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Structural Adjustment and the Sectoral and Geographical Mobility of Labour

By D. Greenaway, R. Upward and P. Wright

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Abstract

Conventional methods for analysing worker flows often focus on gross flows or transition probabilities. This is not necessarily informative for identifying the scale of labour 'adjustment' in an economy in the sense of the expansion and decline of industries. We develop a method which relates the individual characteristics of workers to net, rather than gross flows. Our method also allows for interactions between the regional and sectoral mobility of labour. We apply this to the UK using data from the Labour Force Survey over a period of significant structural change, and quantify the relative importance of education and housing tenure on regional and sectoral mobility.

Outline

1. Introduction
2. Worker reallocation in the UK1975-1995
3. An econometric model of sectoral and regional mobility
4. Two examples
5. Conclusions

Non-Technical Summary

The pattern of employment in OECD countries in general, and the United Kingdom in particular, has changed rapidly over the past two decades. The engineering sector, for example, experienced a decline of nearly 1.6 million workers, requiring an average annual net outflow of 77,000 or about 3% per year. In contrast, the banking sector expanded by over 1.7 million employees, requiring net inflows of a similar order of magnitude.

Conventional methods for analysing worker flows tend to concentrate on *gross flows* or *transition probabilities*. That is, they measure the total number of workers who change industry, or they measure the probability that a particular worker changes industry.

But this is not necessarily informative if we want to identify what factors determine the expansion and decline of industries, because industries change size as a result of the *net flow* of labour: the difference between the inflow and outflow. For example, an industry may experience large numbers of workers leaving and joining (a high gross flow rate) and yet remain with the same level of employment (a low net flow rate). By the same argument, an industry may also experience relatively low gross flow rates but have high net inflows or outflows, and hence change size.

In this paper we develop a method which relates the individual characteristics of workers to net, rather than gross flows. We apply this to the UK using data from the Labour Force Survey over a period of significant structural change, and quantify the relative importance of education and housing tenure on regional and sectoral mobility.

The results illustrate how varied the reallocation process is across different types of worker. Although aggregate net flows are relatively small, some types of worker are far more mobile than others, and have therefore contributed far more to the process of sectoral transformation. For example, individuals with high levels of general skills embodied in degree-level qualifications are more likely to move from the declining to the expanding sector. The model allows us to distinguish between mobility *per se* and the reallocation of labour. Thus, although less-skilled workers are very mobile, their contribution to adjustment is limited as they often flow into the declining sector.

Although owner-occupiers move relatively infrequently, they do not appear to hinder adjustment as they seem to be better able to move from non-employment to the expanding sector than other groups. This is in contrast to private renters who aid adjustment by direct job to job moves but seem to find movement from non-employment relatively difficult. Public-sector renters are less mobile both across regions and across industries.

1 Introduction

The pattern of employment in OECD countries in general, and the United Kingdom in particular, has changed rapidly over the past two decades. Table 1 illustrates the extent to which labour has reallocated across 10 sectors in the UK between 1975 and 1995, defined by the 1-digit 1980 SIC code. As is well known, some of these changes have been large. The engineering sector (SIC 3), for example, experienced a decline of nearly 1.6 million workers, requiring an average annual net outflow of 77,000 or about 3% per year. In contrast, the banking sector (SIC 8) expanded by over 1.7 million employees, requiring net inflows of a similar order of magnitude. These averages disguise large variations in inflows and outflows, but it is clear that there has been substantial reallocation of labour between traditional manufacturing industries and the service sector.

Table 1: Changing employment shares in the UK 1975–1995[a,b]

	1975		*1985*		*1995*		*%*
	000s	*%*	*000s*	*%*	*000s*	*%*	*change*
1 digit 1980 SIC							
0 Agriculture, forestry & fishing	388	1.75	321	1.53	233	1.11	−39.95
1 Energy & water supplies	717	3.23	582	2.78	284	1.35	−60.39
2 Metal manufacturing etc	1185	5.34	769	3.68	561	2.67	−52.66
3 Metal goods, eng. & vehicles	3406	15.34	2410	11.52	1860	8.84	−45.39
4 Other manufacturing	2761	12.43	2075	9.92	1835	8.72	−33.54
5 Construction	1207	5.43	994	4.75	842	4.00	−30.24
6 Distrib., hotels & catering	3906	17.59	4213	20.14	4556	21.66	16.64
7 Transport & communication	1480	6.66	1308	6.25	1180	5.61	−20.27
8 Banking, finance, insurance	1468	6.61	2039	9.75	2747	13.06	87.13
9 Other services	5691	25.62	6209	29.68	6934	32.97	21.84

[a] Employees in employment.
[b] Source: ONS series 3601, Employment and Earnings.

Conventional microeconometric methods for the analysis of labour market adjustment involve calculating transition probabilities between jobs, between labour market states or between geographical regions. However, transition probabilities are not necessarily useful for analysing the process of adjustment because there tend to be large counter-balancing flows between sectors and regions. As noted by Jovanovic & Moffitt (1990), gross flows of labour typically dwarf net flows because many worker movements are actually from expanding to declining sectors. Net flows, on the other hand, are a more direct measure of adjustment because they correspond to differential rates of job creation and destruction between sectors or regions. But because net flows are inherently an aggregate phenomenon, it is less clear how one might relate them to individual characteristics.

In the UK, the focus of econometric work has tended to be on the issue of regional rather than sectoral mobility (Creedy 1974, Pissarides & Wadsworth 1989, Jackman & Savouri 1992, McCormick 1997).[1] However, a key assumption of many theoretical models of adjustment is sectoral mobility of factors (e.g. Grossman & Shapiro 1982). Together with the fact that there has been an enormous sectoral reallocation of labour in the UK, this suggests that the study of sectoral labour flows is important.

A particular issue which has attracted attention in the UK is the relationship between housing tenure and mobility. Several authors have argued that rigidities in the housing market contribute to the immobility of labour, although for various different reasons (Hughes & McCormick 1981, Oswald 1996, Henley 1998). However, the links between regional and sectoral mobility have not been made explicit. If rigidities in the housing market do cause workers to be less mobile between regions, does this have an effect on their mobility between sectors? We argue here that it is not regional mobility *per se* which is of primary importance, but rather the impact which it has on sectoral mobility. If sectors are geographically evenly spread, then one would expect the relationship to be rather unimportant, since individuals will be able to switch sectors without moving

[1]Pissarides (1978) is an exception. There is a large literature on the mobility of labour between labour market states (employed, unemployed), and also on the concept of "mismatch" between sectors, regions and occupations (Padoa Schioppa 1991)

region. If, as seems more plausible, sectors are unevenly distributed across regions, the relationship will be stronger.

The contribution of this paper is therefore twofold. First, we develop a method for relating the characteristics of individual workers to the net, rather than gross flows of labour. This enables us to measure the contribution of, for example, human capital and labour market institutions to the process of adjustment, while controlling for other characteristics in a regression framework. Second, our approach explicitly allows for interactions between regional and sectoral mobility, which allows us to determine the importance of regional mobility in the adjustment process. Our method is one that could be deployed more widely on other micro-level datasets, and to the analysis of sectoral and geographical mobility in other OECD countries.

The paper is structured as follows. In Section 2 we describe the pattern of worker reallocation across industrial sectors and geographical regions of the UK. In Section 3 we outline our method for relating transition probabilities to net worker flows. Section 4 illustrates our method by showing how different qualification levels and different types of housing tenure affect sectoral adjustment. Section 5 concludes.

2 Worker reallocation in the UK 1975–1995

In this section we look at the patterns of worker flows across sectors and regions in the UK. The data source used is the UK Labour Force Survey (LFS) from 1975 to 1995. This is an annual survey of 60,000 households comprising about 120,000 adults (Office for National Statistics 2001).[2] In every year of the survey, individuals are asked about their current labour force status (working, unemployed, out of the labour force), their

[2]Biennial from 1975 to 1983; quarterly from 1992 onwards.

region of residence, and their current industry, if employed. Individuals are also asked about their status, industry and region 12 months previously.

To provide a systematic picture of worker flows, we construct a gross flow matrix for each year, $\mathbf{G}_t$, which contains the number of individuals in each sector or region at time t conditional on their sector or region at $t-1$. We also include flows between employment and non-employment since these flows will also contribute to adjustment.

Each element of $\mathbf{G}_t$ gives the number of workers in sector s_t who were in sector s_{t-1} in the previous year. *Total gross flows* are the sum of the off-diagonal elements of $\mathbf{G}_t$: the total number of workers who switch sector or region in each year. Dividing $\mathbf{G}_t$ by the total number in the sample gives a matrix $\mathbf{Q}_t$ which contains an estimate of the probability of moving between sectors or regions. The sum of the off-diagonal elements of $\mathbf{Q}_t$ gives an estimate of the proportion of the sample who switch sectors or regions in each year.

The size of gross flows depends partly on the dimension of $\mathbf{G}_t$: flows are greater if there are more industries or regions. The limiting case for sectors is to disaggregate down to the level of the firm. For geographical regions, the limiting case is an address. Although it is not possible to calculate $\mathbf{G}_t$ from the LFS disaggregated down to this level, we do know if individuals are in the same firm or address at t as at $t-1$, and from this the sum of the off-diagonal elements of $\mathbf{G}_t$ can be calculated directly. At the other extreme, we also calculate flows at the most aggregated level. Sectors are classified by whether they experienced increases or decreases in employment shares over the period, creating an "expanding" and a "declining" sector.[3] Regions are grouped into "North" and "South". As an intermediate case, we also use 10 1-digit industries and the 11 standard regions of the UK.

[3]See Table 1. The expanding industries are therefore defined as SIC 6, 8 and 9.

Total net flows are those flows of workers which are not cancelled out by return flows. This is a similar though not identical concept to that of "turbulence" (Lilien 1982). Measures of turbulence are typically calculated by summing the total change in employment across all sectors (e.g. Layard, Nickell & Jackman 1991, p.297). Total net flows, in contrast, are given by the sum of net flows between each sector and all other sectors. As with gross flows, net job-to-job flows increase with the number of sectors. To calculate net flows at the finest level of disaggregation we would need to know $\mathbf{G}_t$ itself. Since it is not possible to identify individual firms or addresses from the LFS, it is not possible to estimate net flows at the level of the firm or address.

Estimates of gross and net flows are reported in Tables 2 and 3. Gross flows between sectors are procyclical, which is intuitive if we think that job-to-job moves are primarily voluntary. The effect of disaggregating is quite clear: between 6% and 11% of individuals change firms each year, while only 2%–3% switch from the 'declining' to the 'expanding' sector or *vice versa*. The pattern of net flows is less obviously cyclical, although the peak in 1981 corresponds to a year with particularly high lay-offs. Note that gross flows are approximately 10 times greater than net flows. Only about one-fifth of one percent of the labour force moves between the declining and expanding sectors in a way that contributes to sectoral adjustment. Table 1 showed that the net flows required to account for the actual changes in sectoral employment shares was of the order of 3% per year. It is clear, therefore, that direct job-to-job sectoral flows cannot account for this adjustment.

Tables 2 and 3 also show gross and net flows between regions. As before, the size of these flows increases with disaggregation, but what is striking here is that the vast majority of changes of address are within rather than between regions. Approximately 10% of the workforce change address each year, but less than 2% change region. As

Table 2: Gross worker flows in the UK 1975–1995

	Sectoral			*Geographical*			
	Firms	*10 sectors*	*2 sectors*	*Addresses*	*11 regions*	*2 regions*	*Emp. unemp.*
1975	0.0925	0.0563	0.0277	0.0942	0.0130	0.0062	0.0852
1977	0.0800	0.0442	0.0225	0.0943	0.0112	0.0049	0.0950
1979	0.0906	0.0503	0.0257	0.0987	0.0130	0.0062	0.0844
1981	0.0630	0.0357	0.0191	0.1027	0.0112	0.0046	0.0990
1983	0.0620	0.0292	0.0150	0.0976	0.0102	0.0042	0.1023
1984	0.0703	0.0341	0.0182	0.1028	0.0115	0.0051	0.1044
1985	0.0780	0.0382	0.0209	0.1062	0.0140	0.0064	0.1032
1986	0.0818	0.0375	0.0197	0.1058	0.0134	0.0066	0.1001
1987	0.0899	0.0447	0.0228	0.1103	0.0159	0.0071	0.1029
1988	0.1041	0.0525	0.0271	0.1112	0.0160	0.0072	0.0973
1989	0.1152	0.0586	0.0305	0.1046	0.0178	0.0086	0.0918
1990	0.1130	0.0579	0.0290	0.0881	0.0139	0.0072	0.0907
1991	0.0876	0.0435	0.0217	0.0900	0.0142	0.0068	0.0948
1992	0.0765	0.0374	0.0182	0.0901	0.0106	0.0049	0.1037
1993	0.0701	0.0337	0.0169	0.0895	0.0112	0.0047	0.0983
1994	0.0737	0.0367	0.0182	0.0946	0.0107	0.0049	0.0993
1995	0.0852	0.0425	0.0216	0.0978	0.0112	0.0045	0.0960

with sectoral flows, net flows are only around one-tenth the size of gross flows.[4] Most migration is within region, and that migration which does occur between regions is mostly cancelled out by flows in the opposite direction.

The final column in Tables 2 and 3 shows gross and net flows between employment and non-employment. Non-employment is defined as both unemployment and 'not in the labour force' (NILF). Although we recognise that unemployment and NILF are often distinct states, this grouping is necessary because a proportion of individuals who classify themselves as NILF do move into employment, and indeed a significant element of sectoral adjustment has been achieved by inflows of individuals classified as NILF. Note here that net flows are much larger than net flows between sectors and regions, and nearly half as big as gross flows. This is because flows from employment to non-employment are counter-cyclical, while flows in the reverse direction are pro-cyclical.

[4] These figures correspond to those calculated from NHS central register data by Jackman & Savouri (1992).

Table 3: Net worker flows in the UK 1975–1995

	Sectoral		*Geographical*		
	10 sectors	*2 sectors*	*11 regions*	*2 regions*	*Emp. unemp.*
1975	0.0085	0.0017	0.0025	0.0003	0.0145
1977	0.0044	0.0011	0.0026	0.0002	0.0107
1979	0.0048	0.0015	0.0030	0.0002	0.0168
1981	0.0077	0.0046	0.0029	0.0003	0.0201
1983	0.0046	0.0019	0.0026	0.0005	0.0114
1984	0.0047	0.0005	0.0026	0.0004	0.0123
1985	0.0046	0.0007	0.0031	0.0006	0.0167
1986	0.0049	0.0004	0.0037	0.0000	0.0137
1987	0.0063	0.0007	0.0033	0.0011	0.0147
1988	0.0052	0.0004	0.0039	0.0003	0.0161
1989	0.0077	0.0013	0.0046	0.0005	0.0162
1990	0.0076	0.0005	0.0024	0.0006	0.0121
1991	0.0068	0.0007	0.0031	0.0003	0.0133
1992	0.0080	0.0033	0.0024	0.0004	0.0147
1993	0.0053	0.0023	0.0022	0.0005	0.0131
1994	0.0066	0.0005	0.0021	0.0001	0.0096
1995	0.0048	0.0006	0.0023	0.0001	0.0136

There is therefore less tendency for these flows to cancel each other out.

Are sectoral and geographical mobility related? In Table 4 we describe gross flow rates split between origin and destination, and between those who move address and those who move region. The probability of moving firm and moving sector is higher for those who change address. For example, 72.6% of those in the declining sector at $t-1$ who move address stay with the same firm, compared to 86.8% for those who remain at the same address. Similar patterns can be observed in panel (b), for those in the expanding sector at $t-1$. However, note that the probability of moving into non-employment is also higher for this group: 11.2% of individuals in the declining sector at $t-1$ who move address leave employment, compared to just 6% of those who stay at the same address. Panel (c) in Table 4 shows that there is also a much higher probability of *leaving* non-employment for those who change address. 74.8% of those who change address remain in non-employment, compared to 83% for those who remain at the same address.

Table 4: Average gross flow rates by geographical mobility 1975–1995

	Same firm	*Same Sector*	*New Sector*	*Not Employed*
(a) Employed at $t-1$ ***in declining sector***				
Same address	0.868[a]	0.050	0.022	0.060
New address	0.726	0.104	0.058	0.112
Total	0.856	0.055	0.025	0.064
(b) Employed at $t-1$ ***in expanding sector***				
Same address	0.867	0.058	0.018	0.057
New address	0.689	0.151	0.038	0.121
Total	0.849	0.068	0.020	0.064
(c) Not employed at $t-1$				
	Not employed	*Declining Sector*	*Expanding Sector*	
Same address	0.830	0.060	0.110	
New address	0.748	0.077	0.175	
Total	0.822	0.062	0.012	

[a] Row probability. For an individual employed at $t-1$ in the declining sector who remains at the same address, the estimated probability of remaining in the declining sector is 0.868.

3 An econometric model of sectoral and regional mobility

In this section we develop an econometric framework for analysing sectoral and regional flows at the individual level. The analysis in Section 2 suggests that this framework should allow for (a) flows within as well as between sectors; (b) flows between employment and non-employment and (c) interactions between sectoral and regional mobility.

3.1 Structure

We begin by simplifying the model down to just two sectors, expanding (E) and declining (D), together with a single non-employment state (N). This is necessary because we wish to estimate movement probabilities separately for each origin sector. It is also consistent with our notion of "restructuring" in the sense that we model the movement of workers from declining to expanding sectors. Because of the very small numbers who move region, we also collapse geographical movement choices j to just two: stay at the same address or move address.

Figure 1 shows a stylised picture of the resulting model. Individuals are either geographically mobile or not. Individuals can either remain in the same firm, move to a new firm but remain in the same sector, move to a new sector, or enter non-employment.

This structure does not impose any particular order in which sectoral and geographical moves occur. This is partly determined by the data: the LFS does not reveal in what order movements between addresses and movements between jobs take place. However, even if we could date each type of move precisely, we would not wish to claim that geographical moves "cause" job moves, or *vice versa*. For example, it might be the case that a new job is pre-arranged to start at a particular date, and a geographical move is

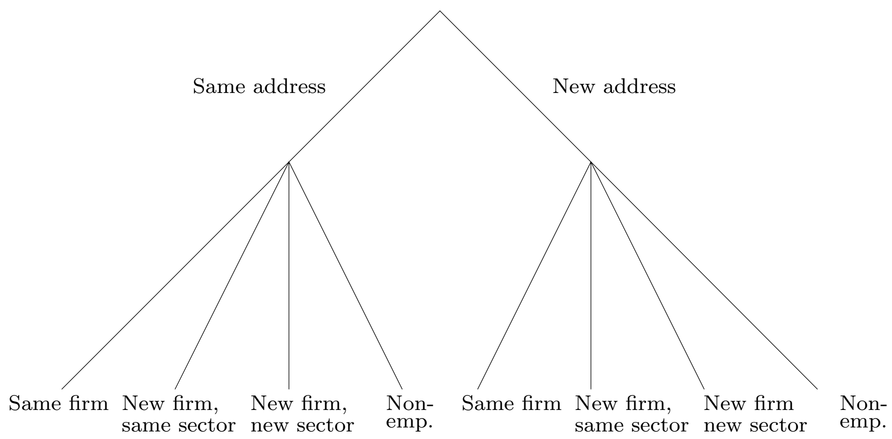

Figure 1: Structure of the model

made just prior to that date.

3.2 Estimating transition probabilities

Our method is to relate the transition probabilities to a set of personal and sectoral characteristics, and to use these estimates to determine the impact of certain characteristics on net flows between sectors and regions. The independent variables used are shown in Table 5. There are two restrictions which make the choice of variables difficult. First, for time-varying information we require information from $t-1$ rather than t, and only some of the questions in the LFS refer to 12 months previously. Thus, for example, we are prevented from including employment tenure as a regressor, since this is only known at time t. Those who move sectors will therefore always have tenure of less than 12 months. Second, we require variables which are consistently defined over a long period of time.

Table 5 splits the vector of independent variables into four groups. First, characteristics which vary across sector: the relative sectoral wage, unemployment and vacancy rates.[5]

[5]The sectoral unemployment rate is constructed from the LFS by tabulating industry of last employ-

Table 5: Means of explanatory variables[a]

	Same address				New address			
	Same firm	*Same sector*	*New sector*	*Not emp.*	*Same firm*	*Same sector*	*New sector*	*Not emp.*
Sectoral wage[b]	0.991	0.984	0.970	0.974	1.007	0.996	0.971	0.974
Sectoral unemployment	0.990	1.054	1.073	1.068	0.972	0.981	1.052	1.039
Sectoral vacancies	0.988	1.069	1.010	1.015	1.007	1.076	0.993	1.060
Female	0.409	0.450	0.449	0.509	0.398	0.465	0.430	0.580
Married	0.746	0.651	0.616	0.676	0.693	0.627	0.615	0.613
Age 26–35	0.230	0.303	0.285	0.263	0.405	0.412	0.367	0.323
Age 36–45	0.273	0.254	0.224	0.175	0.197	0.165	0.161	0.132
Age 46–55	0.246	0.143	0.137	0.163	0.098	0.071	0.065	0.087
Age 55–65	0.129	0.046	0.049	0.176	0.038	0.017	0.018	0.063
Non-white	0.088	0.069	0.062	0.098	0.078	0.069	0.062	0.087
Apprenticeship	0.309	0.366	0.408	0.362	0.324	0.360	0.405	0.411
Degree or equiv.	0.170	0.187	0.157	0.175	0.155	0.124	0.137	0.137
A-level	0.316	0.253	0.191	0.189	0.356	0.374	0.245	0.217
O-level	0.179	0.191	0.154	0.139	0.165	0.151	0.138	0.109
Unskilled non-manual[c]	0.111	0.099	0.068	0.063	0.147	0.173	0.106	0.073
Skilled manual[c]	0.072	0.082	0.080	0.057	0.108	0.117	0.109	0.080
Skilled non-manual[c]	0.230	0.288	0.311	0.219	0.302	0.313	0.337	0.277
Public renting[d]	0.247	0.245	0.280	0.319	0.215	0.175	0.217	0.303
Private renting[d]	0.079	0.075	0.080	0.077	0.197	0.285	0.286	0.276

[a] Full set of descriptive statistics (broken down by year, sector of origin etc) available from the Authors on request.
[b] Sectoral variables are averages across 1-digit sectors, and therefore vary within aggregate sector.
[c] Refers to job held at $t-1$.
[d] Refers to housing status at $t-1$; only available for 1981 and 1984.

Second, personal characteristics, including age, gender, family type and educational qualifications. Third, characteristics of the job at $t-1$: jobs are defined in terms of a skilled/unskilled manual/non-manual split. Finally, we include the housing tenure of the individual at $t-1$.

There are various ways in which the transition probabilities could be estimated. For example, a Multinomial Logit model would allow us to estimate each "branch" in Figure 1. However, as is well known, this model implies that all eight outcomes are equally dissimilar.[6] The factors affecting individual choice for those who remain in the same

ment for the unemployed. The sectoral vacancy rate is constructed from National Online Manpower Information Systems data. The sectoral wage is calculated from New Earnings Survey microdata.

[6]This property is referred to as the "Independence of Irrelevant Alternatives" because it implies that the relative probability of choosing between a pair of alternatives are specified ignoring the other choices.

location may differ from those affecting their choices should they change location.

McFadden (1977, 1981) proposes a method of generalising the Multinomial Logit model so as to allow an option to be more "similar" to some choices than to others. Intuitively, the choice between the two similar alternatives may be viewed as being made according to a binary Logit model whereas the choice between dissimilar alternatives is also a Logit-type choice although additional weights influence the decision. We estimate transition probabilities using this Nested Logit model rather than the Multinomial Logit model. This allows us to test whether the restrictions imposed by the latter are reasonable.

Denote the alternatives for geographical movement by j and the alternatives for sectoral movement by k. Sectors are denoted $s = D, E, N$ for declining, expanding and non-employment. Then the Nested Logit model we estimate takes the following form:

$$P_s(k \mid j) = \frac{\exp(\mathbf{x}_i' \boldsymbol{\beta}_{sjk})}{\sum_k \exp(\mathbf{x}_i' \boldsymbol{\beta}_{sjk})} \tag{1}$$

$$P_s(j) = \frac{\exp(\mathbf{y}_i' \boldsymbol{\alpha}_{sj} + (1-\sigma)_{sj} I_{sj})}{\sum_j \exp(\mathbf{y}_i' \boldsymbol{\alpha}_{sj} + (1-\sigma)_{sj} I_{sj})} \tag{2}$$

$$I_{sj} = \log \left(\sum_k \exp(\mathbf{x}_i' \boldsymbol{\beta}_{sjk}) \right) \tag{3}$$

The joint probabilities $P_s(jk)$ can be calculated from $P_s(k \mid j) \times P_s(j)$. To generate differential flows between the three sectors the model is estimated separately for each origin sector s. The parameters $\boldsymbol{\beta}_{sjk}$ vary across sectors s, and sectoral choices $k = 0, 1, 2, 3$ for each location choice $j = 0, 1$. $\boldsymbol{\beta}_{sjk}$ is normalised to zero for each $k = 0$. The parameters $\boldsymbol{\alpha}_{sj}$ vary across sectors s and location choices $j = 0, 1$ with $\boldsymbol{\alpha}$ normalised to zero for each $j = 0$. The term $(1-\sigma)_{sj}$ is also an estimated parameter with $(1-\sigma)_{sj} = 0$

for $j = 0$. In addition, the model is estimated separately for each year of the data.[7] t subscripts are suppressed for clarity. We exclude years prior to 1979 in the estimation because only a limited set of covariates is available.

The estimates of each element of $\boldsymbol{\beta}_{sjk}$ reveal the impact of a particular covariate on the probability of moving sector, conditional on origin sector s and location choice j. The elements of $\boldsymbol{\alpha}_{sj}$ reveal the impact of covariates on location choice conditional on origin sector s. However, these parameter estimates are difficult to interpret directly for a number of reasons. First, because there are so many of them: for each of 15 years we estimate over 200 parameters because $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ vary across s, j and k. Second, because, as with a Multinomial Logit model, parameter estimates from a single outcome are not informative about the effect of that parameter on the probability of that outcome. As is clear from (1) and (2), the probability of each outcome is a function of parameter estimates across all outcomes. It is therefore particularly important to focus on marginal effects rather than the coefficient estimates themselves.

3.3 Calculating the impact of covariates on net flows

Thus far we have explained how to model the relationship between covariates and transition probabilities. As noted earlier, however, transition probabilities only tell us about gross flows of workers. Net flows, in contrast, are a function of transition probabilities in more than one direction i.e. from declining to expanding and *vice versa*. Net flows are also a function of the relative size of each sector, since for a given transition probability a large sector will generate greater flows.

In order to calculate the impact of covariates on net flows we use the following methods. We calculate the predicted probabilities of each outcome from Equations (1) to (3) by

[7] This allows us to check the robustness of the coefficient estimates across years. In most cases estimates are extremely robust across time.

replacing the data $\mathbf{x}_i$ and $\mathbf{y}_i$ with mean values for each group. In this case we use the mean values for each sector at $t-1$, $\bar{\mathbf{x}}_s$ and $\bar{\mathbf{y}}_s$. We then calculate the predicted transition matrix $\hat{\mathbf{Q}}$ containing the predicted probabilities of moving between each of the three sectors. Each element of $\mathbf{Q}$ contains the row probabilities $Pr(s_t \mid s_{t-1})$.[8]

The matrix $\hat{\mathbf{Q}}$ can be used to quantify the relationship between the characteristics of the sample $\bar{\mathbf{x}}$, the estimated coefficients $\hat{\boldsymbol{\beta}}$ and the size of gross and net flows between sectors. Note that although $\hat{\mathbf{Q}}$ refers only to transition probabilities between *sectors*, the predicted probabilities vary across those who are geographically mobile and those who are not. We can therefore determine whether covariates which have a large impact on geographical mobility also affect sectoral mobility.

In each year of the survey we can calculate the stock of individuals in each sector. Call this (1×3) column vector $\mathbf{s}$. An estimate of the gross flow matrix $\hat{\mathbf{G}}$ is $\mathbf{S}\hat{\mathbf{Q}}$, where $\mathbf{S}$ is a matrix containing $\mathbf{s}$ in the leading diagonal and zero elsewhere. Net flows between sectors are then given by $\hat{\mathbf{N}} = \hat{\mathbf{G}} - \hat{\mathbf{G}}'$. Because $\hat{\mathbf{N}}$ is symmetric with zeros in the leading diagonal (by definition net flows within a sector are zero) we can plot just the lower half of $\hat{\mathbf{N}}$. These three values give net flows between D and E, between D and N and between E and N. Baseline estimates of $\hat{\mathbf{N}}$ (i.e. those based on $\bar{\mathbf{x}}$ and $\bar{\mathbf{y}}$) are plotted in Figure 2.

It is arbitrary whether the proportional net flows shown in Figure 2 are positive or negative — a positive net flow from D to E is a negative net flow from E to D. But it is important to be clear about the direction of flows indicated. The first panel of Figure 2 shows that for 10 of the 15 years in the data a greater proportion of workers flowed from D to E than in the reverse direction. This outflow from D was greatest

[8]For example, the first element $\hat{\mathbf{Q}}$ is the probability of remaining in the declining sector between $t-1$ and t, and is given by the sum of the probabilities $P_d(j=0, k=0) + P_d(j=0, k=1) + P_d(j=1, k=0) + P_d(j=1, k=1)$.

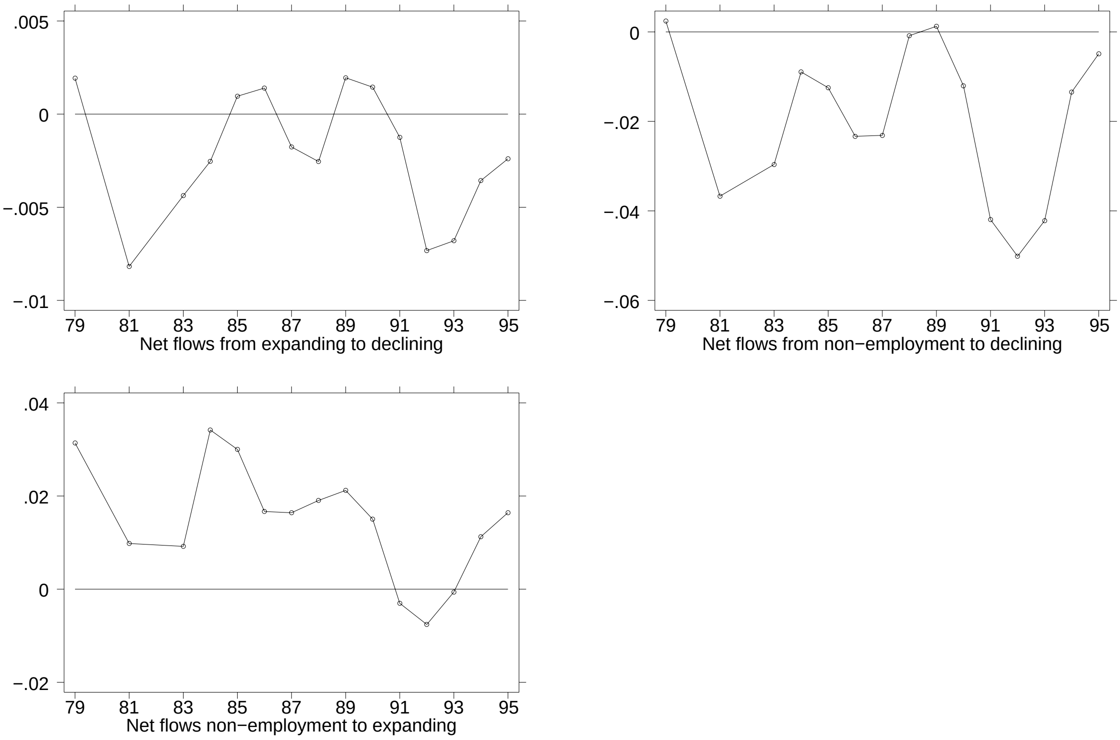

Figure 2: Baseline estimates of net flow matrix

in 1981 and 1992-1993, but still amounted to well under 1%. It is interesting to note that in the remaining 5 years of the data flows were actually in the reverse direction: it is well known that employment is more cyclical in manufacturing than in services, and this is reflected in the net inflow to D from E in 1985–1986 and 1988–1989.

The second panel of Figure 2 shows that net flows from D to N were much larger and negative in every year apart from 1979 and 1989. Thus, for example, the declining sector lost nearly 4% to non-employment during 1981, compared to less than 1% directly to the expanding sector. In the third panel we can see that the expansion of E was driven by movements between E and N, which are positive in every year apart from 1991–1993. Again, these movements are far larger than the direct reallocations between D and E.

We are now able to calculate the marginal effect of each covariate while holding all other covariates constant. This is achieved by replacing the appropriate element of $\bar{\mathbf{x}}$ or $\bar{\mathbf{y}}$ with the appropriate value for that group.

4 Two examples

In this section we illustrate our method by calculating the predicted net flow matrix for (a) different levels of educational qualifications and (b) housing tenure.[9] These examples were chosen because they represent areas of considerable economic and policy interest. It has often been suggested that the large numbers of workers in the UK without any formal educational qualifications has made the process of transition from manufacturing to services more painful. Similarly, it is also claimed that the high levels of home ownership impede the geographical mobility of the workforce.

4.1 Net flows and educational qualifications

In Figure 3 we plot the predicted net flows associated with those in our sample who have degree-level qualifications, and those who have no qualifications. Sample means for these groups are reported in Table 5. The solid lines in Figure 3 are predicted net flows based on the whole sample. These are the same flows as plotted in Figure 2, and provide a baseline for comparison.

The first panel of Figure 3 shows that those with degrees are far more likely to move directly from the declining into the expanding sector. This effect is large and significant, suggesting that the kind of general skills represented by degree-level qualifications are important in aiding mobility from declining to expanding sectors. In contrast, the

[9] Complete net flow calculations for all covariates are available from the Authors.

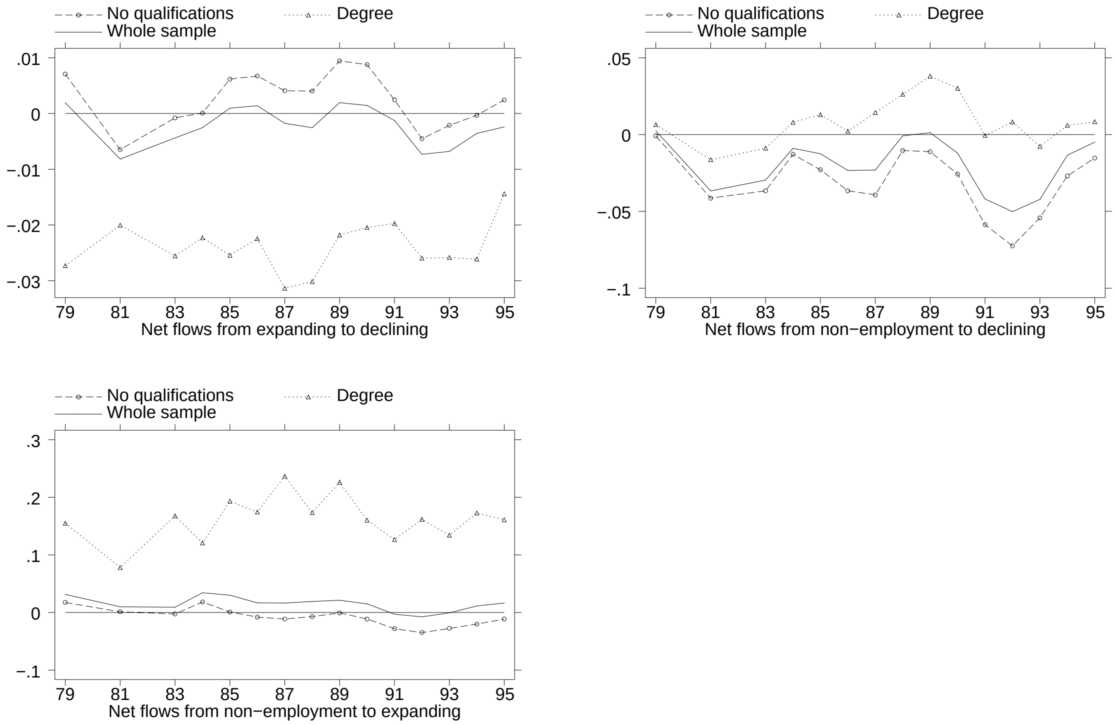

Figure 3: Comparison of $\hat{\mathbf{N}}$ between educational groups

predicted net flows for those with no qualifications are small and often in the "wrong" direction, in the sense that flows for this group tend to be from the expanding to the declining sector.

The second and third panels show that those with degree-level qualifications also have greater net flows out of non-employment, both into the declining sector (panel 2) and especially into the expanding sector (panel 3). This is unsurprising, since it is well-established that exit rates from unemployment are higher for the more educated. The less-educated by contrast have very low flow rates of either type. The relative deterioration in the labour market outcomes of less-qualified workers over this period is further emphasised by the increasing net flow from the declining sector to non-employment for workers with no qualifications.

4.2 Net flows and housing tenure

What role did the housing market play in this sectoral adjustment process? Estimates of the impact of housing tenure on regional and sectoral mobility are only made for 1981 and 1984, since these are the only two years in which data for housing tenure at $t-1$ are available. In order to make predictions about the impact of these variables across the whole period we therefore assume that the estimates for 1981 apply over the period 1979-1983, and that the estimates for 1984 apply for the period 1984 onwards.

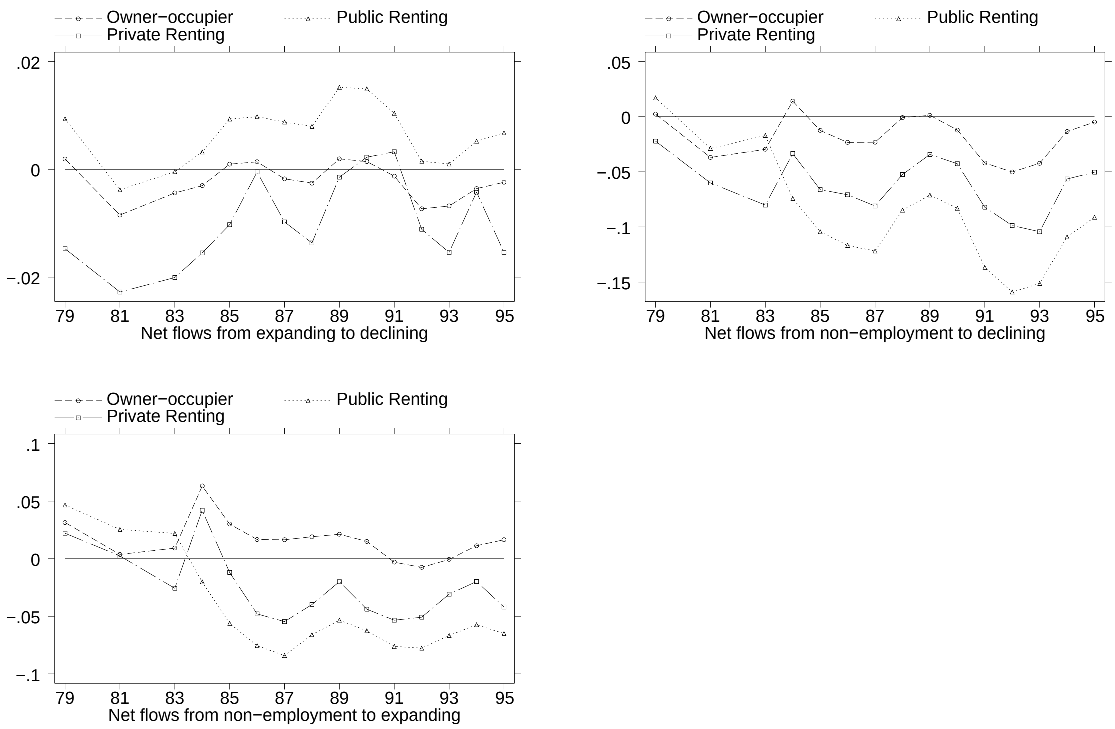

Figure 4: Comparison of $\hat{\mathbf{N}}$ between housing groups

The first panel of Figure 4 shows that for most of the years in the sample private renters moved from the declining to the expanding sector at a faster rate than owner-occupiers or those renting in the public sector, suggesting that such individuals contribute to sectoral adjustment. However, this is not the complete story. Although private renters are more mobile in this sense, the second panel shows that both private and public renters are more likely to enter non-employment from the declining sector than home owners. They are also less likely than owner-occupiers to move from non-employment to the expanding sector (panel 3). Thus the effect of private renting on sectoral reallocation is a two-edged sword: although those in the private rented sector are more able to make direct job to job moves, they also appear to be more prone to periods of unemployment. Those in the public rented sector are invariably those who find adjustment most difficult.

Are private renters more likely to change sector *because* they are more geographically mobile? Figure 5 shows predicted net flows for those who do not change address, while Figure 6 shows predicted net flows for those who do change address. This allows us to examine whether the differential impact of housing tenure occurs because some individuals are better able to move in order to find work.

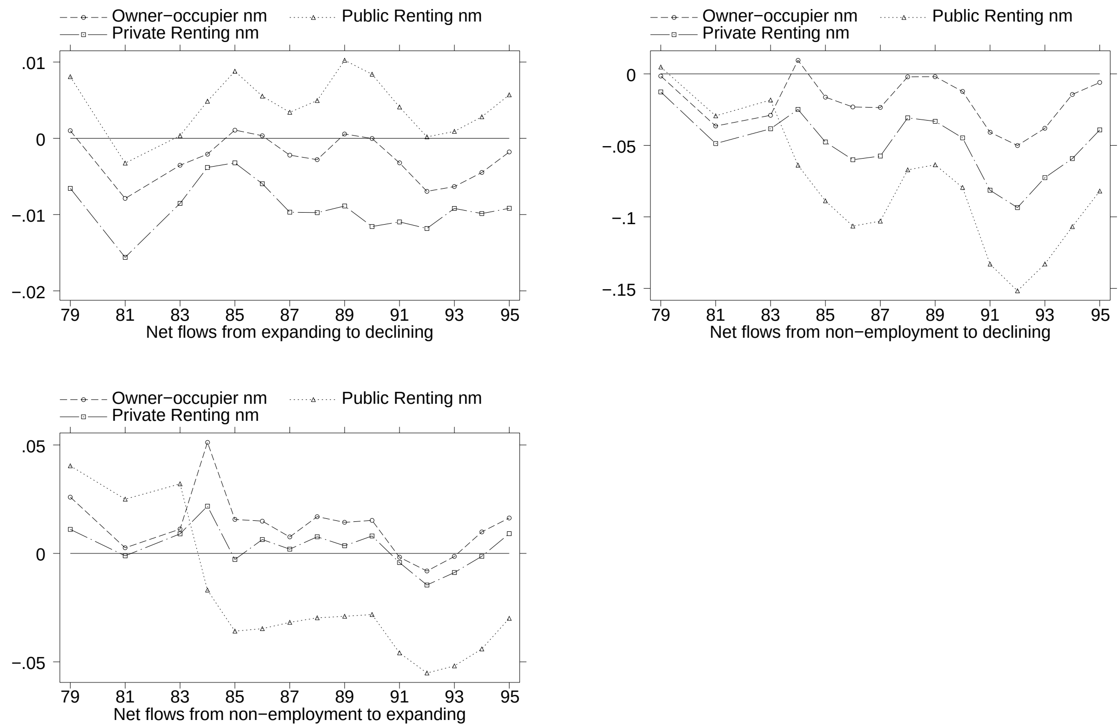

Figure 5: Comparison of $\hat{\mathbf{N}}$ by housing tenure, non-movers

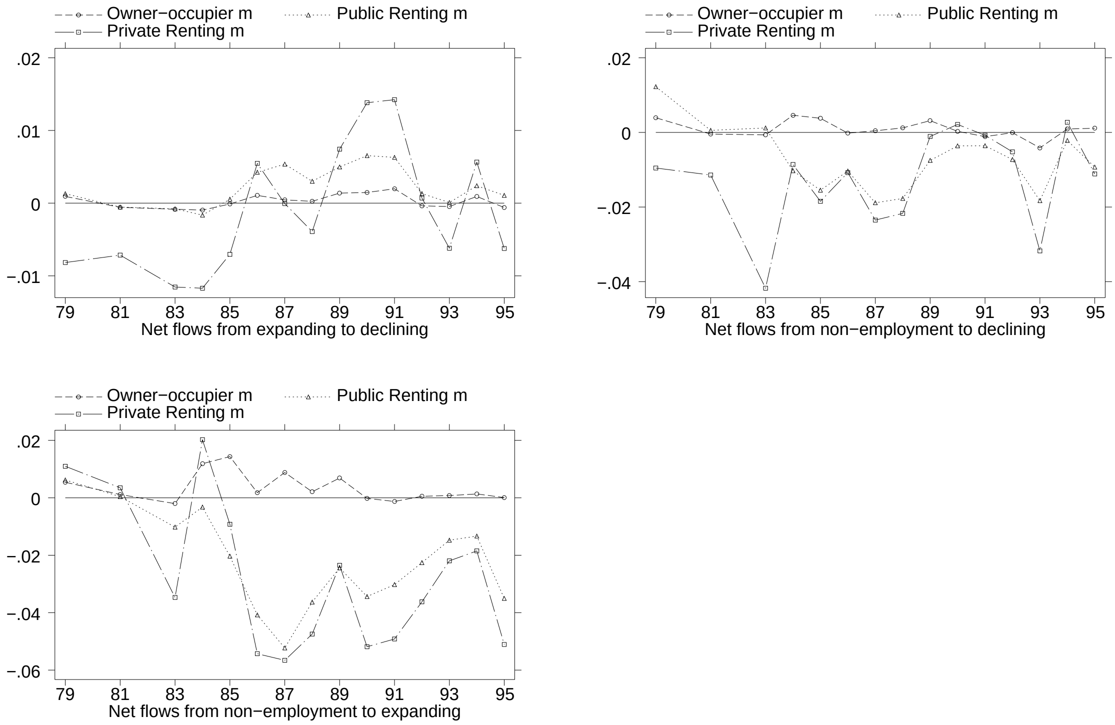

Figure 6: Comparison of $\hat{\mathbf{N}}$ by housing tenure, movers

The first panel of Figure 5 shows that private renters are more likely to move from the declining to the expanding sector even though they are not geographically mobile. That is, private renters are not sectorally mobile because of their additional geographic mobility. In contrast, the first panel of Figure 5 shows more volatile flows between sectors for those who changed address. Interestingly, geographic movers do not exhibit greater net flows from the declining to the expanding sector, and in fact in the mid- to late-1980s net flows for this group tended to be in the reverse direction.

Taken together, these results suggest that the greater sectoral mobility of private renters does not come about because of their greater geographical mobility, but rather this group have inherently less stable employment patterns. This is supported by the evidence of panels 2 and 3 in Figures 5 and 6, which shows that private renters are more likely to move from employment into non-employment.

5 Conclusions

This paper has developed a new method for analysing the relationship between individuals' characteristics and aggregate adjustment across industrial sectors. This method also allows for interactions between sectoral and geographical mobility. In doing do it fills a gap in the existing literature, which has tended to focus on transition probabilities, or gross flows, and on regional mobility rather than industrial restructuring.

The results reported in Section 4 illustrate the heterogeneous nature of the reallocation process. Although aggregate net flows are relatively small, some types of worker are far more mobile than others, and have therefore contributed far more to the process of sectoral transformation. For example, individuals with high levels of general skills embodied in degree-level qualifications are more likely to move from the declining to the expanding sector. The model allows us to distinguish between mobility *per se* and the reallocation of labour. Thus, although less-skilled workers are very mobile, their contribution to adjustment is limited as they often flow into the declining sector.

Similarly, although owner-occupiers move relatively infrequently, they do not appear to hinder adjustment as they seem to be better able to move from non-employment to the expanding sector than other groups. This is in contrast to private renters who aid adjustment by direct job to job moves but seem to find movement from non-employment relatively difficult.

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