Estimates of a Cultural Consumption Price Index by Australian Region

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ABSTRACT

We propose a method to construct a price index of cultural consumption in geographic space. The index—the Cultural Consumption Price Index (CCPI)—is calculated from a standardized cultural consumption basket purchased by a representative consumer over 30 locations in Australia, using 2010 price data. We use a full cost method (direct plus indirect cost) to estimate the index value of the cultural consumption basket; highlighting the extent that price differences by Australian location are accounted for by larger indirect costs (particularly travel) in consumption. The CCPI thus offers an empirical estimate of variation in the real cost of cultural consumption throughout Australia, based on existing investments and technologies with uniform preference. We find that the smaller cities of Perth and Adelaide have the lowest index value, with the larger cities of Sydney and Melbourne next. Regional centers have index values that range between 20 percent and 100 percent higher, and remote towns scored considerably higher again. We then recalculate the index based on non-linear per capita scaling, which shifts the index away from major cities and toward evidently productive smaller cultural centers including Byron Bay and Fremantle.

Keywords: Cultural consumption, Price index, Creative industries, Urban studies

1. INTRODUCTION

There are cultural costs and benefits associated with where one chooses to live in Australia. City living, for example, offers proximity to a greater range of cultural opportunities but carries higher costs of living than in a smaller town. Better access and variety is traded off against higher prices. The Cultural Consumption Price Index (CCPI) is an attempt to quantify this trade-off for a representative household by estimating the full cost of a weighted basket of standardized cultural goods and services. The objective of this paper is to do so by providing a measure of how real costs of cultural consumption vary by geographic location in Australia. We estimate the CCPI over 30 postcode defined Australian locations, ranging from inner city metro regions to outback communities. The CCPI climbs, at first slowly but then quickly, as cultural consumption is undertaken further and further away from its lowest point in the metro urban conglomerates of Western and South Australia, rising along the east coast and spreading inland. The highest prices of cultural consumption are in the remote center and north of Australia.

The Cultural Consumption Price Index is similar to the Consumer Price Index (CPI), which is also estimated from a standardized basket of goods and services purchased by a representative household (Boskin et al., 1998), and which also may then be calculated at specific geographic locations (although these are usually then averaged to estimate an Australia-wide index). Yet the CCPI differs from the CPI in three important ways. First, the CCPI is primarily intended as an estimate of the differing costs (i.e. prices for a standardized basket) of cultural consumption at a *point in time* over *varying locations*. The CPI however is a measure of changes in prices (as a measure of 'cost of living') through time averaged over all locations. The CCPI is primarily intended to highlight price differences in geographic space. Second, the CCPI contains only six consumption items, compared to almost 100 in the CPI. In this sense the CCPI can be considered a subset of the CPI in that cultural consumption is approximately six percent of all consumption. The justification for the six items in the CCPI basket is discussed below. Third, and perhaps most significantly, because of the focus on the real differential costs of living in different locations, the CCPI methodology involves a full cost estimation of engaging in the particular consumption items (e.g. seeing a movie) that involves not only the direct cost (e.g. ticket price) but all other indirect costs, including travel costs and a compensating factor for the implications of limited variety or inferior quality offerings in smaller centers or more remote locations.

While such an index may be relatively 'flat' in nations with relatively high and even population density, such as Western Europe or Japan for example, countries with large land mass and both highly concentrated and dispersed populations, such as Australia, Russia or Canada are expected to face significant differentials in the real cultural consumption costs across its geography. The CCPI is an endeavor to estimate and map the cardinal extent of these differentials, both to reveal this gradient at a point in time and also to benchmark any subsequent changes through time due to changes in technology, infrastructure or demographics.

There are multiple potential uses of the cultural consumption price index. First, to assist capital investment decisions in relation to *regional policy* with respect to both economic development and socio-cultural goals. Second, to further assess the comparative advantages of *metro cities* in economic growth and development due to relatively more abundant cultural consumption opportunities. Third, to assist *entrepreneurial* decision-making with respect to perceived opportunities to reduce these higher relative costs by for example creating new markets or introducing new technologies or business models. Fourth, to track changes in the effects of *regional*

policy initiatives and investments to improve cultural consumption opportunities; different cities and regions may track their progress with respect to one another by changes in their real-cost index measures.

In a world with zero transaction costs, zero marginal cost of distribution, and perfect competition (i.e. zero rents), the index would have zero variance (i.e. all values = 100). The motivating hypothesis is that the index measures the extent to which these costs and rents depart from zero. The CCPI thus estimates the distribution of relative costs of standardized cultural consumption over different Australian locations. Subsequent recalculations of the index will enable us to track how changes in cultural investment, infrastructure, migration and institutions affect the distribution of the real price of Australian cultural consumption.

The CCPI is of course a *price index*, not an index of cultural consumption levels, quality or variety. It does not tell us anything about what cultural consumption is actually occurring, or its value. It can only tell us its relative cost or price compared to some standardized basket of cultural consumption in a normalized setting. Actual cultural consumption at different Australian locations is a separate question. The CCI-CCPI only aims to construct a price index of what a standardized basket of cultural consumption would cost, were it to be undertaken at each of the various points in our index. Most of the data points will thus necessarily be hypothetical (due to expected consumer substitution), except for the base, which is the measure from which other points on the index depart. As such, the index does not predict what cultural consumption is expected in various regions, only the extra cost to consume the standardized set.

Why attempt a cultural consumption price index to isolate relative consumption costs, rather than the standard focus of production outputs? Or why focus on this implied spatial gradient in relation to consumption, when most focus is on cultural production. A price index provides different information to a producer-centered indicator index: it tells us about the real price paid to live away from easy sources of cultural consumption that are available in metro regions. It tells us about the real opportunity cost of cultural consumption that accrues to regional living. There is nothing new in constructing cultural consumption (and production) indices at different geographic locations, as for example Richard Florida's (2003) creative class/creative cities index. Yet Florida's spatial index is constructed from economic and demographic indicators (percentage of people with given level of educational attainment; "creative class" occupational share; minority, foreign born and gay/lesbian population share), and not from local prices. Clearly, different locations differ in cultural production capabilities (e.g. the score of a particular region on the Florida index). A corollary is that these different locations also differ in cultural consumption possibilities. Our specific index addresses the real cost of doing so over a standardized cultural basket.

A price index differs from an indicator index in that it specifically seeks to track the real cost of a particular basket of consumption activities at each location and is unconcerned with what cultural consumption or production actually occurs in those locations. Obviously, if a location does have a lot of such cultural production, we might expect that under market competition that specific cultural forms will be relatively cheap to consume there, which would reflect in the index as a lower relative price. Indirectly, the CCPI does integrate local cultural production factors that have been the main focus of creative economy metrics. But its focus remains ostensibly on the demand side with an endeavor to estimate real price (including both direct and indirect costs) of a standardized cultural consumption basket.

Price indices are not usually disaggregated by geographic location for particular components of consumption. The most obvious explanation is that there is simply little obvious demand: most policy, whether cultural or industry policy, works on the supply side and has little use for information about the market environment that consumers actually face. Moreover, to the extent that real prices of cultural consumption is a concern, there is little reason to develop a targeted regional policy when blanket Australia-wide policy formulations relating to, for example, cultural and industry policy can be justified on equity grounds and defended without the need for detailed information at specific locations. Instead, it is only with the cost-benefit calculations suggested by new generations of public communications and media infrastructure that draws attention to the actual price differentials faced by consumers of culture across the vast Australian space. By estimating the gradient of real costs of cultural consumption in geographic space, the CCPI will offer a useful artificial data series from which to evaluate such (regional) investment decisions. Moreover, the expected benefits are often difficult to estimate because consumers substitute and make trade-offs, consuming less culture when it is relatively more expensive. It is this implicit differential that a cultural consumption price index seeks to identify.

While there are many measures of real levels and types of cultural consumption by country or even region, and while there exist several indices of price of cultural consumption by country (e.g. CUPIX 2008, which is a six-item cultural consumption price index for 20 European countries), and of changing cultural consumption real costs through time for particular countries (see MacDonald, 2013), there are, so far as we are aware, no indices of cultural consumption that index by local region within a country. This project thus introduces a new class of cultural economic index, a real-price index of a standardized cultural consumption basket by spatial location.

2. METHOD AND DATA

2.1 Cultural Consumption in Price Indexes

In Australia, cultural consumption is a small part of the standard consumer price index (CPI) basket, on the order of three percent. This includes 'audio, visual and computing media services' (1.38% weighting), 'books, newspapers and magazines' (0.85% weighting) and 'toys, games and hobbies' (0.51% weighting), and possibly 'other recreational activities' (1.09% weighting). In comparison, 'alcoholic drinks' has a 4.38% weighting. However, estimates of the size of the creative industries (which is a broader set that cultural industries per se) range between 5-11 percent for OECD nations (Potts & Cunningham, 2008), suggesting that the CPI measure may underweight cultural consumption.

Thus while it is certainly possible to assemble a cultural consumption price index as a component from most national CPI accounts, thus furnishing a time series measure of how the real cost of cultural consumption had changed though time in particular countries, there is no basis for such a construction to provide regionally disaggregated information. Such indices at best provide comparative information about the different relative costs between nations at a point in time (as in the CUPIX index for Europe), plus also providing information about changing relative prices through time. But because the basket items are relatively narrow it is difficult to adduce much of a detailed profile from this. The CCPI seeks to fill a significant gap in cultural consumption data.

Approximate indicators of cultural consumption are usually calculated for expenditure rather than prices, for example in the survey by Australian Bureau of Statistics presented in Table 1 (see also Bennett et al., 1999). The problem with these surveys is that they do not offer much insight into the different effects of changed preferences,

Table 1. Cultural expenditure in Australia

		Average weekly household expenditure (current prices)				
		1984	1989	1994	1999	2004
Literature		4.16	5.82	7.54	7.56	8.43
Music		0.68	1.21	1.29	2.07	1.65
Performing arts		0.81	0.92	1.92	1.48	1.59
Visual arts and crafts		0.42	0.58	0.72	1.09	1.66
Broadcasting and film		1.28	2.01	3.13	4.13	7.87
Other arts		0.95	1.22	1.41	1.28	1.86
Heritage		0.09	0.13	0.25	0.17	0.39
Other culture		6.94	7.94	9.13	8.90	12.94
	Total	**15.33**	**19.83**	**25.39**	**26.74**	**36.40**

Source: Household Expenditure Survey - Detailed Expenditure Items, 2003-04

changed technologies and opportunities, or changed prices. The estimation of the CCPI offers a way to redress part of that limitation.

We also note, in passing, that price indices have been constructed and studied for particular segments of arts consumption, specifically for fine arts auctions (e.g. Candela and Scorcu, 1997; Candela et al., 2004). Long run price indexes are also available for input prices into artistic production such as musical instruments (MacDonald, 2013). Yet none of these indexes seeks to estimate a representative consumer basket or are sufficient inclusions in such a basket.

2.2 Index Construction

The CCPI is a price index defined about a base that represents an ordinal rank of multiple points on the index corresponding to the measured and estimated price of a basket of cultural consumption by representative households in different geographic locations.

The index is constructed from a representative basket of cultural consumption goods and services $X = (x_1, x_2, ... x_6)$. Each element in X is weighted by $W = (w_1, w_2, ... w_6)$ where $\sum w_i = 1$. The weighted basket is then $X'=(w_1 x_1, w_2 x_2, ... w_6 x_6)$. A price index then multiplies each $w_i x_i$ by price p_i. For our initial estimates, the weights we have used are equal over the six elements. Obviously, a different index can be constructed with dif-ferent weightings. The weighted index is then normalized about a base observation (Perth).

$$CCPI = pX' = \sum w_i x_i \ p_i \quad (1)$$

We define the basket X, apply the weights W (to arrive at X'), and then input price data, some which is artificially constructed (to arrive at $pX'= CCPI$). The index is calculated with an arithmetic mean yielding an ordinal measure of the spatial variation in cultural consumption prices within Australia. The elements of the set as measures on the index are representative households in $n = 30$ geographic locations in Australia. Costs are measured by $p_i q_i$ summed over a standardized set x_i. The vector $p_i q_i$ is full cost, including direct and indirect costs. The index can be both decomposed and elaborated along any of these dimensions.

The index can be calculated at a point in time, say 2008 (using audited data) or 2010 (using real time data), as an index of real full prices (of cultural consumption) in differing Australian population geography. It is a price index of cultural consumption of a representative basket at each location. It is made of: (1) a set; (2) a basket; (3) weights; and (4) prices (full consumption costs).

2.3 The Set of Sample Locations

The first consideration is the set of sample locations for which the CCPI will be calculated.

There are several ways to construct the set of points on the index. This can be viewed as both a demographic spatial distribution or, at the other extreme, as metric-space geography. Simply putting a 30 cell grid over Australia would give a representative geographic array of index points, but would significantly lump significant differences in the real cost of cultural consumption between, say, the east coast cities, towns and regions between Brisbane and Melbourne. Conversely, a demographic distribution would put most points on the index in metro regions. It would not tell us much about the actual geographic distribution. A solution is to use a mixed method, such as *post-codes*. These reflect both geographic and demographic measures, and are a natural unit for spatial statistical analysis of socio-economic data.

We have selected 30 (4-digit) post-codes, seeking to set a balance between different types of region, whether predominantly (1) inner city metro, (2) suburb metro, (3) regional center, (4) small country town, and (5) remote. The main capital metro regions are represented, along with representatives from the other 4 classifications, forming from 5 to 8 locations in each class. The sample from each geographic set (or measure in the index) will need to be as representative as possible, recognizing that higher quality representation is becomes increasingly costly to estimate. We have attempted to cover the full geographic space in constructing the set of points on the index, selecting sample locations from the various location categories (e.g. inner city, regional) but also discriminating on population size (demographics) and distance from major population centers (spatial distribution). This more or less corresponds to the post-code method, although for a preliminary sample size of just 30 location points some 2-digit post-codes (and potentially includable sample location points) have been overlooked. For each postcode, information on population density and distribution can be used to estimate parameters such as average travel time, and therefore opportunity cost.

2.4 The Six-item Basket

The formulation of the basket is the most difficult conceptual part of index construction. It needs to embody a theory of why particular elements are included in the bundle while others are not, while conforming to the necessary requirements that the elements be standardized, well defined, general and replicable. This is a particular challenge when the consumption items are heterogeneous and accompanied by substantial uncertainty of value, as they plainly are with cultural consumption. The basket must be representative enough that there would be consensus that the items included do suitably represent population-wide cultural consumption. The items in the basket must also be able to be consumed at all locations in the index: i.e. all prices in the basket must remain finite and well below absorption of the entire household budget.

This constrains the basket to appear simplistic at first, seemingly missing the texture and the fullness of contemporary cultural consumption possibilities. But a good index is a simple index of as few items as is defensible, with their criteria for inclusion being representativeness in cost structure. The limits of the basket approach are that it does not easily differentiate on quality or variety. But it is necessary to adopt a *prima facie* simplistic basket in order to generate a comparative index. Put differently, the index is only as good as it is representative and standardized (*The Economist*'s 'Big Mac index' is an extreme example, with only one item in the bundle, but it succeeds because it is an excellent representative and standardized item, embodying local land rents, wages, costs of primary produce, transport, and so forth).

The six items in our basket correspond to six proposed dimensions of cultural consumption: (1) mass culture (blockbuster movie); (2) high culture (theatre); (3) family culture (library); (4) cultural learning (music lesson); (5) social

Table 2. The CCPI basket

Class	Item	Substitutes	Constraints	Weight
Mass culture	1 movie	Ten-pin bowling, < Hoyts quality	Digitally projected, < 2 weeks opening on 50+ screens	1/6
High culture	1 international stage performance	National, poorly reviewed, < 4 stages	Well reviewed, showing > 4 stages across Australia	1/6
Family culture	1 library visit	Zoo, museum, botanical gardens	Library with permanent staff, +100,000 books	1/6
Cultural learning	1 piano lesson	Unlicensed, other instruments	Introductory, one hour, qualified, private lesson	1/6
Interactive culture	1 arts/music festival	< 10k people, < $30 ticket	'A-list' festival, +10k people, +$30 ticket	1/6
Home culture	1 music album	Hard copy CD, radio	Legal access download on 'standard' plan	1/6

interactive culture (festival); and (6) home culture (music download) (Table 2). While there are many other aspects we may have sought to include, we maintain that these six dimensions capture a significant range of variation in the full cost of cultural consumption in Australia.

(1) Mass culture: Why a blockbuster movie?

As the most commonly consumed cultural event, movies are an excellent standardized unit that can be priced independent of content. This reflects the principle that the basket should include only standardized 'containers' with complete freedom of content. Imposing the digital projection constraint standardizes the technology experience, and within 2 weeks of opening on more than 50 screens ensures that we are capturing the most likely cultural choices of the representative household. Direct costs in admission tickets, parking and other complementary goods were relatively easy to acquire by contacting the cinemas directly. Indirect cost was more challenging, requiring estimates of population distribution and average travel times and opportunity costs.

(2) High culture: Why an international stage show?

A high-quality theatre performance provides a measure of the cost of attending to international live theatre. While live theatre is found in most cities and even towns, we sought to include a visit to a theatre of world standing, which almost entirely concentrate in the main capital cities. An international stage show reflects the costs of assembling, coordinating and performing with a large company. It is a measure of the costs of other such high-quality high-production value cultural productions as travelling exhibitions, and such like. It also reflects the relative attractiveness and viability of high-end cultural spaces and amenities.

(3) Family culture: Why a library visit?

A library visit is a very common cultural activity, especially for families. Libraries can provide gateways to other cultural consumption. For example, a visit may combine with other cultural and community-based events—often associated with children—that gather at libraries or are coordinated from libraries. While free to access libraries nevertheless may involve significant travel and time costs in consumption. Including a library visit in the bundle thus captures the cost of local cultural access, while representing the indirect costs of such community-based cultural coordination. A library visit may also be expected to be a high quality local source of cultural variety at very low direct cost.

(4) Cultural learning: Why a piano lesson?

Perhaps seemingly a strange pick because it is not in the majority of cultural consumption baskets, and it is not obviously even consumption (rather, it is investment in cultural human capital). But it is a good estimate of the costs of cultural consumption training. A piano lesson—specifically a licensed private introductory piano lesson—is a standardized unit for the formation of cultural preferences that underpins future cultural consumption. The notion of investment in learning taste and developing preferences is a well-known argument in cultural economics (Throsby, 1994). One hour of private piano lessons is a good proxy for all other such investment as it involves purchasing the time and learning resources of a skilled instructor. The cost structure of learning visual art, dance, theatre or even design would likely be similar. One introductory piano lesson is included in our basket because it is a sufficiently common service both demanded and supplied that we might expect to observe such a market in all postcodes, as well as in other countries or at times previous.

(5) Interactive culture: Why a festival?

About one-in-five adults reportedly attend a cultural or music festival per year. A significant fraction of these are attendance at large events running one or more days. While plainly not a majority consumption item, arts and music festivals of various all share a similar cost structure associated with a festival site, administration, local costs of resources and services, and of course payment to artists. This cost is mostly neutral with respect to genre, whether the Bundy Rum Country Music Festival, the FNQ chamber music festival, or the Big Day Out. A festival is thus like a 'Big Mac' in this respect, in that a single ticket price captures many indirect costs of providing the festival. Festivals are also reasonably competitive and relative subsidies from local governments can be factored in to the full cost calculation. We found significant variation in the indirect costs of

attending festivals due to travel costs and other necessary arrangements for consumption. The festival experience also involves a degree of consumer novelty (e.g. sampling) and thus provides opportunity for cultural learning, mixing, and gateways to other cultural consumption.

(6) Home culture: Why a music album (download)?

Home culture reflects the attempt to estimate the costs of cultural consumption that is consumed in the home. This could equally be books, or radio or TV, for example, but we selected a full-length music album at the lowest price point available, which circa 2010 in Australia mostly means a digital download (for example on iTunes). In earlier times this would have involved an LP, tape or CD bought from a music retailer, and would have had more significant price variation as consumption moved away from urban centers due to higher transportation costs, less competition and reduced variety. This item in the basket also captures the effects of digitally provided culture into the home through the Internet.

2.5 Representative Household

These six proposed elements are representative consumption items of the median household in one year. We define the *representative household* in order to anchor the bundle to a particular cohort. Subsequent indices may yet seek to construct demographically decomposed indices based about other specific cohorts, but the most obvious place to start is with a standard representative household. According to the Australian Bureau of Statistics, this is composed of a 35-44 year old married Australian male, living in a major city in NSW with a wife and dependent children. The household's health is fair and has weekly contact with friends and family. Our household head has finished high school, works full time, and has a computer at home. The household feels safe financially and comfortable among its neighbors, whom he does not mind asking small favors of. It is in the middle third of the

socio-economic index quintile and has transport to get where it needs to go. The representative household employed in the CCPI has the same range as this standard household.

Table 3. Relative popularity of cultural events in Australia

Proportion of Australian population attending selected cultural events 2002	
Art galleries	25%
Museums	25%
Libraries	42%
Zoological parks and aquariums	40%
Botanic gardens	42%
Classical music concerts	9%
Popular music concerts	26%
Theatre	18%
Dance	11%
Musicals and opera	19%
Other performing arts	20%
Cinema	70%
Attended 1+ cultural event in past 12 months	88%

It is reasonable to suppose that this representative household will be involved in all of these activities, or have access to them, even if not currently choosing to consume them. Table 3, as a point of calibration, illustrates the surveyed percentage of Australians over 18 attending cultural events. Cinemas, libraries and cultural festivals, which will feature in our basket, are all far from minority consumption items.

2.6 The Weights

In our preliminary formulation of the CCPI we have proposed a simple unweighted index (i.e. giving components an equal 1/6 weighting). The purpose of weighted index (as opposed to a nominal aggregate index) is that it better represents mean consumption. It also eliminates replication of cost structures and limits the impact of atypical cost structures. We have however employed equal weights by implicitly assuming that each component of our index is equally important in tracking cultural consumption price changes. We have done so first for simplicity and second because the relative cost shares for the components

of cultural consumption in the representative household's budget are not yet available. Indeed, a refined CCPI would estimate these cost shares (e.g. from cultural consumption expenditure surveys of households, or from aggregate size rankings of cultural markets in Australia) and apply them as weights in the index.

An exhaustive CCPI would include all cultural consumption items that our representative household in Melbourne (3000) might consume within a year, weighted by the cost shares of each item in the household's yearly cultural consumption budget. Clearly we have set the vast majority of these weights to zero, allowing only six to be positive. While this may seem extreme, the particular components we have chosen have already been justified on the basis of the necessary requirements that they be standardized, well defined, general and replicable. We also consider them to capture the most of cultural consumption in the smallest basket of items.

An obvious point is that the weights must sum to unity. Any additional item weakens the weighting on others so we want to select the smallest possible set of best items. A poor choice of item weakens the power of the index. We have considered the next four possible items to include (e.g. galleries, high profile sports event, national newspaper subscription, MMOG subscription), but because each of these items is in part orthogonal with the first six, they do not necessarily add explanatory power (through meaningful variance) that compensates for the weakening of the index through dilution.

Could there be less than six? Perhaps, but arts and cultural consumption is a wide set, and one that arrives in multiple instantiations and across multiple platforms, and for which there are many substitutes and complements. We suggest that these six minimally and perhaps efficiently captures these various aspects relating to for

example, local costs of production and supply, development of local cultural markets, variety of consumption possibility sets, and costs of access.

The issue of weighting is mostly non-contentious for a single representative household, where weights can be derived from cost shares in the household's cultural consumption budget. But this becomes a more substantial issue when multiple indices are constructed using the same basket over different demographic cohorts. It is here that the meaning of different cohorts will express by the extent to which the extant weightings are misrepresentative. It is well known, for example, that the two major predictors of cultural consumption are income and education (Throsby 1994). This expresses in both levels of cultural consumption (as a fraction of income) and also on the types or classes of cultural consumption.

The challenge for the index is that to be a comparable index not only must the items in the basket be standardized and fixed, so too must be the weights. The challenge, then, is to weight the index in such a way that minimizes the misfit of other possible index formulations by cohort. No weighting will be perfect; the goal is to have the least imperfect weighting. Given all the above considerations, our preliminary construction of the CCPI as a simple equally index of six components seems an ideal benchmark formulation.

2.7 Full Cost Estimates of Input Costs/Prices

Prices p_i are constructed from direct and indirect prices (or opportunity costs in the latter), such that $p_i = p_{direct} + p_{indirect}$, where p_{direct} equals to direct prices in acquiring cultural good or service, such as ticket or billing price; and $p_{indirect}$ equals to indirect prices as full cost, including opportunity cost, travel costs, time costs, etc.

As expected, indirect costs loomed larger in regional centers contributing to higher index measures as distance increases from metro centers. This was a non-monotonic function in its components, for example as higher rents increase direct costs in metro centers, but higher travel costs increase indirect costs in regional centers. The challenge was to collect prices for what in many cases was a hypothetical consumption set.

Consider a cinema visit for example. The representative Melbourne 3000 household might face:

Direct cost

Tickets	2 x adult, 1 x child	$45
Parking	1 car	$5
Complementary goods	1 medium popcorn, 3 drinks	$15

Indirect cost

Travel	Local bus	$10
Opp. cost of time	1 hour	$50
Total		**$125**

The representative Mt Isa 4825 household might face:

Direct cost

Tickets	2 x adult, 1 x child	$35
Parking	Free	$0
Complementary goods	1 medium popcorn, 3 drinks	$15

Indirect cost

Travel	Private car, 50c/km	$35
Opp. cost of time	2 hours	$90
Total		**$155**

Obviously there are many other direct and indirect costs we might include. But observe that even this simple construction involves different opportunity costs due to different average income levels, as well as different direct costs due to lower land prices, as well as effects from differing levels of competition. Note also that because the complementary goods measure was identical it can be eliminated from the index with no loss of variation or power. Nevertheless, even allowing that, by normalizing Melbourne 3000 to 1.00, then Mt Isa's index value is calcula-

ble at (155/125) 1.24 for this item in the basket. This methodology is repeated across the other basket items at each location.

These figures are obviously subject to different ranges of estimates that depend upon many factors. Someone living further away, with a lower income, or with alternative transport arrangements or preferences for complementary and substitute goods may face a very different price profile, and thus revealed consumption demand. The only way to properly address this issue is to seek to improve the ongoing representativeness of the estimate, for example by aggregating further observations on prices actually paid by people undertaking this consumption basket. The estimate of the 'true value' of the index for each location may improve with additional estimation and replication.

2.8 Purchase Price, Travel Cost, Opportunity Cost, Substitution Factor

We begin by considering the standardized CCPI component cultural good (e.g. an outing to a library for a family of two adults and one child; an outing to a music festival for one adult). Each component is defined according to quantifiable metrics (e.g. libraries should be non-specialist and at least 100,000 volumes in size; festivals should be "A-list" international music festivals, with multiple stages and many national and international acts, of at least 10,000 attendees in size and with a minimum ticket price of $30).

Acceptable substitutes are also listed, with deviation from the standardized good for a substitute or lesser quality good (e.g. an outing to a zoo or museum or a library that is not non-specialist or insufficient in size; festivals of lesser reputation and smaller size, or other types of festivals (e.g. food, comedy, film, arts, family or community festivals) attracting a penalty in the form of a substitution factor. This penalty is based on a quantitative measure of similarity to the standardized component culture good (e.g. the number of volumes in the library; the number of stages or total attractions/gig timeslots at the festival) and is applied ex post to the total cost of the component.

Numerous alternatives are then tested with the aim of choosing the least cost option. For example, in a regional town people may rationally decide to partake in a lower quality cultural outing (and accept an implied substitution penalty) rather than travel to a regional center or state capital city (thus greater travel costs) for the standardized good.

Potential costs vary according to the cultural consumption component, but generally include: admission or purchase price; travel costs to travel to the nearest place with the good (sometimes the nearest next town if not available or no suitable substitute locally); opportunity cost of travel time; other expenses (e.g. parking, food and beverages, accommodation, borrowing fees); and finally the ex post substitution penalty. Final costs are then summed and compared among alternatives for each town, and the lowest cost option accepted. The CCPI for each individual dimension (e.g. family culture; interactive culture), for each location, is simply the index of the lowest final cost option relative to that of the lowest total CCPI location. As it happened, Perth city (6000) was found to have the lowest CCPI and in view of that the CCPIs were scaled relative to Perth (e.g. CCPI Perth = 1.00). Meta-indices were also calculated for the location categories (e.g. inner city, regional center) and reported relative to the lowest CCPI category (e.g. CCPI inner city = 1.00).

2.9 Non-linear Population Scaling

The CCPI is a linear per capita indicator for ranking cities by the affordability of cultural consumption. However, we might expect the non-linear agglomeration affects typical of social interaction in cities to have a role to play. For example, it has been shown that larger cities produce and spend wealth faster, create new ideas more frequently

and suffer from greater prevalence of crime all approximately to the same degree (e.g. Bettencourt et al., 2010). These relationships generally scale based on population according to power law relations that are remarkable stable across a broad range of urban indicators ("the 15% rule" whereby metrics scale up or down by ≈ 15%).

That is, population size can be considered an aggregate proxy for a set of general processes made possible by the more intense social interactions between diverse individuals and social organizations in larger cities (e.g. more efficient economic specialization and division of labor, more efficient socioeconomic matching that facilitates social and economic markets, easier sharing of resources resulting in greater economies of scale and faster learning and innovation) (Bettencourt et al., 2010).

If cities are self-similar across population levels and all more or less follow non-linear power law scaling then simple urban indicators (perhaps even the CCPI) conflate general non-linear effects common to all cities (e.g. the benefits of larger population in cities such as Sydney and Melbourne marked by lower CCPIs) with the true local dynamics specific to each city (e.g. the effects of local events, historical contingency, and policy on cultural affordability, independent of population size). If we use the agglomeration laws (e.g. sub-linear power law scaling of CCPI) to model the expected average CCPI that a city of a given size *should* manifest (in the absence of any specific local features) then local characteristics will be represented by how particular cities deviate from their expected baseline behavior (e.g. the residuals). That is, deviations from scaling laws provide truly local measures of a city's cultural organization and dynamics and should actually be used to measure performance relative to their larger or smaller peers. In this sense, while Sydney may be considered a scaled-up version of Newcastle according to the baseline power law

model (with better CCPI score), it may actually be underperforming based on regression residuals (e.g. Newcastle may have a negative cost residual and Sydney may have a positive cost residual).

Therefore we model the CCPI as a power law according to the expression:

$$CCPI_i = CCPI_0 \, Pop_i^{\beta} \qquad (2)$$

where $CCPI_i$ is the CCPI measured for each location i, $CCPI_0$ is a normalization constant, Pop_i is the population at location i, and β is the scaling factor by which the CCPI increases or decreases in relation to population. β reflects the general dynamic rules at play across the urban system i.e. cultural production is expected to exhibit economies of scale; hence we would expect $\beta < 1$. Sub-linearly scaling indicators are driven by optimization and efficiency and can be thought of as an increasing capacity in larger cities to be able to efficiently allocate and use infrastructural related resources.

Power laws can be identified by plotting quantities on a log-log scale and observing that their relation becomes linear with some slope β, which is the scaling exponent (Bettencourt et al., 2010). Therefore, we estimate the slope coefficient β in a regression of log population on log CCPI for our 30 locations and compute the residuals of this regression as measures of the true local dynamics specific to each location.

The residuals are given by:

$$\xi_i = log \, (CCPI_i) - log(CCPI_0 \, Pop_i) \qquad (3)$$

where $CCPI_i$ is the observed value of CCPI and is the predicted value based on sub-linear log power law scaling. ξ_i is known as a Scale-Adjusted Metropolitan Indicator (SAMI) and is completely independent of size. SAMIs thus enable direct comparison between cities of different scale by representing the true local dynamics specific to

each city (e.g. the effects of local events, histori-cal contingency, and policy).

3. RESULTS

The index results for the 30 locations are present-ed in Table 4, while Table 5 details the individual estimates of the index and its components at each location. It remains for subsequent research to analyze the rank findings for correlation with lo-cal factors so as to seek explanation of the specific rankings. As mentioned, the index was initially calculated setting Melbourne 3000 as the base (we

conjectured that would be the lowest cost location overall for the basket). This turned out to be false, and the index was subsequently recalculated with Perth as the base (i.e. Perth = 1.00).

The index estimates were entirely in accord with expectations, whereby capital cities had the low-est index values (lowest cost cultural consump-tion with respect to the representative basket) with the index values increasing as cultural consumption moved through outer suburbs, re-gional cities, towns and having its highest value in remote towns.

Table 4. Cultural consumption price index estimates ranking

Rank	Location	Postcode	Description	Approx. Pop.	CCPI
1	Perth	6000	Inner city	1,300,000	1.00
2	Adelaide	5000	Inner city	1,000,000	1.03
3	Sydney	2000	Inner city	3,600,000	1.05
4	Melbourne	3000	Inner city	3,400,000	1.11
5	Bendigo	3550	Regional center	80,000	1.14
6	Brisbane	4000	Inner city	1,700,000	1.14
7	Canberra	2600	Medium-sized city	350,000	1.15
8	Newcastle	2300	Medium-sized city	540,000	1.16
9	Fremantle	6160	Outer-suburb city	38,000	1.16
10	Penrith	2750	Outer-suburb city	185,000	1.18
11	Byron Bay	2481	Country town	5,000	1.18
12	Bunbury	6230	Regional center	66,000	1.21
13	Hobart	7000	Regional center	210,000	1.22
14	Alice Springs	0870	Remote town	27,000	1.26
15	Ipswich	4305	Outer-suburb city	160,000	1.28
16	Cairns	4870	Regional center	170,000	1.31
17	Geelong	3220	Outer-suburb city	220,000	1.32
18	Wollongong	2500	Outer-suburb city	285,000	1.37
19	Coffs Harbour	2450	Regional center	72,000	1.38
20	Gold Coast	4217	Medium-sized city	515,000	1.45
21	Port Lincoln	5606	Country town	13,000	1.47
22	Darwin	0800	Regional center	125,000	1.59
23	Tamworth	2340	Country town	34,000	1.79
24	Devonport	7310	Country town	22,000	2.16
25	Mildura	3500	Country town	30,000	2.22
26	Roma	4455	Country town	7,000	2.45
27	Broome	6725	Remote town	12,000	2.62
28	Roxby Downs	5725	Remote town	4,000	4.33
29	Bourke	2840	Remote town	2,100	5.02
30	Birdsville	4482	Remote town	100	11.32

The estimates of the index, in the sense of the ranking it furnishes and the relative magnitudes of the (linear) index numbers, seem to accord with rational expectation and local experience. The index does seem about right, in that it makes smaller cities about 20 percent more expensive in full cost that larger cities, which is approximately the order of effect estimated in other city scaling analysis (e.g. Bettencourt et al., 2010). There really is more choice in the city and while most aspects of cultural consumption are possible in regional towns and even remote areas the full cost (and therefore the real relative price) is higher, mostly due to higher opportunity costs. The index estimates do indicate, and which accords with experience, that this real cost increases arithmetically with distance. The very remote towns have similarly higher real prices. Under these real prices, and therefore economic incentives, substitution is both expected and observed to occur, resulting in a narrower cultural consumption basket.

The inspection of the variation within the elements of the index (the components of the basket) is also

Table 5. CCPI estimates by index dimensions

Rank	Location	Mass Culture	High Culture	Family Culture	Cultural learning	Interactive culture	Home Culture	CCPI
1	Perth	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	Adelaide	1.00	1.27	0.90	1.14	0.89	1.00	1.03
3	Sydney	1.00	1.21	0.94	1.00	1.15	1.00	1.05
4	Melbourne	1.50	1.05	0.93	1.14	1.03	1.00	1.11
5	Bendigo	1.13	0.97	1.46	1.14	1.11	1.00	1.14
6	Brisbane	1.75	1.03	0.95	0.86	1.22	1.00	1.14
7	Canberra	1.56	1.04	0.95	1.14	1.18	1.00	1.15
8	Newcastle	1.25	1.03	1.10	1.06	1.50	1.00	1.16
9	Fremantle	1.50	1.23	1.15	1.14	0.96	1.00	1.16
10	Penrith	1.25	1.15	1.14	1.40	1.12	1.00	1.18
11	Byron Bay	1.13	1.04	1.25	1.71	0.97	1.00	1.18
12	Bunbury	1.13	1.09	1.62	1.33	1.08	1.00	1.21
13	Hobart	1.25	1.13	1.06	1.02	1.86	1.00	1.22
14	Alice Springs	1.50	1.10	1.03	1.26	1.68	1.00	1.26
15	Ipswich	2.25	1.00	1.10	1.00	1.32	1.00	1.28
16	Cairns	2.63	1.13	0.69	1.35	1.04	1.00	1.31
17	Geelong	1.50	1.08	1.21	1.71	1.40	1.00	1.32
18	Wollongong	1.88	1.07	1.32	1.52	1.44	1.00	1.37
19	Coffs Harbour	1.50	1.20	0.85	0.93	2.82	1.00	1.38
20	Gold Coast	3.00	1.41	1.21	1.14	0.94	1.00	1.45
21	Port Lincoln	1.50	1.07	1.22	1.79	2.22	1.00	1.47
22	Darwin	2.25	1.16	1.23	2.20	1.68	1.00	1.59
23	Tamworth	1.13	1.04	2.60	1.57	3.38	1.00	1.79
24	Devonport	1.88	1.24	3.86	1.40	3.62	1.00	2.16
25	Mildura	3.94	1.02	2.53	1.56	3.29	1.00	2.22
26	Roma	2.00	1.01	2.82	3.67	4.18	1.03	2.45
27	Broome	1.50	1.24	4.50	1.31	6.19	1.00	2.62
28	Roxby Downs	1.50	5.76	3.11	3.52	4.16	7.93	4.33
29	Bourke	1.50	3.19	4.94	4.46	5.36	10.69	5.02
30	Birdsville	5.00	8.34	4.69	15.18	14.10	20.59	11.32

Table 6. Scale-Adjusted Metropolitan Indicator (SAMI) estimates for CCPI ranking

Rank	Location	Postcode	Description	Approx. Pop.	SAMI
1	Byron Bay	2481	Country town	5,000	*-0.8271*
2	Fremantle	6160	Outer-suburb city	38,000	*-0.4579*
3	Alice Springs	0870	Remote town	27,000	*-0.4403*
4	Port Lincoln	5606	Country town	13,000	*-0.4254*
5	Bendigo	3550	Regional center	80,000	*-0.3334*
6	Bunbury	6230	Regional center	66,000	*-0.3105*
7	Coffs Harbour	2450	Regional center	72,000	*-0.1624*
8	Penrith	2750	Outer-suburb city	185,000	*-0.1392*
9	Ipswich	4305	Outer-suburb city	160,000	*-0.0855*
10	Hobart	7000	Regional center	210,000	*-0.0817*
11	Cairns	4870	Regional center	170,000	*-0.0508*
12	Tamworth	2340	Country town	34,000	*-0.0452*
13	Canberra	2600	Medium-sized city	350,000	*-0.0435*
14	Roma	4455	Country town	7,000	*-0.0325*
15	Geelong	3220	Outer-suburb city	220,000	*0.0059*
16	Adelaide	5000	Inner city	1,000,000	*0.0463*
17	Newcastle	2300	Medium-sized city	540,000	*0.0477*
18	Devonport	7310	Country town	22,000	*0.0597*
19	Perth	6000	Inner city	1,300,000	*0.0667*
20	Darwin	0800	Regional center	125,000	*0.0843*
21	Wollongong	2500	Outer-suburb city	285,000	*0.0924*
22	Broome	6725	Remote town	12,000	*0.1373*
23	Mildura	3500	Country town	30,000	*0.1462*
24	Brisbane	4000	Inner city	1,700,000	*0.2488*
25	Gold Coast	4217	Medium-sized city	515,000	*0.2619*
26	Sydney	2000	Inner city	3,600,000	*0.3095*
27	Melbourne	3000	Inner city	3,400,000	*0.3542*
28	Roxby Downs	5725	Remote town	4,000	*0.4304*
29	Bourke	2840	Remote town	2,100	*0.4555*
30	Birdsville	4482	Remote town	100	*0.6887*

in accord with expectation (see Table 5). The index components all exhibit variation (although perhaps drawn from different distributions) and difference in that variation (i.e. are partially uncorrelated). This suggests the dimensions are partially orthogonal, indicating sufficiency or an absence of redundancy in the measures. Taken together, this gives us some early confidence in the approximate value of these first estimates.

Based on the models of log-scaling laws in relative city size, an immediate further analysis is suggested by regressing the log index ranking on a log population measure. The results and re-estimations of the rankings are presented in Table 6. This index provides a re-calibration of the base CCPI by per-capita production. The CCPI is a pure consumption index, which is independent of population scaling effects by construction (i.e. the use of post-codes as the range). But by rescaling these postcodes into the proximate city or town, we arrive at an index of cultural productivity (which can be inferred by assuming competition). Here we find that the 'sea-change' towns of Byron Bay and Fremantle, for example, are indeed culturally productive, as inferred by the real cost of the cultural

Table 7. Comparison of CCPI and SAMI rankings

CCPI	Location	Rank	Location	SAMI
1.00	Perth	1	Byron Bay	-0.8271
1.03	Adelaide	2	Fremantle	-0.4579
1.05	Sydney	3	Alice Springs	-0.4403
1.11	Melbourne	4	Port Lincoln	-0.4254
1.14	Bendigo	5	Bendigo	-0.3334
1.14	Brisbane	6	Bunbury	-0.3105
1.15	Canberra	7	Coffs Harbour	-0.1624
1.16	Newcastle	8	Penrith	-0.1392
1.16	Fremantle	9	Ipswich	-0.0855
1.18	Penrith	10	Hobart	-0.0817
1.18	Byron Bay	11	Cairns	-0.0508
1.21	Bunbury	12	Tamworth	-0.0452
1.22	Hobart	13	Canberra	-0.0435
1.26	Alice Springs	14	Roma	-0.0325
1.28	Ipswich	15	Geelong	0.0059
1.31	Cairns	16	Adelaide	0.0463
1.32	Geelong	17	Newcastle	0.0477
1.37	Wollongong	18	Devonport	0.0597
1.38	Coffs Harbour	19	Perth	0.0667
1.45	Gold Coast	20	Darwin	0.0843
1.47	Port Lincoln	21	Wollongong	0.0924
1.59	Darwin	22	Broome	0.1373
1.79	Tamworth	23	Mildura	0.1462
2.16	Devonport	24	Brisbane	0.2488
2.22	Mildura	25	Gold Coast	0.2619
2.45	Roma	26	Sydney	0.3095
2.62	Broome	27	Melbourne	0.3542
4.33	Roxby Downs	28	Roxby Downs	0.4304
5.02	Bourke	29	Bourke	0.4555
11.32	Birdsville	30	Birdsville	0.6887

consumption possibilities available. Table 7 shows that the relative rankings of locations noticeably differ between CCPI and SAMI indicators.

4. DISCUSSION

We have thus estimated two indexes: (1) a *cultural consumption rank index*, in which Perth is the city with the lowest opportunity cost of cultural consumption and Birdsville is the highest; and (2) a *cultural consumption efficiency index*, in which Byron Bay has the highest productivity of the 30 Australian sample points. The implications of

this index can be considered both in terms of the meaning of the index per se, and in terms of the implications of relative rank on the index.

First, consider the issue of index interpretation. For any given index map there are at least two ways of interpreting the estimated real price gradient. The first is to interpret higher index numbers as a measure of the 'relative cultural deprivation' that is consequence of living in smaller communities that are further away from urban centers. Assuming no other compensating factors, and that people are in effect 'allocated' to each location (i.e. that mobility is zero), then the index suggests a measure of due compensation or public spending required to equalize cultural access across all Australians. This is the cultural equality interpretation of the index as a measure of relative cultural deprivation.

But a second interpretation is constructed by assuming mobility, to the effect that the index is an estimation of those compensating factors, i.e. of the extent that people are willing to tolerate higher prices, less choice and higher indirect costs of cultural consumption to gain other benefits (say cheap housing, fewer neighbors, etc.). In this case the index may serve only to provide public information to enable better choices about location, both for city folk considering moving to the country, and vice versa.

As such there are several different yet consistent interpretations of the estimated index gradient. First, lower index figures represent better value for cultural consumption budgets. Once deflated by rents, this proxy's a *cultural affordability index*, and suggests an argument to partially explain patterns of regional migration. Higher index figures thus represent relative cultural *deprivation*. Representative households in outback Roma, for example face a real cost of cultural consumption that is almost three times as high as representative consumers of inner city Perth. They must

sacrifice three times as much to consume at the same level, or consume only one-third as much for the same fraction of spending. They are relatively deprived. In turn lower index figures represent feedback from *positive externalities*. Representative households in inner Perth face a real cost of cultural consumption one-third that of consumers in Roma. They can experience as much as three times the cultural consumption at the same spending level. They are relatively advantaged. Greater investment in cultural consumption infrastructure, markets, technologies and institutions can therefore lower the real cost of cultural consumption in Roma compared to Perth, reducing cultural inequality of access. But this same argument can be run the other way by focusing on the gains from mobility. These price differences explain why cultural consumption investment is better spent in capital metro areas where there already significant economies of scale and scope. This lowers overall costs of cultural consumption by *encouraging regional migration* toward metro areas. In consequence, different policy implications can be read from the index depending upon objectives with respect to geographic mobility and priority. If the goal is to reduce inequality of access (assuming rights of cultural consumption) then the index estimates relative gains from investment in the infrastructure, technology and institutions of cultural consumption. But if the goal is to *induce mobility*, the index illustrates the benefits of regional migration. The policy implications of the findings therefore depend upon the prior goals associated with regional policy objectives.

5. CONCLUSION

We have proposed a method to construct a price index of cultural consumption based on a basket of six cultural experiences (i.e. cinema, stage production, library, piano lesson, festival and digital culture), and incorporating both direct and indirect costs (i.e., admission prices and costs relating to travel over geographic space, respectively). First estimates of the CCPI over 30 locations in Australia reveal that geographical price differences are accounted for by large indirect costs in consumption. We find that the smaller cities of Perth and Adelaide have the lowest index value, with the larger cities of Sydney and Melbourne next. Regional centres have index values that range between 20 percent and 100 percent higher, and remote towns scored considerably higher again. Recalculating the index based on non-linear per capita scaling shifts the index away from major cities and toward evidently productive smaller cultural centres including Byron Bay and Fremantle.

We present only initial estimates of the cultural consumption price index, and as such, further research into the index is suggested. First, the current estimates of 30 centers can obviously extended to other Australian towns and cities. Second, while the index was calculated for a representative household, further index measures may be estimated for different cohorts, including for example youth cultural consumption. Third, because there is nothing inherently Australia-specific about the basket, it would also be valuable to replicate this index in other countries and using a purchasing power parity translation, to seek international comparison of index values. It would be of interest to compare with other nations or regions with which Australia 'competes with' for high-valued immigrants, such as New Zealand, USA, Canada, Singapore, Britain, and so on. And fourth, an obvious next step is to seek to explain the index ranking by seeking correlated factors associated with the cities or towns with a high ranking (such as public investment, demographics, industry concentrations, migration, and so forth). This would help to unpack the factors that drive relative cultural affordability as measured by the CCPI.

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