A PRINCIPAL COMPONENTS ANALYSIS OF LABOUR SECTORAL TRANSFERS

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Net sectoral transfers are generally low and stable following the UK's economic shock of the late 80's and early 90's. However, previous work has shown that this low level of general inter-sectoral labour transfer is not homogenous, but rather that the general level conceals the fact that some industrial sectors are more active than others in this regard. This is witnessed in the manner in which sectors correlate differently for labour transfers, showing the extent to which they recruit from and displace to, other sectors within the economy. Indeed, the Construction Sector is the most influential. An all-sector exploratory principal components analysis was undertaken to establish those constructs or dimensions which could account for such observed associations. This has identified underlying characteristics of the labour market that explain the differences in terms of their externality to the variables considered, but which are yet within context; i.e. they explain the movement of workers from one industrial sector to another. The analysis resolves to just two principal components; namely, educational level / skill attainment and the level of skill-specificity attaching to each sector. These may then be mapped to indicate the central position played by the construction sector in the labour market and its position relative to all other sectors.

Keywords: labour mobility, principal components, sectoral transfers, skills.

INTRODUCTION

Following, Greenaway *et al.* (1999 and 2000), on the sectoral re-allocation of labour and Elliott and Lindley (2006), through their work on occupational and sectoral labour mobility; re-establishing the necessity of studying worker movements in relation to assessing the flexibility of the UK economy; and taking as a starting point their comment that "the study of occupational and sectoral mobility of labour is relatively under researched" this work is introduced as follows.

In particular, as few studies have determined the relative strength and importance of the factors affecting job mobility between sectors; this work continues from earlier work in Beaney (2006), wherein it was demonstrated that the construction sector demonstrates the highest level of participation in labour mobility in terms of its connectivity to other industry sectors, as measured by sectoral transference, an explanation for this important observation is offered.

Neal (1995), has provided an explanation of the relative superiority of industry-specific skills (to general or firm-specific skills), in terms of where displaced industry stayers earn returns which are greater than those who are displaced to other industries. This permits a useful starting point in that Neal considered that this effect related to

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the existence of skill sets which are neither completely general nor firm-specific but rather specific to a set of firms that produce similar products and services.

Further work by Neal (1999) showed that whereas experience is used by workers to identify both career-matching as well as specific firm-matching opportunities; nevertheless these two matches are not of equal importance. Neal showed that workers can obtain a relative wage advantage from postponing a firm-matching search until they have a succeeded in obtaining a satisfactory career-match. The reason offered is that an early firm-match coupled with a later unsatisfactory career-match would only be likely to be corrected by a wage-losing change of employer. Thus, just as the duration of education and level and extent of qualifications can operate as a form of Arrow style preliminary filtering to employers, so also industry-specific experience can operate as a signal to workers providing information on the types of careers which it may be possible to develop, and thus contributing to allocative efficiency.

By contrast, recent work in examining human capital skill and industry-specificity has given a different perspective. Poletaev and Robinson (2006), following closely the methodology of Neal (1995) but instead, re-examining human capital theory, to show that broad skill-based-specificity is more important than industry-specific human capital.

Research by Arkes (1999) has also indicated the limitations in the value of educational credentials, in that employers initially value them because they act as character surrogates, signaling things which are otherwise unobservable but important to the employer, e.g. personal motivation and perseverance.

The field of political economy also has bearings upon this subject, Estevez – Abe *et al.* (2001), arguing that the type and extent of engagement of workers with either firm-specific, industry-specific or general skills will depend upon the national employment and also unemployment protection policies in place in an economy. Estevez –Abe proposes, with data from multi-national comparative studies; that there is a scaling-effect upon the extent to which workers are encouraged to engage with skills acquisition, depending on the types and levels of national protection available.

> *"thus employment protection increases the propensity of workers to invest in firm-specific skills, whereas unemployment protection facilitates investment in industry-specific skills. The absence of both gives people strong incentives to invest in general skills." p27*

Estevez-Abe thus explains, workers will see that firm-specific skills are likely to tie them into dependency upon particular employer types and that this may be resisted. The bases for such resistance being the abovementioned protection policies and the memory of recent adverse labour market shocks and consequent displacement effects.

This being supported by Lamo *et al.* (2006) commenting that after a sectoral demand shift:

> *"in the absence of labor mobility, our model indicates that the period of convergence to a steady-state with no mismatch is of the order of magnitude of a generation or more, i.e. the necessary time for older workers with inadequate skills to have retired." p7*

It should also be noted that within an economy, engagement and response to labour signaling is likely to be different for different sectors. The private sector will be more

likely to respond than the public sector; and manufacturing / production based sectors moreso than locally-based consumer services, Lubanski (2004).

From the above it arises that a number of endogenous factors may exist and interact to explain sectoral transfers in general, and industry-specific sectoral transfers in particular. The mix of possibilities thus includes:

1. Length of general education.
2. General education level attained.
3. Level and currency of both experience and skill-sets as specified by matching to, and tenure of attachment to:
    a. Firm-specificity
    b. Occupation-specificity
    c. Industry-specificity
4. Level and frequency of retraining and
5. Worker reaction to national employment and unemployment policies and historical factors
6. Personal attributes of workers

Consequently this research examines constructs likely to arise from this mix.

Greenaway *et al.* (1999) have prepared extensive research into labour mobility and have advocated the study of sectoral transfers as the initial starting point for research in this field, rather than the usual investigation of regional mobility.

Some of these considerations were later developed in Greenaway *et al.* (2000), where in a policy-oriented document they again discuss the issue of sectoral shocks, sectoral structural change, and aspects of measuring labour force response; and especially the preference for using net sectoral transfer data:

> *"..we argue that gross flows are not in themselves indicative of the amount of sectoral allocation occurring in the economy, because a sectoral shock can be accommodated by any amount of gross flows." p32*

JUSTIFICATION OF DATASET - THE LABOUR FORCE SURVEY (LFS)

This appears to satisfy on most counts of suitability. Originally undertaken in 1973, in concert with most other European nations labour force surveys; it is both one of the largest and most detailed of the national surveys with the latest surveys comprising some 450 separate questions. It was undertaken every two years until 1983 and then on a yearly basis between 1984 and 1991; the most recent series since 1992 have been carried out on a quarterly basis.

Not only is the LFS one of the more established resources it also has the advantage of conformity with international standards; where the LFS has the advantage of International Labour Organization (ILO) approval for its concepts and definitions. This is important as both Eurostat and the OECD also use these same definitions, Jones and Smith (2001, p3 and Annex C). Further validation is taken from Clotuche and Grunwald (2003, p3);

DATA ASSEMBLY

Based upon an examination of mainstream national longitudinal surveys the selected dataset for this project has been the Labour Force Survey (LFS), using the Spring Quarter snapshots of the LFS data collection. Data assembled from ESDS data

downloads and unzipped to provide the following categories of data for all SIC(80) headline industry sectors, all taken from two questions:

1. What industry sector are you employed in now? And
2. Which industry sector were you employed in one year ago?

This data is used to measure two different movements:

- In-mig.: Transfers to a sector now, from other sectors (1year ago).
- Out-mig.: Transfers from same sector (1year ago), to other sectors now

Preliminary analysis was undertaken by preparing a matrix of simple correlations of net sector to sector transfers. For the sake of clarity it must be noted that these are all transfers from within employment only; new entrants from education and leavers to retirement are omitted.

For the sake of brevity the data counts and methods of handling LFS data discontinuities, are omitted.

METHODOLOGY AND JUSTIFICATION FOR THE ADOPTION OF A PRINCIPAL COMPONENTS, FACTOR ANALYSIS

This decision is here based upon the reasoning that, the simple correlation analysis, Beaney (2006) shows a 10 /10 correlation thus giving potential for 45 correlation points (excluding duplications and self-correlations). This contains too much surface complexity to offer as a reasonable summation, and in order to obtain a simplification a deeper analysis is employed in order to make reasonable and reliable judgements on the likely causes and the mechanisms by which such sectoral effects arise.

DEFINING A FACTOR

The linkage between factor analysis and correlations is essential to an understanding of the underlying importance of the limitations of correlations, such that it can be said that factor analysis starts from where correlations leave-off. Child (1990, p3), citing Mills definition of "concomitant variations" notes that simply because a relationship between two variables is established does not mean that change in one variable causes change in the other, it was also possible for them both to be affected by some other "causative factor".

Kline (1994, p5), citing Royce provides the following:

> *"… a factor is a dimension or construct which is a condensed statement of the relationships between a set of variables.", and*
>
> *"a factor is a construct operationally defined by its loadings".*

DISTINGUISHING THE MAINS FORMS OF EXPLORATORY AND CONFIRMATORY FACTOR ANALYSIS

Kline (1994, p9) outlines the differences between these two approaches by looking at their primary purpose. Exploratory factor analysis is undertaken to establish those "constructs or dimensions" which could account for an observed set or pattern of correlations. It is important to realize that the technique is only capable of identifying a prioritization of underlying factors, it does not actually explain them and a re-entry into the differences between the circumstances of the variables is necessary in order to produce more useful definitions.

On the other hand, Confirmatory factor analysis is a method of checking the validity of derived factor constructs against a hypothetically predetermined but unproven target set. Klein comments that it is often so difficult in social sciences to specify what the target set should actually be, that this technique has limitations in interpreting the results of principal component factor analysis.

As there is no predetermined set of factors to relate to, the decision here is to use an exploration by way of a Principal Component Analysis.

THE PRINCIPAL COMPONENT ANALYSIS

This has been undertaken initially for the entire 1989 – 2005 period of this study. The following observations relate to Fig2.

These initial summation outputs of the whole survey period are derived from an SPSS 12. programme (see references). Acceptability of the conclusions offered is validated insofar as compliance has been achieved in following the "technical rules for simple structure", as proposed by Kline (1994, 72-73), these are:

1. Whole field inclusion: The whole field of all employment has been mapped with the very minor exception of those in the diplomatic services who have been deliberately excluded as data capture for this sector is relatively recent. As such the exchange of workers (from those already within employment) between sectors is very complete.
2. Internal consistency: By this is meant consideration of whether the data in the variables selected are homogenous or heterogeneous. Briefly, to take homogeneity; this is a judgment of whether the dataset is already selected in such a way as to exclude a particular influencing component. This has not happened here, the cases selected are those moves from within a field of both movers and stayers. Thus the mix is entirely heterogeneous.
3. Sample size: Kline (1994, 73) refers to Guildford's argument that 200 samples would be a minimum figure, but also seems quite comfortable with 100 samples. The dataset used here reduces as follows, and thus shows a more than adequate sufficiency of data points.

Table 1: Data counts

Counts individuals from LFS 1989 – 2005 Spring Quarters (excluding 1990)	948,590
Count of individuals transferring into different industrial sectors within one year.	10,804
Counts of Net sectoral transfer taken from Beaney (2006), (ignoring polarity and dividing by 2 to solve for reflection in the matrix)	5,402

1. Not forgetting randomness: This is served by the adoption of LFS data and is random within the meaning of the methodology adopted by that service, i.e. using UK postcodes.

OBSERVATIONS ON THE GENERAL (WHOLE SURVEY) PRINCIPAL COMPONENT ANALYSIS

The analysis identifies two principal components; a single dominant component, with secondary component of lesser significance, but together they account for a large degree of explanation 91% of the total matrix variance. The other remaining 8 components (one would otherwise expect to obtain 10 components from a 10 x 10 matrix) are of no significance.

In terms of their individual contribution, the two principle components account for the following proportions of the whole matrix variance:

- Component 1 accounts for 49%
- Component 2 accounts for 42%

The range of communalities is high insofar as these two components explain at the lowest level 71% of the matrix variance for net sector transfers in the Mining Sector; and up to, at the highest level, 96% of the matrix variance in the Other Manufacturing Sector.

Component loadings:

- Three particular industrial sectors (i.e. Transport and Communication, Banking, Financial etc, and Other Services) load heavily upon Component 1 and very lightly upon Component 2.
- The Other Manufacturing and Distribution sectors are also worthy of note insofar as the extent of their loading on Component 1.
- Only the Agriculture etc. sector loads particularly upon Component 2. and negatively upon Component 1

This is detailed in Table 4.

An interpretation of this information is now necessary in order to define these factors in terms of "characteristics" which explain these differences, and which are within context. i.e. the reasons as to why workers change from one industrial sector to another. The interpretation offered here is that of:

- Component 1 being an educational and/or skill level and
- Component 2 being an element of specificity in the nature of the education and skills deployed, such as they are transferable.

Such that:

- The educational / skill range effectively distinguishes the upper and lower ranges of Component 1 (i.e. a reasonable contrast of the Services and Agricultural sectors). and that;
- The specificity range also distinguishes in that a high ranking for specificity would relate to a low level of transferability in those same education / skill attainments, such as would inhibit application to, and attraction, from the other sectors.

Total Variance Explained

Table 2: Extraction Method: Principal Component Analysis.

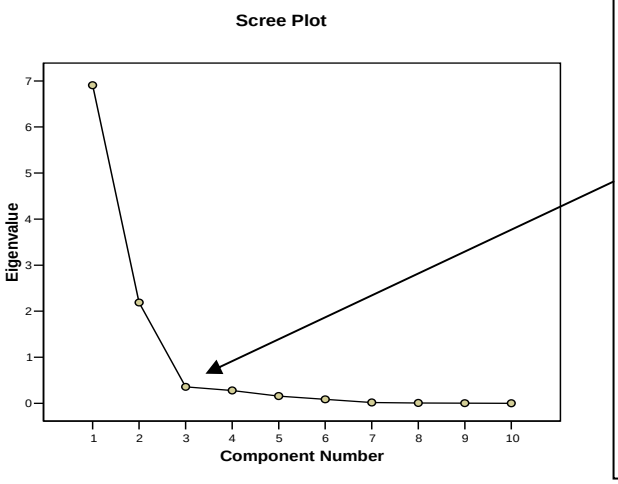
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	6.908	69.076	69.076	6.908	69.076	69.076	4.910	49.100	49.100
2	2.189	21.889	90.965	2.189	21.889	90.965	4.187	41.865	90.965
3	.357	3.567	94.532						
4	.279	2.786	97.317						
5	.157	1.568	98.886						
6	.085	.854	99.739						
7	.017	.172	99.911						
8	.007	.067	99.979						
9	.002	.021	100.000						
10	.000	.000	100.000						

Communalities
Table3: Extraction Method: Principal Component Analysis.

	Initial	**Extraction**
Agric	1.000	.859
Energy	1.000	.894
Mining	1.000	.840
Metalgoods	1.000	.892
OtherManufact	1.000	.979
Construct	1.000	.916
Distrib	1.000	.925
Transport	1.000	.933
Banking	1.000	.937
OtherService	1.000	.923

Rotated Component Matrix(a)
Table4: Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 3 iterations

	Component	
	1	2
Agric	-.351	.858
Energy	.723	.610
Mining	.655	.640
Metalgoods	.705	.629
OtherManufact	.233	.962
Construct	.653	.700
Distrib	.394	.877
Transport	.936	.239
Banking	.954	.162
OtherService	.957	-.080

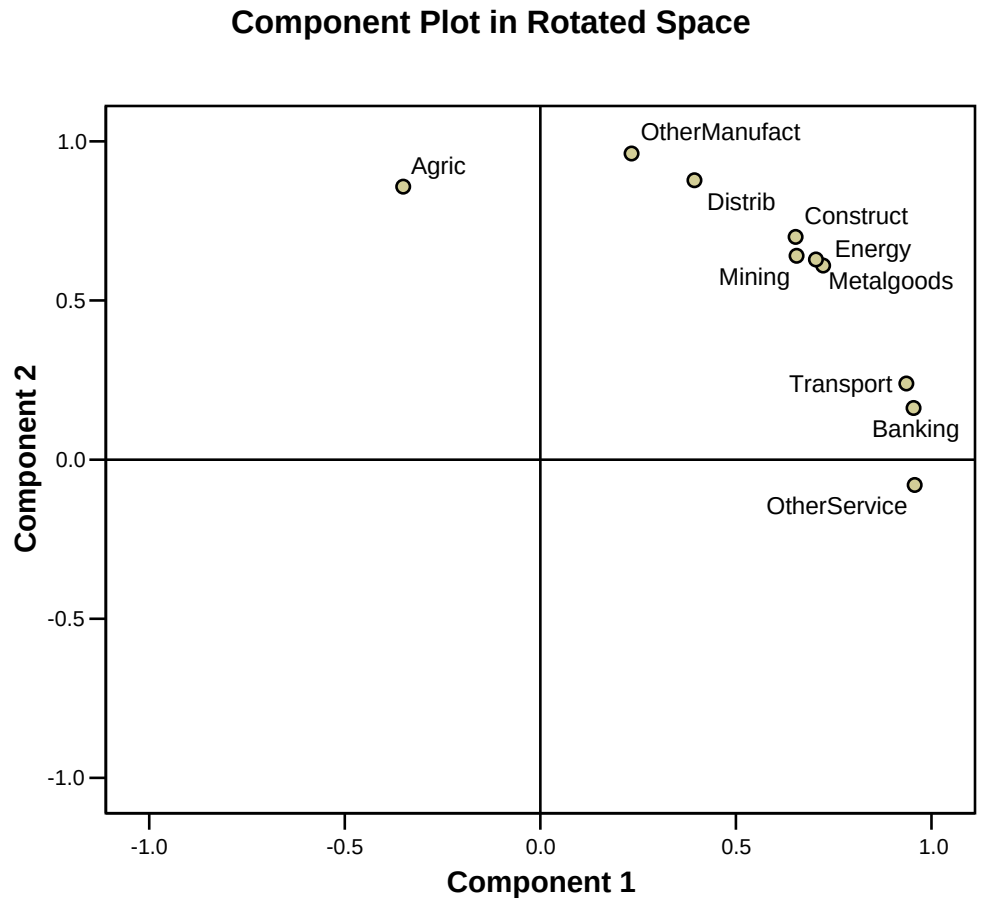


A graphical SPSS explanation, aiding the decision on how many component factors to adopt.

The decision is visually indicated as a major change in slope i.e. on 3. Thus after 2 factors the rate of increase in explanatory power diminishes markedly.

Here after only 2 factors it seems that 90.965% of the total correlation matrix variance is explained by just 2 components

Figure 1: SPSS output General PC Factors



Component1: Education/skills range
Component2: Skill specificity

Figure 2: SPSS output General PC factors all years (1989 – 2005), excl 1990

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

Referring again to the initial research objectives; by working from data indicating the extent of net sectoral transference in the economy as a whole, this research has established that:

1. It is possible to simplify the underlying causes to sectoral transference and that this reduces to just two principal components identified here as educational/skill attainment and the level of specificity of those skills.
2. That in terms of the relative identity of these two components, the construction sector has a marked correspondence with :
    a. Energy and water supply
    b. Mining, ores minerals and chemicals
    c. Metal goods engineering and vehicles.

This may be important for directing recruitment policy, based upon exploiting the common attributes of workers engaged in these sectors.

Further work may reveal more information which would aid in more precise definition of the two principal components but more importantly the mechanism by which they operate and could take the form of more detailed examination in the following areas:

- Skill matching
- Identifying the quality of those workers participating in sectoral transfers
- Identifying the problems which firms have in identifying the difference between leaver and arriver quality.
- Effects of changes in working practices
- The cautionary action of workers in finding a balance between the financial attractiveness of a particular sector and the necessity not to become too skill-defined by it.

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