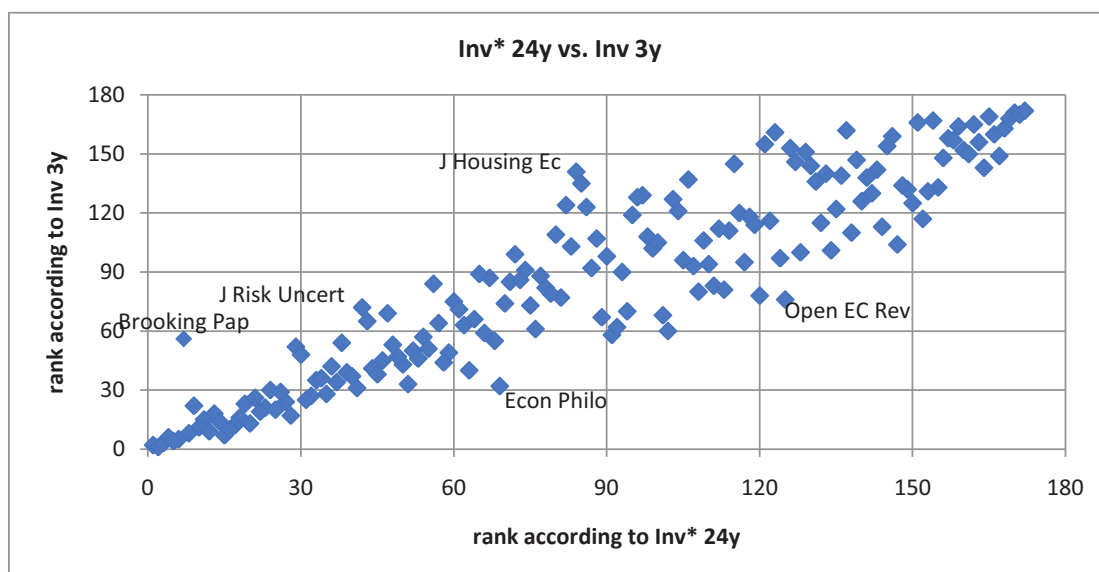


Figure 5: Scatter plot of journal ranks according to $Inv^* 24$ and $Inv 3y$

Journal	$Inv 3y$	$Inv^* 24y$	VA-index w	VA-index u
JOURNAL OF APPLIED ECONOMETRICS	18.2 (29)	15.04 (26)	11.77 (32)	20.66 (30)
WORLD BANK ECONOMIC REVIEW	10.55 (39)	10.4 (39)	11.39 (33)	26.96 (16)
MATHEMATICAL FINANCE	10.2 (42)	10.89 (36)	10.54 (35)	26.97 (15)
JOURNAL OF HEALTH ECONOMICS	6.25 (65)	8.49 (43)	8.87 (38)	21.31 (27)
ECONOMIC THEORY	19.09 (28)	11.1 (35)	8.29 (41)	11.41 (72)
WORLD BANK RESEARCH OBSERVER	10.42 (41)	7.87 (44)	8.23 (42)	22.28 (24)
JOURNAL OF ECONOMIC GEOGRAPHY	4.56 (75)	5.59 (60)	5.61 (54)	23.3 (23)
JOURNAL OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT	6.28 (64)	5.7 (57)	5.48 (56)	24.95 (20)

Figure 5 illustrates the differences between $Inv 3y$ and $Inv^* 24y$. Differences can reflect field specific citation life cycles, changes in journal quality, stochastic variations, or a combination thereof. The Brookings Papers on Economic Activity, the Journal of Economic Growth, and the Journal of Risk and Uncertainty are among those journals that profit most from extending the cited period. Many journals related to finance also profit from extending the cited period, whereas many journals specializing in international economics and economic development fare better in the first rating ($Inv 3y$).

The VA method

Columns four and five of Table 1 present journal ratings based on the VA-index. Assuming that all direct citations of an article are equally important causes older articles to have on average larger VA-indices, because older articles receive both direct as well as indirect returns for their contributions. This article, for example, cites Garfield (1972) and several articles citing Garfield (1972). The direct contribution of Garfield (1972) to this paper, however, is less important than its

refinement by Pinski and Narin (1976).¹¹ Assuming that all citations are equally important will, in general, lead to an overestimation of the direct contribution of older studies. In computing the VA-index, I therefore use yearly weights as in the case of *Inv* 24y*. I also discount article scores by 3.065 percent a year. Moreover, I normalize article scores such that the sum of the article scores in each year equals the number of articles published in this year. Finally, I set δ equal to 0.164, because this value implies that the growth rate of knowledge roughly equals the growth rate of the economy.¹²

I present two versions of the VA-index: Both versions assign exogenous application values to articles published between 2006 and 2008 and then use citations by all articles in the sample to identify the intellectual sources. For the *VA-index w* I assume that a 2006-2008 article's value equals the quality weight of the journal in which the article was published. Journal quality weights are thus determined by a system of equations. The *VA-index u*, on the other hand, relies on unweighted 2006-2008 article value, i.e. every article's application value is normalized to one. In both cases the VA-indices of the quality of articles published between 1986 and 2008 are calculated according to equation 2 and subsequently discounted.

Figure 6 shows that the journal rating based on the *VA-index w* is very close to the rating based on *Inv* 24y*. The correlation between the two ratings is 0.9946 (based on journal scores, not on journal ranks). The ratings of Economic Policy (*Inv* 24y* rank 18; *VA-index w* rank 14), the Journal of Human Resources (23; 18), and the Journal of International Economics (28; 23) increase significantly if value added is taken into account. Many journals devoted to economic theory, however, rank lower according to the *VA-index w*.

Investigating the effects of discounting and of applying the VA-method separately suggests that both have a small but systematic negative effect on the rating of theory journals (see Table 5 in the appendix for the effect of discounting, and Table 6 for the effect of the VA-method). Other differences between the two methods used to compile *Inv* 24* and *VA-index w* seem to disappear at the aggregation level of journals.

One can argue that traditional journal ratings discriminate against more ap-

¹¹Note, that this statement is different from claiming that the overall contribution of Pinski and Narin (1976) is larger than the one by Garfield (1972) as the statement above relates only to direct and not to overall contributions.

¹²The average citation time in my dataset is 12.7 years including citations to articles published before 1985. The average annual productivity growth in OECD countries between 1985 and 2006 has been around 1.2%. If research drives productivity the two growth rates should be the same in the long run. For an illustrative exercise as this one the exact value is not so important, as the estimates at journal level are quite robust to changes in δ . The correlation between the ratings using $\delta = 0.164$ and $\delta = 0.1$ is 0.99998, the correlation between ratings using $\delta = 0.164$ and $\delta = 1/3$ is still 0.99989.

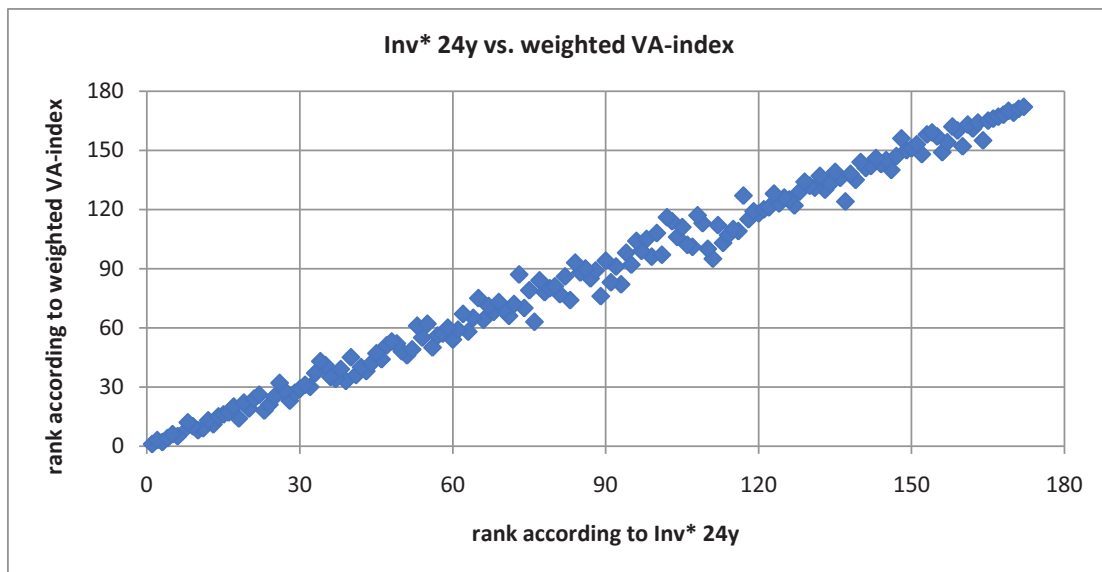


Figure 6: Scatter plot of journal ranks according to $Inv^* 24$ and weighted VA-index

plied journals because the transfer of knowledge to the applied sector and the creation of knowledge are treated as being one thing. Therefore *VA-index u* presents a reference case giving equal voting power to all articles. The *VA-index u* rating is reported in the last column of Table 1.

Figure 7 illustrates the impact of weighting the value of the target items (2006-2008) on the resulting rating. It is no coincidence that the four journals which profit most from weighting are theory journals. Economic theory is the beneficiary of weighting. This finding is perfectly intuitive. Journals specializing in research on transition economics, development, geography, agriculture, or natural resources, on the other hand, fare much better if all 2006-2008 items have equal voting power. By comparing the two ratings one can easily identify the most applied fields of economics, i.e. those fields which provide relatively little input into the progress of general economic thought.

Table 2 provides the coefficients of correlation between the different ratings. All four ratings are highly correlated. This is a typical feature of journal ratings. $Inv^* 24$ and $Imp w$ are the two most highly correlated ratings.

In concluding let me emphasize again that the purely bibliometric application of the VA-index presented in this section may provide more reliable ratings than the invariant method because the VA-index controls for citation quality at article level. Controlling for citation quality at article level is a logical and important step in computing journal ratings. Oswald (2007), for example, shows that article quality varies substantially within journals. Palacios-Huerta and Volij (2004) point out that applying the invariant method to individual articles is not possible

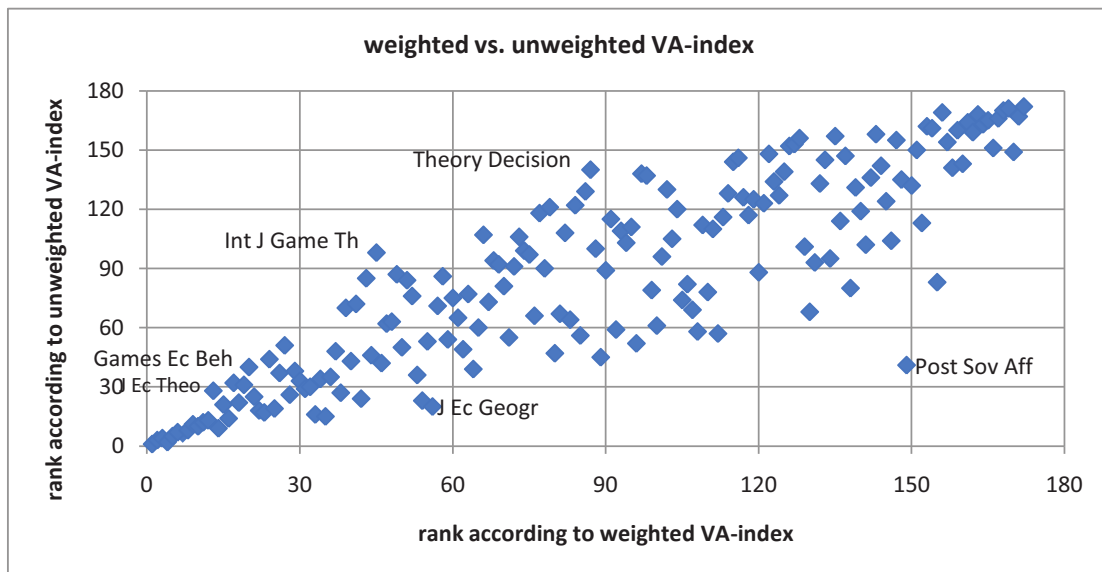


Figure 7: Scatter plot of journal ranks according to weighted and unweighted VA-index

because older articles cannot cite newer ones, implying that a reciprocal relationship cannot be established. If, however, one uses indirect citations of degree one or higher degrees one can very well construct a mapping from journals to journals which takes article specific citation quality into account. In this case, an item does not profit from being directly cited but merely links direct citations to its own references.

3.2 Rating article impact

Measuring the value of individual articles is far more challenging than measuring the quality of journals. Data errors, for example, often cancel out at the journal level. At the level of individual articles, data errors translate, however, directly into erroneous results. The results presented in this subsection therefore need to be interpreted with great caution. In any event, my aim is to illustrate the VA

Table 2: Correlation of journal ratings

	Inv 3y	Inv* 24y	Imp w	Imp u
Inv 3y	1	0.9530	0.9369	0.8632
Inv* 24		1	0.9946	0.9433
Imp w			1	0.9589
Imp u				1

method as applied to the evaluation of individual research items.

Table 3 reports normalized scores of journal articles according to the number of citations, citations weighted by journal quality, and the VA-index. The citing period is again 2006 to 2008. Moreover, all three article scores are discounted by three percent a year. Contrary to the journal ratings presented in the last subsection, I had to include self citations, because I can only identify self citations at the journal level and not at the level of individual authors. The table reports all articles which make it into the top twenty according to at least one of the three criteria.

Table 3: Rank comparison at article level

article	#citations	weighted citations	VA-index
Arellano, Bond (Rev Ec Stud, 1991)	100 (1)	51.63 (17)	48.47 (24)
Artzner, Delbaen, Eber, Heath (Math Finance, 1999)	99.9 (2)	39.64 (32)	40.37 (38)
Engle, Granger (ECONOMETRICA, 1987)	93.02 (3)	25.7 (119)	51.74 (20)
Clarida, Gali, Gertler (JEL, 1999)	90.65 (4)	58.05 (11)	61.7 (12)
La Porta, Lopez-de-Silanes, Shleifer, Vishny (JPE, 1998)	84.82 (5)	66.7 (7)	80.78 (3)
Acemoglu, Johnson, Robinson (AER, 2001)	78.94 (6)	95.34 (2)	67.33 (7)
Newey, West (ECONOMETRICA, 1987)	77.2 (7)	83.34 (3)	100 (1)
Romer (JPE, 1990)	73.99 (8)	35.29 (40)	61.5 (13)
Lucas (JME, 1988)	71.89 (9)	29.29 (74)	82.61 (2)
Bollerslev (J Econometrics, 1986)	69.11 (10)	28.41 (86)	41.15 (34)
Johansen (J EC Dyn Contr, 1988)	68.82 (11)	16.44 (378)	27.04 (107)
Bertrand, Duflo, Mullainathan (QJE, 2004)	68.3 (12)	100 (1)	65.68 (9)
Christiano, Eichenbaum, Evans (JPE, 2005)	66.64 (13)	70.06 (4)	42.82 (28)
Im, Pesaran, Shin (J Econometrics, 2003)	65.94 (14)	16.6 (365)	10.36 (886)
Staiger, Stock (ECONOMETRICA, 1997)	63.15 (15)	66.08 (8)	62.27 (11)
Fama, French (J Financial Ec, 1993)	62.47 (16)	69.86 (5)	67.7 (6)
Kwiatkowski, Phillips, Schmidt, Shin (J Econometrics, 1992)	62.27 (17)	20.13 (228)	16.35 (358)
Clarida, Gali, Gertler (QJE, 2000)	61.4 (18)	59.66 (9)	56.61 (17)
Fehr, Schmidt (QJE, 1999)	60.8 (19)	69.63 (6)	56.38 (18)
Hall, Jones (QJE, 1999)	59.06 (20)	48.66 (20)	48.92 (23)
Romer (JPE, 1986)	58.69 (21)	21.71 (190)	70.31 (4)
Jensen (AER Papers Proc, 1986)	48.27 (30)	42.41 (25)	56.62 (16)
Bolton, Ockenfels (AER, 2000)	45.65 (35)	52.48 (15)	42.01 (32)
Melitz (ECONOMETRICA, 2003)	43.56 (38)	57.16 (13)	38.19 (42)
Laibson (QJE, 1997)	41.25 (41)	57.82 (12)	60.06 (14)
Grossman, Hart (JPE, 1986)	37.62 (46)	34.34 (45)	66.18 (8)
Barro (QJE, 1991)	36 (52)	13.19 (598)	62.34 (10)
Bils, Klenow (JPE, 2004)	31.92 (67)	54.31 (14)	35.09 (51)
Gul, Pesendorfer (ECONOMETRICA, 2001)	25.74 (118)	58.44 (10)	42.58 (30)
Katz, Murphy (QJE, 1992)	24.79 (130)	28.35 (87)	70.03 (5)
Summers, Heston (QJE, 1991)	23.79 (141)	13.14 (605)	58.9 (15)
Miguel, Kremer (ECONOMETRICA, 2004)	12.01 (673)	50.07 (18)	31.18 (77)
Shimer, Smith (ECONOMETRICA, 2000)	11.2 (799)	49.51 (19)	31.51 (76)
Strömberg (QJE, 2004)	10.89 (861)	51.97 (16)	35.31 (50)
Summers, Heston (Rev Inc Wealth, 1988)	5.81 (3114)	3.11 (5749)	52.43 (19)

It is not surprising that the rank variation at the article level is much higher than the rank variation at the journal level. The differences are remarkable considering that all ratings are based on the same data. Still, nine articles are among the top twenty according to all three criteria. Some articles even receive quite similar ratings, for example the 1998 JPE article by La Porta and co-authors.

“The Penn World Table (Mark 5)” published by Summers and Heston in the Quarterly Journal of Economics (QJE) is a different case. “The Penn World Table (Mark 5)” takes rank fifteen according to the VA-index, but is ranked only 141st according to the number of citations and 605th according to weighted citations. This implies that the Penn World Tables are less intensively used in

current research but they nevertheless made an important indirect contribution to the literature which is still noticeable. The indirect contributions are even more pronounced for the last article in Table 3 which is an earlier version of the Penn World Tables. The earlier versions of the Penn World Tables laid the foundation for the version published 13 years later in the QJE. Ratings based the two traditional indices fail, however, to capture this important input. The ratings of the two articles by Romer (JPE 1986 and 1990) tell a similar story. Romer's 1990 article "Endogenous Technological Change" ranks higher according to the two traditional indices, but not according to the VA-index. Here, the VA-index again captures the contribution of the earlier and maybe more innovative work.

Given the variation of article quality within journals, the VA-index is likely to be more reliable than ratings based on unweighted or weighted citations. Moreover, the VA-index also reduces incentives for strategic manipulations since the cited source receives only a fraction of the credit and it would be rather tedious to figure out who else is going to profit from such a manipulation.

4 Conclusion

In this paper I have presented a theoretical basis for an ideal measure of research performance, the VA-index. I have also provided a first implementation of the index to research in economics, which illustrates some features of the index. The implementation illustrates the gap that exists between the current potential of bibliometric data and the informational requirements of the VA-index. Closing this gap is a challenge for future research. In the meantime, the theoretical concept of the VA-index provides a point of reference for existing indicators.

Fortunately, improvements to research assessment are fairly easy to make. Campbell (2008) mentions that Nature's editorial policy followed some medical journals in now giving authors the option to report contributions of particular authors to a piece of research. Moreover, he mentions the possibility of not citing entire papers but to refer to particular (sub)sections of a paper. Such local citations allow, for example, differentiating citations due to methodological aspects from citations due to a paper's main conclusion. A related option is to use local references that indicate the part of an article for which a reference was relevant. Classifying references into, say, essential, important, and useful references could be another simple, but important step towards better metrics.

An aspect often ignored in evaluating research is that measuring the success of research and rewarding it are two related but not necessarily identical issues. Measuring research success is necessary for developing a rational research policy.

Only when we understand how much different parts of science add to human well-being, how these parts interact, how the realization of value-added evolves over time, and how risky the production of science is, will we be able to establish efficient institutions for research. Consider for example the risk in producing research. If no risk were involved in producing research, a linear reward scheme can be optimal, whereas in a purely stochastic environment fixed rewards would suffice.

Understanding and improving the science system, however, clearly goes beyond assessing research output. We also need to gain a better understanding of the determinants of research success. Ellison (2002), for example, claims that, in economics, a paper’s main contribution has become less important for publication success than other aspects of quality (such as generality, robustness checks, extensions, discussions of related literature, etc.). According to Ellison, this shift reflects changing norms in the economics profession and provides little benefit at high cost. Sunderland, Sunderland-Groves, Shanley, and Campbell (2009) point at a ‘research-implementation gap’ in conservation biology and suggest ways to improve the transmission of knowledge from researchers to practitioners and also a transmission of experience in the opposite direction. Shanley and López (2009) find that contemporary researchers in conservation biology face wrong incentives and propose that research institutions should “restructure institutional incentive structures to take into account actual ‘impact’ rather than solely ‘high impact’ journals”. This is exactly what the VA-index does by linking actual impact to its scientific sources.

A Appendix

Table 4 presents a comparison of journal ratings for the full set of journals.

Table 4: Comparison of journal ratings

Journal	Inv 3y	Inv* 24y	VA-index w	VA-index u
QUARTERLY JOURNAL OF ECONOMICS	96.37 (2)	100 (1)	100 (1)	99.75 (2)
ECONOMETRICA	100 (1)	79.96 (2)	74.18 (2)	71.15 (4)
JOURNAL OF POLITICAL ECONOMY	86.97 (3)	79.63 (3)	73.34 (3)	71.23 (3)
JOURNAL OF ECONOMIC LITERATURE	51.13 (6)	73.03 (4)	69.3 (4)	100 (1)
AMERICAN ECONOMIC REVIEW	75.23 (5)	59.46 (6)	56.56 (5)	64.35 (5)
REVIEW OF ECONOMIC STUDIES	80.71 (4)	61.6 (5)	53.95 (6)	48.32 (7)
BROOKINGS PAPERS ON ECONOMIC ACTIVITY	7.1 (56)	35.23 (7)	41.11 (7)	52.92 (6)
JOURNAL OF FINANCIAL ECONOMICS	28.74 (15)	25.88 (11)	29.61 (8)	36.58 (11)
JOURNAL OF ECONOMIC PERSPECTIVES	34.95 (11)	28.06 (9)	27.63 (9)	38.37 (9)
JOURNAL OF MONETARY ECONOMICS	25.89 (18)	24.29 (13)	26.12 (10)	33.05 (12)
JOURNAL OF ECONOMIC GROWTH	24.18 (22)	27.7 (10)	26.03 (11)	37.53 (10)
RAND JOURNAL OF ECONOMICS	40 (8)	28.57 (8)	25.5 (12)	30.35 (13)
JOURNAL OF ECONOMIC THEORY	39.11 (9)	25.1 (12)	22.51 (13)	21.31 (28)
ECONOMIC POLICY	27.26 (16)	18.94 (17)	20.69 (14)	38.89 (8)
JOURNAL OF LABOR ECONOMICS	31.2 (14)	20.83 (15)	20.24 (15)	24.91 (21)

Journal	Inv 3y	Inv* 24y	VA-index w	VA-index u
REVIEW OF ECONOMICS AND STATISTICS	40.65 (7)	21.24 (14)	19.34 (16)	28.51 (14)
GAMES AND ECONOMIC BEHAVIOR	32.69 (12)	17.89 (18)	17.94 (17)	17.09 (39)
JOURNAL OF HUMAN RESOURCES	24.26 (21)	16.5 (21)	17.68 (18)	24.02 (22)
INTERNATIONAL ECONOMIC REVIEW	35.82 (10)	20.02 (16)	17.66 (19)	19.81 (32)
JOURNAL OF ECONOMETRICS	23.92 (23)	17.28 (20)	17.08 (20)	26.57 (16)
JOURNAL OF LAW & ECONOMICS	31.92 (13)	17.78 (19)	16.76 (21)	20.28 (31)
AER Papers & Proceedings	18.12 (30)	15.88 (24)	16.58 (22)	21.57 (25)
JOURNAL OF INTERNATIONAL ECONOMICS	26.48 (17)	15.11 (26)	15.69 (23)	26.05 (17)
REVIEW OF ECONOMIC DYNAMICS	20.86 (26)	16.2 (22)	15.42 (24)	16.05 (43)
JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS	25.8 (19)	16.1 (23)	14.75 (25)	17.27 (38)
JOURNAL OF ACCOUNTING & ECONOMICS	7.87 (52)	13.28 (30)	14.52 (26)	13.96 (50)
ECONOMIC JOURNAL	25.56 (20)	15.6 (25)	14.36 (27)	25.18 (19)
JOURNAL OF BUSINESS & ECONOMIC STATISTICS	22.97 (24)	14.65 (27)	13.78 (28)	21.36 (27)
JOURNAL OF LAW ECONOMICS & ORGANIZATION	8.9 (48)	13.08 (31)	13.12 (29)	17.52 (37)
JOURNAL OF PUBLIC ECONOMICS	19.33 (27)	12.64 (32)	12.2 (30)	19.66 (33)
JOURNAL OF APPLIED ECONOMETRICS	18.2 (29)	14.56 (28)	12.13 (31)	20.51 (30)
JOURNAL OF INDUSTRIAL ECONOMICS	21.46 (25)	13.65 (29)	11.73 (32)	20.58 (29)
MATHEMATICAL FINANCE	10.2 (42)	9.92 (39)	11.68 (33)	27.61 (15)
WORLD BANK ECONOMIC REVIEW	10.55 (39)	10.91 (35)	11.14 (34)	26.04 (18)
EUROPEAN ECONOMIC REVIEW	12.19 (34)	11.06 (33)	10.76 (35)	18.57 (34)
JOURNAL OF MONEY CREDIT AND BANKING	17.54 (31)	10.2 (36)	10.44 (36)	17.95 (36)
JOURNAL OF ECONOMICS & MANAGEMENT STRATEGY	11.27 (35)	11.03 (34)	10.35 (37)	14.5 (47)
ECONOMETRIC THEORY	7.46 (54)	10.1 (38)	9.38 (38)	11.68 (61)
JOURNAL OF HEALTH ECONOMICS	6.25 (65)	8.49 (43)	9.07 (39)	21.56 (26)
ECONOMIC THEORY	19.09 (28)	10.18 (37)	8.89 (40)	11.35 (67)
JOURNAL OF RISK AND UNCERTAINTY	4.83 (72)	9.25 (41)	8.88 (41)	16.56 (41)
JOURNAL OF MATHEMATICAL ECONOMICS	11.25 (36)	9.61 (40)	8.68 (42)	10.51 (78)
WORLD BANK RESEARCH OBSERVER	10.42 (41)	8.21 (44)	8.09 (43)	21.76 (24)
INTERNATIONAL JOURNAL OF GAME THEORY	10.97 (37)	8.93 (42)	7.88 (44)	9.27 (94)
JOURNAL OF URBAN ECONOMICS	9.31 (45)	7.35 (45)	7.23 (45)	15.27 (46)
JOURNAL OF ECONOMIC DYNAMICS & CONTROL	10.78 (38)	7.33 (46)	6.85 (46)	11.8 (60)
JOURNAL OF DEVELOPMENT ECONOMICS	14.12 (33)	6.95 (47)	6.84 (47)	16.13 (42)
ECONOMIC INQUIRY	10.09 (43)	6.67 (48)	6.3 (48)	11.64 (63)
SOCIAL CHOICE AND WELFARE	5.12 (69)	6.39 (51)	6.22 (49)	10.19 (82)
JOURNAL OF ECONOMIC HISTORY	8.64 (50)	6.38 (52)	6 (50)	9.73 (84)
MACROECONOMIC DYNAMICS	8.93 (47)	6.45 (50)	5.85 (51)	10.94 (76)
IMF STAFF PAPERS	3.9 (84)	5.93 (55)	5.81 (52)	13.73 (51)
JOURNAL OF ECONOMIC SURVEYS	7.51 (53)	6.59 (49)	5.81 (53)	18.15 (35)
JOURNAL OF ECONOMIC GEOGRAPHY	4.56 (75)	5.56 (60)	5.69 (54)	23.43 (23)
LABOUR ECONOMICS	6.97 (57)	6.09 (54)	5.65 (55)	13.26 (52)
JOURNAL OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT	6.28 (64)	5.7 (57)	5.6 (56)	24.93 (20)
JOURNAL OF ECONOMIC BEHAVIOR & ORGANIZATION	8.73 (49)	5.52 (61)	5.32 (57)	10.79 (77)
SCANDINAVIAN JOURNAL OF ECONOMICS	9.38 (44)	5.84 (56)	5.22 (58)	11.08 (71)
INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION	9.07 (46)	6.14 (53)	5.21 (59)	11.49 (64)
OXFORD ECONOMIC PAPERS-NEW SERIES	4.83 (71)	5.7 (58)	5.15 (60)	12.91 (54)
EXPLORATIONS IN ECONOMIC HISTORY	10.5 (40)	5.29 (62)	4.96 (61)	9.55 (91)
OXFORD BULLETIN OF ECONOMICS AND STATISTICS	8.01 (51)	5.61 (59)	4.9 (62)	14.2 (49)
REVIEW OF INCOME AND WEALTH	6.84 (61)	3.82 (73)	4.74 (63)	11.13 (69)
REGIONAL SCIENCE AND URBAN ECONOMICS	6.22 (66)	4.59 (64)	4.54 (64)	11.68 (62)
ENERGY JOURNAL	6.89 (59)	4.55 (65)	4.47 (65)	16.91 (40)
NATIONAL TAX JOURNAL	3.68 (85)	4.05 (71)	4.35 (66)	8.16 (103)
ECONOMICA	6.3 (63)	4.89 (63)	4.32 (67)	11.11 (70)
JOURNAL OF PRODUCTIVITY ANALYSIS	3.64 (87)	4.14 (69)	4.09 (68)	13.13 (53)
JOURNAL OF POPULATION ECONOMICS	4.7 (74)	4.14 (70)	3.94 (69)	9.56 (90)
CANADIAN JOURNAL OF ECONOMICS-REVUE CANADIENNE D ECONOMIQUE	7.35 (55)	4.4 (66)	3.88 (70)	9.13 (97)
JOURNAL OF BANKING & FINANCE	2.58 (99)	3.74 (74)	3.87 (71)	9.51 (92)
OXFORD REVIEW OF ECONOMIC POLICY	3.13 (91)	3.89 (72)	3.77 (72)	10.22 (81)
JOURNAL OF THE JAPANESE AND INTERNATIONAL ECONOMIES	2.44 (103)	2.91 (83)	3.73 (73)	9.13 (96)
ECONOMICS AND PHILOSOPHY	17.04 (32)	4.24 (67)	3.65 (74)	7.94 (106)
JOURNAL OF REGULATORY ECONOMICS	3.54 (89)	4.19 (68)	3.51 (75)	9.07 (98)
PUBLIC CHOICE	4.8 (73)	3.62 (75)	3.3 (76)	7.14 (119)
ECONOMICS OF EDUCATION REVIEW	4.46 (77)	3.12 (81)	3.21 (77)	7.38 (117)
INTERNATIONAL TAX AND PUBLIC FINANCE	4.19 (82)	3.33 (78)	3.21 (78)	9.63 (86)
JOURNAL OF RISK AND INSURANCE	2.15 (109)	3.14 (80)	3.12 (79)	11.01 (73)
INTERNATIONAL REVIEW OF LAW AND ECONOMICS	1.34 (124)	2.83 (88)	3.11 (80)	6.62 (126)
JOURNAL OF COMPARATIVE ECONOMICS	5.66 (67)	3.1 (82)	3.11 (81)	10.98 (74)
RESOURCE AND ENERGY ECONOMICS	4.25 (79)	3.32 (79)	3.02 (82)	14.46 (48)
JOURNAL OF POLICY ANALYSIS AND MANAGEMENT	3.54 (90)	2.55 (93)	3.01 (83)	7.88 (108)
HEALTH ECONOMICS	3.01 (92)	2.85 (84)	3 (84)	12.66 (56)
ECONOMICS LETTERS	3.54 (88)	3.35 (77)	2.98 (85)	7.06 (122)
ECONOMIC DEVELOPMENT AND CULTURAL CHANGE	6.94 (58)	2.8 (90)	2.87 (86)	11.37 (65)
THEORY AND DECISION	3.67 (86)	3.61 (76)	2.85 (87)	5.39 (139)

Journal	Inv 3y	Inv* 24y	VA-index w	VA-index u
JOURNAL OF REAL ESTATE FINANCE AND ECONOMICS	1.1 (135)	2.84 (85)	2.75 (88)	8.91 (100)
LAND ECONOMICS	2.25 (107)	2.83 (87)	2.66 (89)	15.34 (45)
REAL ESTATE ECONOMICS	1.36 (123)	2.81 (89)	2.66 (90)	9.6 (88)
JOURNAL OF HOUSING ECONOMICS	0.91 (141)	2.83 (86)	2.56 (91)	8.11 (104)
ECONOMICS OF TRANSITION	1.64 (119)	2.4 (94)	2.51 (92)	12.01 (59)
STUDIES IN NONLINEAR DYNAMICS AND ECONOMETRICS	2.58 (98)	2.59 (92)	2.45 (93)	8.47 (101)
SOUTHERN ECONOMIC JOURNAL	6.59 (62)	2.67 (91)	2.44 (94)	7.48 (115)
REVIEW OF WORLD ECONOMICS	4.18 (83)	1.87 (108)	2.18 (95)	7.62 (112)
JOURNAL OF INSTITUTIONAL AND THEORETICAL ECONOMICS	4.95 (70)	2.4 (95)	2.16 (96)	5.71 (134)
ECONOMIC GEOGRAPHY	2.51 (102)	2.22 (97)	2.1 (97)	12.81 (55)
JOURNAL OF EVOLUTIONARY ECONOMICS	2.25 (108)	1.97 (101)	2.08 (98)	11.04 (72)
KYKLOS	2.96 (93)	1.83 (109)	2.07 (99)	9.03 (99)
ENERGY ECONOMICS	1.22 (129)	2.27 (96)	2.04 (100)	10.06 (83)
REVIEW OF INDUSTRIAL ORGANIZATION	1.3 (128)	2.15 (98)	2.02 (101)	7.22 (118)
JOURNAL OF DEVELOPMENT STUDIES	2.87 (94)	1.9 (106)	2.01 (102)	11.37 (66)
ECONOMIC HISTORY REVIEW	5.5 (68)	2.12 (99)	2.01 (103)	5.39 (138)
JOURNAL OF TRANSPORT ECONOMICS AND POLICY	0.95 (137)	1.95 (103)	1.98 (104)	6.41 (130)
INDUSTRIAL AND CORPORATE CHANGE	1.4 (121)	1.9 (107)	1.92 (105)	10.29 (80)
WORLD ECONOMY	4.22 (81)	1.82 (110)	1.89 (106)	7.84 (109)
INSURANCE MATHEMATICS & ECONOMICS	1.56 (120)	1.47 (118)	1.89 (107)	7.61 (113)
ENVIRONMENTAL & RESOURCE ECONOMICS	2.31 (105)	2.03 (100)	1.86 (108)	12.12 (58)
WORLD DEVELOPMENT	2.12 (111)	1.79 (112)	1.78 (109)	10.98 (75)
CHINA ECONOMIC REVIEW	0.82 (145)	1.53 (116)	1.77 (110)	10.49 (79)
JOURNAL OF REGIONAL SCIENCE	2.75 (96)	1.94 (105)	1.66 (111)	7.69 (110)
INTERNATIONAL JOURNAL OF FORECASTING	1.31 (127)	1.95 (104)	1.65 (112)	6.43 (129)
AMERICAN JOURNAL OF AGRICULTURAL ECONOMICS	2.09 (112)	1.75 (114)	1.65 (113)	12.17 (57)
FISCAL STUDIES	2.25 (106)	1.79 (111)	1.65 (114)	7.44 (116)
JOURNAL OF ECONOMIC PSYCHOLOGY	1.71 (118)	1.51 (117)	1.64 (115)	5.31 (142)
INFORMATION ECONOMICS AND POLICY	4.24 (80)	1.76 (113)	1.6 (116)	6.68 (124)
JAPANESE ECONOMIC REVIEW	6.89 (60)	1.96 (102)	1.59 (117)	5.19 (146)
CONTEMPORARY ECONOMIC POLICY	4.41 (78)	1.45 (120)	1.52 (118)	7.11 (121)
REVIEW OF INTERNATIONAL POLITICAL ECONOMY	0.42 (155)	1.37 (121)	1.35 (119)	9.57 (89)
SCOTTISH JOURNAL OF POLITICAL ECONOMY	1.91 (114)	1.56 (115)	1.35 (120)	6.55 (128)
JOURNAL OF ECONOMIC EDUCATION	0.82 (146)	1.19 (127)	1.32 (121)	5.21 (145)
JOURNAL OF AFRICAN ECONOMIES	1.77 (116)	1.31 (124)	1.3 (122)	6.91 (123)
FEMINIST ECONOMICS	0.15 (162)	0.92 (138)	1.18 (123)	6.64 (125)
MANCHESTER SCHOOL	0.43 (153)	1.24 (126)	1.14 (124)	5.34 (141)
JOURNAL OF ECONOMICS	2.75 (95)	1.46 (119)	1.12 (125)	4.47 (152)
JOURNAL OF MACROECONOMICS	2.64 (97)	1.33 (122)	1.12 (126)	5.51 (136)
OPEN ECONOMIES REVIEW	4.55 (76)	1.27 (125)	1.09 (127)	4.48 (151)
ECONOMIC DEVELOPMENT QUARTERLY	0.21 (161)	1.32 (123)	1.08 (128)	4.37 (153)
CAMBRIDGE JOURNAL OF ECONOMICS	2.55 (100)	1.09 (128)	1.02 (129)	8.42 (102)
EUROPEAN REVIEW OF AGRICULTURAL ECONOMICS	0.92 (140)	1.01 (133)	0.98 (130)	11.15 (68)
AGRICULTURAL ECONOMICS	1.01 (136)	1.07 (130)	0.97 (131)	9.45 (93)
JOURNAL OF AGRICULTURAL AND RESOURCE ECONOMICS	0.48 (151)	1.05 (131)	0.94 (132)	9.19 (95)
JAPAN AND THE WORLD ECONOMY	1.85 (115)	1.02 (132)	0.93 (133)	5.14 (148)
ECONOMIC RECORD	2.54 (101)	1 (134)	0.93 (134)	5.18 (147)
ECONOMIC MODELLING	0.85 (144)	1.08 (129)	0.93 (135)	5.77 (132)
ECOLOGICAL ECONOMICS	0.93 (139)	0.92 (136)	0.92 (136)	7.69 (111)
ECONOMIST-NETHERLANDS	0.61 (147)	0.88 (139)	0.92 (137)	4.25 (156)
AUSTRALIAN JOURNAL OF AGRICULTURAL AND RESOURCE ECONOMICS	2.14 (110)	0.92 (137)	0.83 (138)	9.69 (85)
APPLIED ECONOMICS	1.38 (122)	0.95 (135)	0.82 (139)	5.99 (131)
ECONOMY AND SOCIETY	0.27 (159)	0.59 (146)	0.77 (140)	7.14 (120)
SMALL BUSINESS ECONOMICS	1.32 (126)	0.81 (141)	0.77 (141)	5.36 (140)
JOURNAL OF POLICY MODELING	1.22 (130)	0.76 (142)	0.76 (142)	5.67 (135)
FOOD POLICY	0.95 (138)	0.83 (140)	0.73 (143)	8.05 (105)
JCMS-JOURNAL OF COMMON MARKET STUDIES	0.43 (154)	0.63 (145)	0.72 (144)	6.59 (127)
DEFENCE AND PEACE ECONOMICS	1.92 (113)	0.7 (143)	0.69 (145)	4.03 (158)
JOURNAL OF AGRICULTURAL ECONOMICS	0.9 (142)	0.7 (144)	0.65 (146)	7.93 (107)
AMERICAN JOURNAL OF ECONOMICS AND SOCIOLOGY	2.38 (104)	0.54 (147)	0.61 (147)	4.19 (157)
BULLETIN OF INDONESIAN ECONOMIC STUDIES	1.75 (117)	0.42 (150)	0.59 (148)	5.5 (137)
POST-SOVIET AFFAIRS	0.6 (148)	0.3 (156)	0.53 (149)	15.61 (44)
CANADIAN JOURNAL OF AGRICULTURAL ECONOMICS-REVUE CANADIENNE D AGROECONOMIE	1.16 (132)	0.49 (148)	0.4 (150)	5.72 (133)
APPLIED ECONOMICS LETTERS	1.32 (125)	0.44 (149)	0.38 (151)	4.78 (149)
VALUE IN HEALTH	0.12 (166)	0.4 (152)	0.37 (152)	3.76 (161)
HITOTSUBASHI JOURNAL OF ECONOMICS	1.13 (134)	0.41 (151)	0.35 (153)	2.91 (167)
EUROPE-ASIA STUDIES	0.47 (152)	0.24 (158)	0.34 (154)	7.5 (114)
SOUTH AFRICAN JOURNAL OF ECONOMICS	0.34 (158)	0.28 (157)	0.32 (155)	3.74 (162)
DEVELOPING ECONOMIES	1.14 (133)	0.3 (155)	0.31 (156)	4.37 (154)
JOURNAL OF POST KEYNESIAN ECONOMICS	1.19 (131)	0.35 (153)	0.3 (157)	5.29 (143)
EURASIAN GEOGRAPHY AND ECONOMICS	0.86 (143)	0.13 (164)	0.3 (158)	9.61 (87)
WORK EMPLOYMENT AND SOCIETY	0.1 (167)	0.3 (154)	0.28 (159)	3.93 (159)

Journal	Inv 3y	Inv* 24y	VA-index w	VA-index u
POST-COMMUNIST ECONOMIES	0.13 (164)	0.23 (160)	0.24 (160)	5.25 (144)
JOURNAL OF ECONOMIC ISSUES	0.37 (157)	0.24 (159)	0.19 (161)	3.89 (160)
TIJDSCHRIFT VOOR ECONOMISCHE EN SOCIALE GEOGRAFIE	0.13 (165)	0.2 (161)	0.17 (162)	3.41 (164)
JAHRBUCHER FUR NATIONALOKONOMIE UND STATISTIK	0.56 (150)	0.19 (162)	0.17 (163)	2.86 (168)
EMERGING MARKETS FINANCE AND TRADE	0.37 (156)	0.15 (163)	0.12 (164)	3.47 (163)
FUTURES	0.06 (169)	0.12 (165)	0.11 (165)	3.4 (165)
EASTERN EUROPEAN ECONOMICS	0.26 (160)	0.09 (166)	0.1 (166)	4.33 (155)
JOURNAL OF MEDIA ECONOMICS	0.58 (149)	0.08 (167)	0.07 (167)	3.05 (166)
TRIMESTRE ECONOMICO	0.14 (163)	0.06 (168)	0.06 (168)	2.67 (170)
REVUE D ETUDES COMPARATIVES EST-OUEST	0 (171)	0.01 (170)	0.01 (169)	2.5 (171)
POLITICKA EKONOMIE	0.08 (168)	0.01 (169)	0.01 (170)	4.67 (150)
EKONOMICKY CASOPIS	0.05 (170)	0 (171)	0 (171)	2.83 (169)
EKONOMISKA SAMFUNDETS TIDSKRIFT	0 (172)	0 (172)	0 (172)	2.33 (172)

Table 5 presents two ratings according to the invariant method adapted to a cited period of 24 years and two ratings according to the VA-index. The first version of a rating uses nominal weights, whereas the second version uses discounted weights. The ordering of journals follows the relative loss in ranks a journal experiences when moving from nominal to discounted weights based on the invariant method.

Table 5: Nominal vs. discounted weighting

Journal	Inv 24 nom	Inv 24 disc	VA w nom	VA w disc
JOURNAL OF MATHEMATICAL ECONOMICS	34	40	42	43
JOURNAL OF ECONOMIC GROWTH	9	10	11	10
SOCIAL CHOICE AND WELFARE	47	51	49	51
MATHEMATICAL FINANCE	36	39	33	35
JOURNAL OF APPLIED ECONOMETRICS	26	28	31	32
INTERNATIONAL REVIEW OF LAW AND ECONOMICS	82	88	80	86
OXFORD BULLETIN OF ECONOMICS AND STATISTICS	55	59	62	62
JOURNAL OF LABOR ECONOMICS	14	15	15	15
GAMES AND ECONOMIC BEHAVIOR	17	18	17	20
ECONOMIC THEORY	35	37	40	41
JOURNAL OF ECONOMETRICS	19	20	20	22
INTERNATIONAL JOURNAL OF GAME THEORY	40	42	44	45
REVIEW OF ECONOMIC DYNAMICS	21	22	24	24
INFORMATION ECONOMICS AND POLICY	108	113	116	117
JOURNAL OF REGULATORY ECONOMICS	65	68	75	75
JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS	22	23	25	26
THEORY AND DECISION	73	76	87	87
REAL ESTATE ECONOMICS	86	89	90	90
JOURNAL OF ACCOUNTING & ECONOMICS	29	30	26	27
JOURNAL OF ECONOMIC BEHAVIOR & ORGANIZATION	59	61	57	60
JOURNAL OF LAW ECONOMICS & ORGANIZATION	30	31	29	29
JOURNAL OF EVOLUTIONARY ECONOMICS	98	101	98	105
JOURNAL OF ECONOMICS & MANAGEMENT STRATEGY	33	34	37	37
JOURNAL OF PRODUCTIVITY ANALYSIS	67	69	68	71
INDUSTRIAL AND CORPORATE CHANGE	104	107	105	106
JOURNAL OF BANKING & FINANCE	72	74	71	72
JOURNAL OF HOUSING ECONOMICS	84	86	91	93
JOURNAL OF ECONOMIC DYNAMICS & CONTROL	45	46	46	47
STUDIES IN NONLINEAR DYNAMICS AND ECONOMETRICS	90	92	93	94
REVIEW OF INDUSTRIAL ORGANIZATION	96	98	101	104
JOURNAL OF ECONOMIC SURVEYS	48	49	53	53
MACROECONOMIC DYNAMICS	49	50	51	52
HITOTSUBASHI JOURNAL OF ECONOMICS	148	151	153	156
KYKLOS	107	109	99	101
FISCAL STUDIES	109	111	114	113
AMERICAN JOURNAL OF AGRICULTURAL ECONOMICS	112	114	113	112
INSURANCE MATHEMATICS & ECONOMICS	116	118	107	109
JOURNAL OF ECONOMICS	117	119	125	127
JOURNAL OF AFRICAN ECONOMIES	122	124	122	121
ECONOMICA	62	63	67	67
JOURNAL OF AGRICULTURAL AND RESOURCE ECONOMICS	129	131	132	134
JOURNAL OF INSTITUTIONAL AND THEORETICAL ECONOMICS	94	95	96	98
INTERNATIONAL JOURNAL OF FORECASTING	103	104	112	114
CHINA ECONOMIC REVIEW	115	116	110	110

Journal	Inv 24 nom	Inv 24 disc	VA w nom	VA w disc
FEMINIST ECONOMICS	137	138	123	124
SMALL BUSINESS ECONOMICS	140	141	141	144
JOURNAL OF AGRICULTURAL ECONOMICS	143	144	146	146
VALUE IN HEALTH	151	152	152	153
JOURNAL OF ECONOMIC ISSUES	158	159	161	162
POST-COMMUNIST ECONOMIES	159	160	160	160
JAHRBUCHER FUR NATIONALOKONOMIE UND STATISTIK	161	162	163	163
ECONOMETRICA	2	2	2	3
JOURNAL OF FINANCIAL ECONOMICS	11	11	8	9
JOURNAL OF MONETARY ECONOMICS	13	13	10	11
PUBLIC CHOICE	75	75	76	79
INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION	53	53	59	61
JAPAN AND THE WORLD ECONOMY	132	132	133	137
ECONOMETRIC THEORY	38	38	38	39
JOURNAL OF RISK AND INSURANCE	80	80	79	81
REGIONAL SCIENCE AND URBAN ECONOMICS	64	64	64	65
JOURNAL OF THE JAPANESE AND INTERNATIONAL ECONOMIES	83	83	73	74
REVIEW OF INTERNATIONAL POLITICAL ECONOMY	121	121	119	120
JOURNAL OF ECONOMIC EDUCATION	127	127	121	122
MANCHESTER SCHOOL	126	126	124	125
JCMS-JOURNAL OF COMMON MARKET STUDIES	145	145	144	145
DEVELOPING ECONOMIES	155	155	156	157
JOURNAL OF POST KEYNESIAN ECONOMICS	153	153	157	158
AMERICAN ECONOMIC REVIEW	6	6	5	5
AMERICAN JOURNAL OF ECONOMICS AND SOCIOLOGY	147	147	147	147
APPLIED ECONOMICS	135	135	139	139
BROOKINGS PAPERS ON ECONOMIC ACTIVITY	7	7	7	7
CAMBRIDGE JOURNAL OF ECONOMICS	128	128	129	129
CONTEMPORARY ECONOMIC POLICY	120	120	118	118
EASTERN EUROPEAN ECONOMICS	166	166	166	166
ECOLOGICAL ECONOMICS	136	136	136	136
ECONOMIC DEVELOPMENT QUARTERLY	123	123	128	128
ECONOMICS OF EDUCATION REVIEW	81	81	77	77
ECONOMY AND SOCIETY	146	146	140	140
EKONOMICKY CASOPIS	171	171	171	171
EKONOMISKA SAMFUNDETS TIDSKRIFT	172	172	172	172
EMERGING MARKETS FINANCE AND TRADE	163	163	164	164
ENVIRONMENTAL & RESOURCE ECONOMICS	100	100	108	108
EUROPEAN REVIEW OF AGRICULTURAL ECONOMICS	133	133	130	130
FUTURES	165	165	165	165
INTERNATIONAL TAX AND PUBLIC FINANCE	78	78	78	78
JOURNAL OF BUSINESS & ECONOMIC STATISTICS	27	27	28	28
JOURNAL OF ECONOMIC GEOGRAPHY	60	60	54	54
JOURNAL OF ECONOMIC LITERATURE	4	4	4	4
JOURNAL OF ECONOMIC THEORY	12	12	13	13
JOURNAL OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT	57	57	56	56
JOURNAL OF MEDIA ECONOMICS	167	167	167	167
JOURNAL OF POLICY MODELING	142	142	142	142
JOURNAL OF POPULATION ECONOMICS	70	70	69	69
JOURNAL OF PUBLIC ECONOMICS	32	32	30	30
JOURNAL OF REAL ESTATE FINANCE AND ECONOMICS	85	85	88	88
JOURNAL OF REGIONAL SCIENCE	105	105	111	111
LABOUR ECONOMICS	54	54	55	55
NATIONAL TAX JOURNAL	71	71	66	66
POLITICKA EKONOMIE	169	169	170	170
POST-SOVIET AFFAIRS	156	156	149	149
QUARTERLY JOURNAL OF ECONOMICS	1	1	1	1
RAND JOURNAL OF ECONOMICS	8	8	12	12
REVIEW OF ECONOMIC STUDIES	5	5	6	6
REVUE D ETUDES COMPARATIVES EST-OUEST	170	170	169	169
TRIMESTRE ECONOMICO	168	168	168	168
WORK EMPLOYMENT AND SOCIETY	154	154	159	159
SOUTH AFRICAN JOURNAL OF ECONOMICS	157	157	155	154
ECONOMIC RECORD	134	134	134	133
OPEN ECONOMIES REVIEW	125	125	127	126
JAPANESE ECONOMIC REVIEW	102	102	117	116
ECONOMICS LETTERS	77	77	85	84
JOURNAL OF POLICY ANALYSIS AND MANAGEMENT	93	93	83	82
ECONOMIST-NETHERLANDS	139	139	137	135
EURASIAN GEOGRAPHY AND ECONOMICS	164	164	158	155
JOURNAL OF ECONOMIC HISTORY	52	52	50	49
WORLD BANK RESEARCH OBSERVER	44	44	43	42
RESOURCE AND ENERGY ECONOMICS	79	79	82	80

Journal	Inv 24 nom	Inv 24 disc	VA w nom	VA w disc
JOURNAL OF HEALTH ECONOMICS	43	43	39	38
AER Papers & Proceedings	24	24	22	21
ECONOMIC JOURNAL	25	25	27	25
INTERNATIONAL ECONOMIC REVIEW	16	16	19	17
JOURNAL OF POLITICAL ECONOMY	3	3	3	2
TIJDSCHRIFT VOOR ECONOMISCHE EN SOCIALE GEOGRAFIE	162	161	162	161
APPLIED ECONOMICS LETTERS	150	149	151	151
CANADIAN JOURNAL OF AGRICULTURAL ECONOMICS-REVUE CANADIENNE D AGROECONOMIE	149	148	150	150
DEFENCE AND PEACE ECONOMICS	144	143	145	143
FOOD POLICY	141	140	143	141
AUSTRALIAN JOURNAL OF AGRICULTURAL AND RESOURCE ECONOMICS	138	137	138	138
AGRICULTURAL ECONOMICS	131	130	131	131
ECONOMIC MODELLING	130	129	135	132
JOURNAL OF ECONOMIC PSYCHOLOGY	118	117	115	115
ENERGY ECONOMICS	97	96	100	99
ECONOMICS OF TRANSITION	95	94	92	92
SOUTHERN ECONOMIC JOURNAL	92	91	94	91
ECONOMIC DEVELOPMENT AND CULTURAL CHANGE	91	90	86	83
LAND ECONOMICS	88	87	89	89
EUROPE-ASIA STUDIES	160	158	154	152
BULLETIN OF INDONESIAN ECONOMIC STUDIES	152	150	148	148
ENERGY JOURNAL	66	65	65	64
EXPLORATIONS IN ECONOMIC HISTORY	63	62	61	58
JOURNAL OF MACROECONOMICS	124	122	126	123
WORLD DEVELOPMENT	114	112	109	107
IMF STAFF PAPERS	56	55	52	50
ECONOMIC HISTORY REVIEW	101	99	103	97
ECONOMIC GEOGRAPHY	99	97	97	96
JOURNAL OF URBAN ECONOMICS	46	45	45	44
JOURNAL OF RISK AND UNCERTAINTY	42	41	41	40
WORLD ECONOMY	113	110	106	103
REVIEW OF WORLD ECONOMICS	111	108	95	95
OXFORD REVIEW OF ECONOMIC POLICY	74	72	72	70
JOURNAL OF TRANSPORT ECONOMICS AND POLICY	106	103	104	102
ECONOMICS AND PHILOSOPHY	69	67	74	73
CANADIAN JOURNAL OF ECONOMICS-REVUE CANADIENNE D ECONOMIQUE	68	66	70	68
SCOTTISH JOURNAL OF POLITICAL ECONOMY	119	115	120	119
HEALTH ECONOMICS	87	84	84	85
SCANDINAVIAN JOURNAL OF ECONOMICS	58	56	58	57
JOURNAL OF DEVELOPMENT STUDIES	110	106	102	100
REVIEW OF INCOME AND WEALTH	76	73	63	63
ECONOMIC INQUIRY	50	48	48	48
OXFORD ECONOMIC PAPERS-NEW SERIES	61	58	60	59
JOURNAL OF LAW & ECONOMICS	20	19	21	19
ECONOMIC POLICY	18	17	14	14
JOURNAL OF INDUSTRIAL ECONOMICS	31	29	32	31
REVIEW OF ECONOMICS AND STATISTICS	15	14	16	16
JOURNAL OF INTERNATIONAL ECONOMICS	28	26	23	23
JOURNAL OF DEVELOPMENT ECONOMICS	51	47	47	46
JOURNAL OF COMPARATIVE ECONOMICS	89	82	81	76
JOURNAL OF HUMAN RESOURCES	23	21	18	18
JOURNAL OF ECONOMIC PERSPECTIVES	10	9	9	8
WORLD BANK ECONOMIC REVIEW	39	35	34	33
EUROPEAN ECONOMIC REVIEW	37	33	35	34
JOURNAL OF MONEY CREDIT AND BANKING	41	36	36	36

Table 6 illustrates the methodological influence of the VA-index compared to the Invariant method. Table 5 is reorganized such that the nominal and discounted versions of Inv* 24y and VA-index w can be compared to each other more easily.

Table 6: Invariant method vs. VA-index

Journal	Inv 24 nom	VA w nom	Inv 24 disc	VA w disc
RAND JOURNAL OF ECONOMICS	8	12	8	12
JOURNAL OF MATHEMATICAL ECONOMICS	34	42	40	43
JOURNAL OF ECONOMIC GROWTH	9	11	10	10
REVIEW OF ECONOMIC STUDIES	5	6	5	6
JOURNAL OF APPLIED ECONOMETRICS	26	31	28	32
THEORY AND DECISION	73	87	76	87
INTERNATIONAL ECONOMIC REVIEW	16	19	16	17
JOURNAL OF REGULATORY ECONOMICS	65	75	68	75
JAPANESE ECONOMIC REVIEW	102	117	102	116
ECONOMIC THEORY	35	40	37	41
REVIEW OF ECONOMIC DYNAMICS	21	24	22	24
JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS	22	25	23	26
OXFORD BULLETIN OF ECONOMICS AND STATISTICS	55	62	59	62
JOURNAL OF ECONOMICS & MANAGEMENT STRATEGY	33	37	34	37
INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION	53	59	53	61

Journal	Inv 24 nom	VA w nom	Inv 24 disc	VA w disc
JOURNAL OF ECONOMIC SURVEYS	48	53	49	53
ECONOMICS LETTERS	77	85	77	84
INTERNATIONAL JOURNAL OF GAME THEORY	40	44	42	45
INTERNATIONAL JOURNAL OF FORECASTING	103	112	104	114
JOURNAL OF ECONOMIC THEORY	12	13	12	13
JOURNAL OF HOUSING ECONOMICS	84	91	86	93
ECONOMICA	62	67	63	67
ECONOMIC JOURNAL	25	27	25	25
ENVIRONMENTAL & RESOURCE ECONOMICS	100	108	100	108
INFORMATION ECONOMICS AND POLICY	108	116	113	117
ECONOMICS AND PHILOSOPHY	69	74	67	73
JOURNAL OF LABOR ECONOMICS	14	15	15	15
JOURNAL OF ECONOMICS	117	125	119	127
REVIEW OF ECONOMICS AND STATISTICS	15	16	14	16
JOURNAL OF REGIONAL SCIENCE	105	111	105	111
JOURNAL OF ECONOMETRICS	19	20	20	22
REVIEW OF INDUSTRIAL ORGANIZATION	96	101	98	104
JOURNAL OF LAW & ECONOMICS	20	21	19	19
REAL ESTATE ECONOMICS	86	90	89	90
FISCAL STUDIES	109	114	111	113
SOCIAL CHOICE AND WELFARE	47	49	51	51
MACROECONOMIC DYNAMICS	49	51	50	52
ECONOMIC DEVELOPMENT QUARTERLY	123	128	123	128
ECONOMIC MODELLING	130	135	129	132
RESOURCE AND ENERGY ECONOMICS	79	82	79	80
JOURNAL OF BUSINESS & ECONOMIC STATISTICS	27	28	27	28
JOURNAL OF REAL ESTATE FINANCE AND ECONOMICS	85	88	85	88
HITOTSUBASHI JOURNAL OF ECONOMICS	148	153	151	156
STUDIES IN NONLINEAR DYNAMICS AND ECONOMETRICS	90	93	92	94
WORK EMPLOYMENT AND SOCIETY	154	159	154	159
JOURNAL OF INDUSTRIAL ECONOMICS	31	32	29	31
ENERGY ECONOMICS	97	100	96	99
APPLIED ECONOMICS	135	139	135	139
CANADIAN JOURNAL OF ECONOMICS-REVUE CANADIENNE D ECONOMIQUE	68	70	66	68
JOURNAL OF POST KEYNESIAN ECONOMICS	153	157	153	158
JOURNAL OF AGRICULTURAL AND RESOURCE ECONOMICS	129	132	131	134
JOURNAL OF ECONOMIC DYNAMICS & CONTROL	45	46	46	47
SOUTHERN ECONOMIC JOURNAL	92	94	91	91
JOURNAL OF INSTITUTIONAL AND THEORETICAL ECONOMICS	94	96	95	98
JOURNAL OF AGRICULTURAL ECONOMICS	143	146	144	146
ECONOMIC HISTORY REVIEW	101	103	99	97
JOURNAL OF ECONOMIC ISSUES	158	161	159	162
LABOUR ECONOMICS	54	55	54	55
JOURNAL OF MACROECONOMICS	124	126	122	123
OPEN ECONOMIES REVIEW	125	127	125	126
JOURNAL OF PRODUCTIVITY ANALYSIS	67	68	69	71
FOOD POLICY	141	143	140	141
PUBLIC CHOICE	75	76	75	79
JAHRBUCHER FUR NATIONALOKONOMIE UND STATISTIK	161	163	162	163
LAND ECONOMICS	88	89	87	89
INDUSTRIAL AND CORPORATE CHANGE	104	105	107	106
AMERICAN JOURNAL OF AGRICULTURAL ECONOMICS	112	113	114	112
SCOTTISH JOURNAL OF POLITICAL ECONOMY	119	120	115	119
CAMBRIDGE JOURNAL OF ECONOMICS	128	129	128	129
JAPAN AND THE WORLD ECONOMY	132	133	132	137
SMALL BUSINESS ECONOMICS	140	141	141	144
DEFENCE AND PEACE ECONOMICS	144	145	143	143
CANADIAN JOURNAL OF AGRICULTURAL ECONOMICS-REVUE CANADI- ENNE D AGROECONOMIE	149	150	148	150
APPLIED ECONOMICS LETTERS	150	151	149	151
VALUE IN HEALTH	151	152	152	153
DEVELOPING ECONOMIES	155	156	155	157
POST-COMMUNIST ECONOMIES	159	160	160	160
EMERGING MARKETS FINANCE AND TRADE	163	164	163	164
POLITICKA EKONOMIE	169	170	169	170
AGRICULTURAL ECONOMICS	131	131	130	131
AMERICAN JOURNAL OF ECONOMICS AND SOCIOLOGY	147	147	147	147
AUSTRALIAN JOURNAL OF AGRICULTURAL AND RESOURCE ECONOMICS	138	138	137	138
BROOKINGS PAPERS ON ECONOMIC ACTIVITY	7	7	7	7
EASTERN EUROPEAN ECONOMICS	166	166	166	166
ECOLOGICAL ECONOMICS	136	136	136	136
ECONOMETRIC THEORY	38	38	38	39

Journal	Inv 24 nom	VA w nom	Inv 24 disc	VA w disc
ECONOMETRICA	2	2	2	3
ECONOMIC RECORD	134	134	134	133
EKONOMICKY CASOPIS	171	171	171	171
EKONOMISKA SAMFUNDETS TIDSKRIFT	172	172	172	172
FUTURES	165	165	165	165
GAMES AND ECONOMIC BEHAVIOR	17	17	18	20
INTERNATIONAL TAX AND PUBLIC FINANCE	78	78	78	78
JOURNAL OF AFRICAN ECONOMIES	122	122	124	121
JOURNAL OF ECONOMIC LITERATURE	4	4	4	4
JOURNAL OF EVOLUTIONARY ECONOMICS	98	98	101	105
JOURNAL OF MEDIA ECONOMICS	167	167	167	167
JOURNAL OF POLICY MODELING	142	142	142	142
JOURNAL OF POLITICAL ECONOMY	3	3	3	2
QUARTERLY JOURNAL OF ECONOMICS	1	1	1	1
REGIONAL SCIENCE AND URBAN ECONOMICS	64	64	64	65
SCANDINAVIAN JOURNAL OF ECONOMICS	58	58	56	57
TIJDSCHRIFT VOOR ECONOMISCHE EN SOCIALE GEOGRAFIE	162	162	161	161
TRIMESTRE ECONOMICO	168	168	168	168
REVUE D ETUDES COMPARATIVES EST-OUEST	170	169	170	169
JCMS-JOURNAL OF COMMON MARKET STUDIES	145	144	145	145
JOURNAL OF RISK AND INSURANCE	80	79	80	81
SOUTH AFRICAN JOURNAL OF ECONOMICS	157	155	157	154
JOURNAL OF BANKING & FINANCE	72	71	74	72
JOURNAL OF POPULATION ECONOMICS	70	69	70	69
ECONOMIST-NETHERLANDS	139	137	139	135
ENERGY JOURNAL	66	65	65	64
MANCHESTER SCHOOL	126	124	126	125
OXFORD ECONOMIC PAPERS-NEW SERIES	61	60	58	59
REVIEW OF INTERNATIONAL POLITICAL ECONOMY	121	119	121	120
CONTEMPORARY ECONOMIC POLICY	120	118	120	118
JOURNAL OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT	57	56	57	56
JOURNAL OF TRANSPORT ECONOMICS AND POLICY	106	104	103	102
ECONOMIC GEOGRAPHY	99	97	97	96
JOURNAL OF URBAN ECONOMICS	46	45	45	44
EUROPEAN REVIEW OF AGRICULTURAL ECONOMICS	133	130	133	130
WORLD BANK RESEARCH OBSERVER	44	43	44	42
JOURNAL OF RISK AND UNCERTAINTY	42	41	41	40
INTERNATIONAL REVIEW OF LAW AND ECONOMICS	82	80	88	86
JOURNAL OF ECONOMIC PSYCHOLOGY	118	115	117	115
BULLETIN OF INDONESIAN ECONOMIC STUDIES	152	148	150	148
OXFORD REVIEW OF ECONOMIC POLICY	74	72	72	70
ECONOMICS OF TRANSITION	95	92	94	92
EXPLORATIONS IN ECONOMIC HISTORY	63	61	62	58
JOURNAL OF LAW ECONOMICS & ORGANIZATION	30	29	31	29
JOURNAL OF ECONOMIC BEHAVIOR & ORGANIZATION	59	57	61	60
HEALTH ECONOMICS	87	84	84	85
EURASIAN GEOGRAPHY AND ECONOMICS	164	158	164	155
EUROPE-ASIA STUDIES	160	154	158	152
JOURNAL OF ECONOMIC HISTORY	52	50	52	49
ECONOMIC INQUIRY	50	48	48	48
ECONOMY AND SOCIETY	146	140	146	140
CHINA ECONOMIC REVIEW	115	110	116	110
WORLD DEVELOPMENT	114	109	112	107
POST-SOVIET AFFAIRS	156	149	156	149
JOURNAL OF ECONOMIC EDUCATION	127	121	127	122
ECONOMICS OF EDUCATION REVIEW	81	77	81	77
EUROPEAN ECONOMIC REVIEW	37	35	33	34
ECONOMIC DEVELOPMENT AND CULTURAL CHANGE	91	86	90	83
WORLD ECONOMY	113	106	110	103
JOURNAL OF PUBLIC ECONOMICS	32	30	32	30
NATIONAL TAX JOURNAL	71	66	71	66
IMF STAFF PAPERS	56	52	55	50
JOURNAL OF DEVELOPMENT STUDIES	110	102	106	100
KYKLOS	107	99	109	101
INSURANCE MATHEMATICS & ECONOMICS	116	107	118	109
JOURNAL OF DEVELOPMENT ECONOMICS	51	47	47	46
AER Papers & Proceedings	24	22	24	21
MATHEMATICAL FINANCE	36	33	39	35
JOURNAL OF COMPARATIVE ECONOMICS	89	81	82	76
JOURNAL OF HEALTH ECONOMICS	43	39	43	38
JOURNAL OF ECONOMIC GEOGRAPHY	60	54	60	54
JOURNAL OF ECONOMIC PERSPECTIVES	10	9	9	8
FEMINIST ECONOMICS	137	123	138	124

Journal	Inv 24 nom	VA w nom	Inv 24 disc	VA w disc
JOURNAL OF ACCOUNTING & ECONOMICS	29	26	30	27
JOURNAL OF POLICY ANALYSIS AND MANAGEMENT	93	83	93	82
JOURNAL OF THE JAPANESE AND INTERNATIONAL ECONOMIES	83	73	83	74
JOURNAL OF MONEY CREDIT AND BANKING	41	36	36	36
WORLD BANK ECONOMIC REVIEW	39	34	35	33
REVIEW OF WORLD ECONOMICS	111	95	108	95
AMERICAN ECONOMIC REVIEW	6	5	6	5
REVIEW OF INCOME AND WEALTH	76	63	73	63
JOURNAL OF INTERNATIONAL ECONOMICS	28	23	26	23
JOURNAL OF HUMAN RESOURCES	23	18	21	18
ECONOMIC POLICY	18	14	17	14
JOURNAL OF MONETARY ECONOMICS	13	10	13	11
JOURNAL OF FINANCIAL ECONOMICS	11	8	11	9

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