

# Job Flows, Worker Flows and Churning

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First draft: October 1994

This draft: March 1996

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We are grateful to CEPR for providing some funding for this project, and to Michael Burda, Francis Kramarz, Steve Nickell and seminar participants in Berlin, Bristol, Oxford and Paris for helpful comments. Any errors are our own.

## **Abstract**

We utilize a large establishment-level panel dataset to explore the links between gross job flows and gross worker flows. Our findings have relevance for models of job creation and job destruction, and labour reallocation. We find churning flows (the difference between worker and job flows at the level of the establishment) to be high, pervasive and highly persistent within establishments, suggesting that they arise as a correlate of an equilibrium personnel policy. We find the dynamic relationship between job and worker flows to be quite complex: lagged job flows raise churning flows, and lagged churning flows reduce employment growth.

JEL categories: J23, J63, E32

Keywords: gross job flows, worker flows, labour reallocation

## ***1. Introduction***

The analysis of the reallocation of labour currently has two major strands. The search and matching approach is about *worker* flows<sup>1</sup>. The set of papers on job creation and job destruction is about *job* flows<sup>2</sup>. These two literatures have largely developed along separate tracks. Yet their synthesis is essential to an understanding of labour market dynamics and the reallocation of labour in general, and unemployment in particular. This paper advances this synthesis by exploring the empirical relationship between job and worker flows at establishment level.

The relationship between aggregate job and worker flows is non-trivial, although most models assume them to be equal. Recent microeconomic evidence from Hamermesh, Hassink and van Ours (1996) and Burgess, Lane and Stevens (1996) has shown that behaviour at the micro level is complex: shrinking establishments engage in hiring and growing establishments fire workers.

In this paper, we label that component of worker flows which exceeds job flows as "churning" flows<sup>3</sup> and focus on the joint processes generating job and churning flows at level of the establishment. Put differently, we examine match heterogeneity over and above establishment heterogeneity: simultaneous hiring and firing by establishments (establishments churning workers) and/or workers quitting and being replaced (workers churning establishments). Splitting worker turnover into job reallocation and churning flows provides, we believe, a useful alternative perspective on labour market flows<sup>4</sup> as it gets closer to the two fundamental processes

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<sup>1</sup> References include Pissarides (1985, 1990), Blanchard and Diamond (1989, 1990).

<sup>2</sup> This includes papers such as Leonard (1987), Dunne, Roberts and Samuelson (1988), and Davis and Haltiwanger (1990, 1992).

<sup>3</sup> These are defined in detail below, but a simple example illustrates: suppose an employment gain of 10 is achieved by 15 hires and 5 separations: then the gross job flow is +10, the gross worker flow is 20 and the churning flow is 10.

<sup>4</sup> That it is a different perspective, that churning flows are not just worker turnover under another name, can be demonstrated as follows. A simple regression of separation rates on churning flow rates (defined precisely below) in our data yields an  $R^2$  of just 0.29. But this combines time-series variation and cross-section variation. A harder test is to take the correlation

underlying job and worker reallocation. These are: the re-evaluation by the establishment of the number of job slots it wants, and the re-evaluation by both parties of the match of a particular job slot and a particular worker. Thus, worker flows have two components: those which are an immediate consequence of job creation and destruction, and those in excess of job flows. The second component, which is what we call churning flows, could be the result of random mismatches or could be an equilibrium phenomenon.

In this paper, we show that churning is not the response to an unfortunate mismatch, scattered randomly across establishments, but is highly persistent in particular establishments suggesting that it is an equilibrium phenomenon, associated with a particular set of optimal personnel policies. We also examine the dynamic relationship between job flows and churning flows establishment-by-establishment finding, among other things, that churning flows have significant effects on employment growth.

Cutting the data this way, into job and churning flows, yields a number of new facts, which we set out below. The paper is organised as follows: section 2 briefly describes the data (details are in the Appendix) and the framework we use to interpret the results; section 3 presents the results. Finally, Section 4 concludes.

## ***2. Preliminary Issues***

In this section we briefly review some previous work on this topic, describe the dataset, set up the notation and discuss the economic decisions underlying churning.

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between the two variables establishment-by-establishment and look at the distribution of this pure time-series correlation across establishments. We find that median  $R^2$  is just 0.31, and that the top and bottom quartiles are 0.57 and 0.08 respectively. So the two are definitely distinct variables.

*(a) Previous Work*

There is a large amount of work on the matching approach to labour markets, and also on gross job flows (for example, the references in footnotes 1 and 2). Few papers, however, address both worker flows and job flows together. One exception is Mortensen and Pissarides (1994), who introduce a job creation and destruction process into a matching framework. Even so, their assumptions imply that total hires equal total (gross) jobs created, total separations equal total (gross) jobs destroyed, and so total job flows equal total worker flows. There is a little empirical work but it has had to rely on less than ideal datasets. For example, Davis, Haltiwanger and Schuh's (1994) data contains no information on workers, and so they are forced to combine a number of different data sources; Blanchard and Diamond (1990) face the same problem; Anderson and Meyer's (1994) study of separations and post-separation experience provides some useful evidence on the importance of job flows for worker flows, but uses a worker-based dataset. As noted above, Hamermesh, Hassink and van Ours (1996) and Burgess, Lane and Stevens (1996) do have datasets appropriate to this particular issue, though the former does not have a long panel element. Using aggregate data, Burda and Wyplosz (1994) display the gap between job and worker flows for Germany, and discuss other aggregate findings. The ideal dataset for this problem is based on the universe of establishments (job flows are *defined* on establishments), matched with the universe of workers. We are able to exploit a panel of such data, incorporating data on both job flows and worker flows.

*(b) Data*

The database is drawn from the universe of Maryland quarterly wage reports. Maryland collects quarterly information about employee earnings from employers who report in compliance with its unemployment compensation law. This includes everyone employed in Maryland except for those who are self-employed, who work for certain nonprofit organizations, or who work on family farms or as seasonal or migrant farm workers. Employers who are required to comply with the state's unemployment compensation law include virtually all employers of one or more paid employees. The only major excluded employers are the Federal government, self-employed

individuals, some small agricultural enterprises, and philanthropic and religious organizations. Employment of individuals who receive no salary at all, who are totally dependent upon commissions and who work on an itinerant basis with no fixed location or home base, is not reported by covered employers. State and local government employment is reported.

There are roughly 1 1/2 million employees every quarter; and over 100,000 reporting units. Our database consists of these records from 1985:3 - 1993:3 and complementary four digit Standard Industrial Classification codes. A vintage data element identifies the year/month when each business enterprise first acquired an unemployment compensation account number in the state, dating back to 1938.

One consequence of our having almost the universe of employment is that the data include all individual employment spells with an establishment, of whatever duration. If, however, we describe all hires and separations this will result in very short employment spells dominating the picture, since Anderson and Meyer (1994) have documented that 23% of job matches dissolve within a quarter. An analysis of these short spells is of interest in its own right, but as Anderson and Meyer point out, although short spells characterize the average job, long spells characterize the average person's current experience. We explicitly and deliberately focus on non-ephemeral jobs, which we define as those lasting at least a quarter. All flows and stocks described below are of people into and out of jobs lasting at least a full quarter. It seems likely that including all shorter spells would in fact give rise to much higher churning, and would enhance the case we are making here. By the same token, we make a positive sample selection decision on establishments: both of size and lifetime. It is usual in studies of job flows to have a minimum establishment size for inclusion; usually, this is imposed by the dataset, but here we can choose, and we take establishments with an average size of at least 20. We also restrict the dataset to establishments which exist for at least 10 quarter. This enables us to focus on the decision making process of long-lived establishments which employ 90% of the workers in our dataset.

*(c) Terminology*

Employment at establishment  $i$  at time is denoted  $E_{it}$ <sup>5</sup>. In calculating rates, we follow Davis and Haltiwanger (1990) in using as the denominator the average of current and past employment, denoted  $N_{it} = (E_{it} + E_{it-1})/2$ . Job flows refer to the change in employment:  $JF_{it} = E_{it} - E_{it-1}$  and job reallocation is the absolute value of job flows,  $AJF = |JF|$ . Job creation (JC) is a positive job flow, job destruction (JD) is a negative job flow:  $JC = AJF$  if  $JF \geq 0$ ,  $JD = -AJF$  if  $JF < 0$ . The corresponding rates (JFR, AJFR, JCR, JDR) are the levels divided by  $N_{it}$ . The Davis and Haltiwanger definition of the JCR is the sum of all employment gains in a defined aggregate of establishments, divided by the total employment (amongst growing, declining and stationary establishments) in the aggregate. An employment weighted average over establishments of our definition of JCR produces the Davis and Haltiwanger JCR as long as the base (the sum of the weights) is total employment not total employment in the group averaged over (growing establishments). The employment weighted average of the absolute job flow rate is the Davis and Haltiwanger job reallocation rate, JRR ( $AJFR = JCR + JDR$ ). We use this terminology below.

Total worker flows are defined as the sum of hires and separations,  $WF_{it} = H_{it} + S_{it}$ . Job flows are clearly  $JF_{it} = H_{it} - S_{it} = E_{it} - E_{it-1}$ . Worker flows can thus be written as  $WF_{it} = AJF_{it} + CF_{it}$  where  $CF$  is the level of excess worker flows, or churning. The first of these components,  $AJF$ , is the counterpart to job flows and is necessary to accomplish the establishment's growth or decline. This is the job reallocation component which has been studied by others (Leonard, 1987; Dunne, Roberts, and Samuelson, 1989; Davis and Haltiwanger, 1990, 1992; Anderson and Meyer, 1994; OECD, 1994). The second of these,  $CF$ , is worker flows in excess of job flows, which we call churning and is the focus of the subsequent section. It represents the difference between labour reallocation and job reallocation and can arise from establishments churning workers or workers quitting and being replaced<sup>6</sup>.

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<sup>5</sup> Recall that this is the total of all non-ephemeral jobs (lasting at least one quarter).

<sup>6</sup> One component of worker flows is temporary layoffs and recalls. In this paper, we treat these no differently from other flows (Anderson and Meyer, 1994, discuss the proportion of

The introductory example can be used to illustrate these definitions. Suppose an establishment of 10 employees increases employment by 10 and this is achieved by 15 hires and 5 separations. The gross job flow JF is 10 (15 hires - 5 separations), as is the absolute job flow, AJF. The gross worker flow, WF is 20 (15 hires + 5 separations), and the churning flow CF is 10 (WF-AJF). Job creation, JC is 10 and job destruction, JD is 0. There are thus 10 jobs but 20 workers reallocated, and a focus on job reallocation would miss half of the labour reallocation occurring in the establishment.

*(d) Framework*<sup>7</sup>

The two components of churning flows are: simultaneous hiring and firing by the establishment, and the replacement of quits by the establishment. These are essentially the same activity but initiated by different agents, namely the re-evaluation of a job match<sup>8</sup>. This re-evaluation is an investment decision in which the agent compares the cost of changing a partner with the discounted benefit stream. A useful model is the dynamic programming approach of search theory with both parties setting a reservation match value level. However, if some aspects of a match are 'experience goods' rather than 'inspection goods', they can only be observed once a match has been made. The value of the match will evolve as its 'experience' characteristics become apparent: the working conditions as viewed by the worker; the motivation and true ability of the worker as viewed by the establishment. The decision to maintain or dissolve the match then needs to be reviewed continuously by both the worker and the establishment. The decision by either side that they wish to change partners but remain in the same state (for the worker: remain employed; for the establishment: keep the same employment level) produces

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temporary layoffs in total separations). The ability to engage in temporary layoffs differs between industries and this also will be reflected in the churning figures. Given that we can identify *ex post* recalls, in future work we intend to quantify this contribution to churning differences.

<sup>7</sup> More detail on these arguments is provided in Burgess, Lane and Stevens (1994).

<sup>8</sup> See Jovanovic (1979) and McLaughlin (1991)

churning flows. Churning flows vary between establishments and over time. Over time, the establishment's planned employment changes may influence churning: when firing, the establishment will select the lowest quality (lowest match value) workers; when hiring they will draw from the distribution represented in the current hiring pool. So increases in the establishment's employment level in the recent past will mean an influx of people of uncertain quality, generating an increase in churning, and recent negative job flows mean that the establishment has just had a chance to sort through its quality distribution, therefore reducing the need for current churning.

Cross-sectional variation in churning arises from the conjunction of the establishment's optimal personnel policy and the stochastic processes governing the evolution of the match value. The environmental parameters that will influence the establishment's personnel policy include turnover costs, the nature of the technology, skill requirements and managerial matching ability. There are a number of issues here. For some establishments, turnover costs are high and so the best strategy is to put a lot of effort into matching/hiring and consequently churning will tend to be lower; for low turnover cost establishments, it may be better to hire almost anyone and sort through the stock whilst they are employed. Other factors include the degree to which skills are observable prior to employment, the relative costs of false negatives and false positives<sup>9</sup>, the frequency with which the establishment needs to change technology and hence skills. It also may be the case that in some establishments there is value in a constant inflow of new blood into an establishment. Finally, it is also possible that managers differ in their ability to select well-matched applicants<sup>10</sup>.

We now briefly consider the reverse question, namely the possible effect of churning flows on job flows. Here there is a less obvious model to use, since we do not have a standard model of

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<sup>9</sup> We are grateful to Michael Burda for this description.

<sup>10</sup> See Isaac, Lane and Stevens (1996) for more details.

the determination of gross job flows<sup>11</sup> (contenders include Davis and Haltiwanger, 1990, Caballero and Hammour, 1994, Mortensen and Pissarides, 1994). These models do not include a discussion of churning; the excess of worker flows over and above job flows. In the absence of a formal model, we simply highlight two issues. First, efficiency wage models often stress the deleterious effects on an establishment of excess turnover (Salop, 1979). If CFR contains a large component of quit replacement, then it could be that high CFR will negatively affect job growth. This view suggests that establishment has chosen the wrong personnel/recruitment strategy and is suffering as a result. Second, just as an establishment invests in new equipment for an anticipated expansion, it could be that it also invests in the quality of its workforce. The reservation match value level will depend on the establishment's view of its future prospects. This improvement in quality will raise productivity and will improve prospects for the establishment's growth.

### **3. Results**

#### *(a) Basic Facts*

We now consider the distribution of worker and job flows. Table 1 gives the results for manufacturing and Table 2 provides the same information for nonmanufacturing industries. Taking manufacturing first, a mean worker flow (hires plus separations) rate of 24% per quarter indicates a vast amount of labour reallocation. One in four job matches either forms or breaks up each quarter. Two points should be borne in mind in interpreting this statistic. First, it is constructed as the *sum* of hiring and separation rates to make it analogous to the job reallocation rate, so this figure is equivalent to balanced hiring and separations of 12% per quarter. Second, recall that we are focussing on worker reallocation from non-ephemeral jobs and non-ephemeral employers. The Anderson and Meyer (1994) estimate of a 23% overall separation rate in their sample gives an idea of the order of magnitude of the turnover of transient job matches.

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<sup>11</sup> One can argue that job creation and job destruction are simply labour demand writ small; for this, of course, there is a vast literature for which we simply reference Hamermesh (1993). It is still the case, however, that most of this literature does not consider the effect of churning on labour demand.

The worker reallocation rate is the sum of a job reallocation rate of 13% per quarter and a churning rate of 11%. The job reallocation rate is lower than that obtained by Davis and Haltiwanger (1992), but as just noted, this is expected<sup>12</sup>. One feature of interest is the very high churning flow rate, indicating an enormous amount of worker reallocation, over and above that occasioned by job reallocation. The Table also shows the new result that the churning rate generally declines with age and size of the establishment. Even so, it is still about 10% per quarter in the oldest establishments and 7% in the largest establishments.

There are two ways of measuring the importance of churning flows in worker flows. The question, what proportion of all worker flows are churning flows, is answered by dividing 11% by 24% to get 0.46, whereas the final column shows that the mean of the ratio (CFR/WFR) over time and establishments is 0.71. The rest of the Table shows that the average over different subgroups does not vary substantially from this figure, never falling below 48%. Our figure of 54% of worker flows accounted for by job flows in manufacturing can be compared to the estimate of 35 - 56% constructed by Davis and Haltiwanger (1992), using their establishment data plus data from the CPS. In their sample, Anderson and Meyer (1994) find 24% of worker flows in manufacturing to arise from permanent job flows.

Turning to nonmanufacturing industries in Table 2, the data reveal even greater churning flows. A slightly higher worker flow rate is made up of a churning rate that is 76% higher than in manufacturing and a job reallocation rate that is considerably lower. Churning flows account for 71% of all worker flows, and the ratio (CFR/WFR) averages 66%. Again, churning flows are important throughout the age and size distribution. A comparison here can be made to Anderson and Meyer's (1994) finding that 31% of total worker flows are due to permanent job flows<sup>13</sup>.

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<sup>12</sup> Results in Davis and Haltiwanger (1995) confirm that our data produce numbers in line with their own work and that of others.

<sup>13</sup> This figure relates to all industries, which is dominated by non-manufacturing.

The frequency distribution of the ratio (CFR/WFR) is shown in Figure 1. The source of the polymodal shape is explained below when we examine the dynamic evolution of churning and job flows. Clearly, for most establishments for most of the time, job reallocation flows are a minor factor in their worker flows.

Figure 2 presents the aggregated flows over time for the aggregate (Maryland) manufacturing and non-manufacturing sectors. In both pictures, there is evidence of seasonality in CFR (and hence WFR), and a negative correlation between CFR and JRR. Also in both, CFR tends to be somewhat lower at the end of the period. These impressions are confirmed in Table 3. These aggregate flows are regressed on the Maryland unemployment rate, seasonal dummies and the interest rate. The results confirm that aggregate churning flows are procyclical and that the job reallocation rates is counter-cyclical. The former effect is stronger indicating that the aggregate worker reallocation rate is pro-cyclical<sup>14</sup>.

For each of JFR, JRR, CFR and WFR, we can think of the total variation being split up into aggregate time effects, industry specific effects, and establishment specific (idiosyncratic) effects. The establishment effect in turn can be split up into the establishment mean and variation around that. Much has been made of the overwhelming importance of the idiosyncratic component in job reallocation. Here we show that the same is true of worker reallocation, both in total and looking specifically at the churning flows. To do this we regress each of the flow rates on combinations of: time dummies, 3-digit industry specific dummies and establishment dummies (fixed effects), and compare the proportion of variance explained. The results are in Table 4, which simply presents the  $R^2$ s from these regressions separately for manufacturing and non-manufacturing. First, we can confirm the findings of Leonard (1987) and Davis and Haltiwanger (1990) who demonstrate the importance of the idiosyncratic component for gross job flows. Even in a relatively small state such as Maryland, with time dummies and establishment fixed effects, less

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<sup>14</sup> Anderson and Meyer (1994) also find similar results for their breakdown of worker flows.

than 10% of the variation in JFR is explained. The  $R^2$ s are a little higher in the JRR regressions, indicating the greater importance of industry effects in explaining job reallocation. For churning flows, the numbers are twice as high: idiosyncratic factors still account for about 40% of the variation (in nonmanufacturing; 60% in manufacturing) but there are more influential systematic factors. The most important single factor is the establishment fixed effect. Comparing manufacturing and non-manufacturing, the figures for JFR and JRR are similar, but in CFR the  $R^2$ s are far higher in the latter. The implication of this is that time-invariant establishment-level factors are more important for churning flows than for job reallocation flows. We explore this persistence further in the next section.

*(b) Establishment Effects in Churning Flows and Job Flows*

The preceding discussion has described the order of magnitude of churning and job reallocation. The establishment specific contribution to churning - the idiosyncratic component - is defined as

$$ICFR_{it} = CFR_{it} - CFR_{st}$$

where  $CFR_{it}$  is the churning rate of establishment  $i$  at time  $t$ , and  $CFR_{st}$  is the sector (3-digit industry) churning rate at time  $t$ .  $IJFR_{it}$  is defined analogously as the idiosyncratic job flow rate.

Figure 3 illustrates the key result of Table 4 in a most striking way. We rank all establishments by their idiosyncratic churning in 1985:3 and assign them into quintiles on the basis of this. We then calculate the average idiosyncratic churning of each quintile in each following time period. We then repeat this procedure based on the idiosyncratic job flow rate. If there is no persistence, there should be little long term pattern in the figures. This is indeed the case for job reallocation. But Figure 3 demonstrates that the reverse is true for idiosyncratic churning flows.

Establishments who were ranked in the highest quintile in 1985:3 still have high churning in each subsequent period. The average idiosyncratic churning remains at similar levels and well above 0.1 until the end of the data period. A similar stability of idiosyncratic churning is evident in the

other quintiles: there is only one cross over during the entire time and the order of magnitude of churning in the group is also remarkably constant. Bearing in mind that the data underlying this picture have had 3-digit industry average effects removed, this shows a remarkable persistence in establishment level churning. Regardless of industry affiliation, there are high churning establishments and low churning establishments<sup>15</sup>. These differences presumably arise from enduring features of an establishment's personnel policies, arising in turn from the fundamentals of its technology, skills, and cost structure. The efficiency wage literature considers the case of establishments setting wages to discourage costly excess turnover (churning) and minimise total costs. In a set of establishments with differing technologies (including monitoring costs), there may coexist a variety of optimal policies: a high wage-low churning strategy or a low wage-high churning strategy. Note that the argument is not that high wage establishments should have low *worker* flows, because some worker flows are required for the establishment to reach its desired size, but that excess worker turnover should be low. We can explore this issue since we have average earnings information for the establishments. Specifically, each employer reports earnings for each worker each quarter. We take the mean of these for full-quarter workers as our measure of average earnings, and the difference between this and the 3 digit industry average as the measure of idiosyncratic average earnings. We have this information for three dates: 1987.3 (a boom year), 1990.3 (recessionary year) and 1993.3 (recovery). We regress idiosyncratic churning (defined above) on the establishment's idiosyncratic average earnings and size. The results are in Table 5. We do this with churning dated contemporaneously with the wage, with the wage lagged one period behind churning. Table 5 consistently shows a negative correlation between idiosyncratic churning and the wage, controlling for size. This is repeated across all three dates and whether the wage is lagged or not. The results suggest that there is some systematic component to churning flows, which is correlated with the establishment's wage/personnel policy. It is also clear that differences in wages explain little of the differences in churning, the  $R^2$ 's being very low.

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<sup>15</sup> This is not to say that there are no industry differences, quite the reverse. An almost identical graph is created (but not reported here) if the unit of observation is the three digit industry. This is consistent with industry differences in hiring and training costs relative to wage costs.

This section has established that high and low churning flows are persistent features of some establishments' personnel policies. Since most of our establishments are long-lived, this suggests to us that there are different and sustainable (ie. successful) personnel/recruitment policies available. That is, churning is an equilibrium phenomenon. This view is strengthened by the correlation between excess churning and idiosyncratic wages. Some of the modelling issues were noted above in section 2. There appear to be a number of interesting questions to be asked in this area.

*(c) The Dynamic Relationship between Churning Flows and Gross Job Flows*

We now turn to analyse the dynamic determination of churning flows, the relationship between gross worker and gross job flows over time at establishment-level. At the aggregate level, the evidence is as follows: Davis and Haltiwanger (1990)<sup>16</sup> show that gross job destruction is more sensitive to the cycle than is gross job creation, implying that gross job reallocation is countercyclical. On the other hand, gross worker flows tend to be procyclical. If it is more profitable to reallocate jobs in a recession, it seems more profitable to reallocate workers in a boom. The evolution of churning flows (the difference between worker and job flows) is the link between the two and may give us some further clues as to the determination of the reallocation of labour. Using our dataset, we can explore this link at the level of the establishment.

A useful first step is a graphical investigation. We plot an establishment's gross job flow rate (or employment growth rate) against its gross worker flow rate in a particular quarter. Since worker flows are never less than job flows, all points will lie on or above a pair of 45° lines. The vertical distance between a point and the diagonal is the churning flow rate. What might we expect to see? If churning is greatest when establishments are experiencing rapid growth or decline, we would expect the mass of points to lie around lines steeper than 45°; if churning occurs when job

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<sup>16</sup> A thorough survey of the international evidence is contained in OECD (1994).

flows are lower, we would expect a flatter plot. There is no reason why it should be symmetrical about  $JFR = 0$ .

Figure 4 shows a plot of all the data points we have, ie. all dates for all establishments. This picture therefore combines the time series pattern for an establishment with the distribution of establishments across this space. The picture shows that higher churning flow rates tend to be associated with lower (absolute) job flow rates. For high JRR, almost all worker flows are accounted for by job flows. Below that, where the bulk of the data points lie, churning flows on average dominate worker flows. This picture explains the shape of the frequency plot of churning flows in Figure 1: some establishments with high JRR have very low CFR, whereas the main mass of establishments with lower JRR have much higher CFR.

However, as noted, this combines the time series variation establishment-by-establishment with the cross-section distribution of establishments. To isolate the former, in Fig. 5 we plot the  $\{WFR, JFR\}$  sequence separately for a selection of randomly-chosen establishments. As might be expected, there is a great variety of shapes. For example, in panel A, there are some "flares" as both JFR and WFR increase dramatically together and then fall back together. This case shows WFR being driven by JFR: the establishment wants to expand and so hires to achieve that. These are flows, so once the new desired employment level is reached, the flows fall back to previous levels. This is the sort of pattern that might be expected if churning flows were just 'froth' on top of the driving JFR. But a quite different sort of picture is evident in panel B. Here there is no obvious pattern, with negative co-movements as likely as positive. Examining a number of such pictures, it is clear that there are many episodes for many establishments when JFR and WFR are negatively correlated, or when the JFR changes with no impact on WFR, or vice versa.

Reporting impressions from our viewing of several such plots, out of potentially many thousands of establishment plots, is not very scientific. To estimate the dynamic relationship between churning and job flows<sup>17</sup>, we specify a VAR on the panel of establishments. We show two things

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<sup>17</sup> These are the fundamental components; their sum gives worker flows which are plotted in

from this. First, the nature of causality between these series, and second the magnitude of the effects. The issues involved in the estimation of dynamic models using panel data have been discussed by Anderson and Hsiao (1982), Arrelano and Bond (1991), and VARs on panels have been discussed by Holtz-Eakin, Newey and Rosen (1988). The latter discuss ways of allowing for heterogeneity between the different units, in the coefficients and error variance. In fact, we have a very long time dimension for panel data: in our non-manufacturing sample, 635 establishments had runs of at least 20 periods, and 472 had runs of at least 30 periods. Consequently, we were able to allow for the maximum heterogeneity by estimating a *separate* VAR for each establishment. We included establishments with at least 10 observations. Each VAR was of the following form:

$$CFR_{it} = \sum_{s=1}^m \alpha_{1si} CFR_{i,ts} + \sum_{s=1}^m \alpha_{2si} JFR_{i,ts} + v_{1it}$$

$$JFR_{it} = \sum_{s=1}^m \beta_{1si} CFR_{i,ts} + \sum_{s=1}^m \beta_{2si} JFR_{i,ts} + v_{2it}$$

where  $i$  indexes establishments, and  $t$  indexes time and the  $v_{it}$  are establishment-specific error terms. The lag length chosen was 4.

The results on Granger causality tests show significant interactions between these two series for many establishments. In non-manufacturing, at the 5% significance level, job flows Granger cause churning flows in 23% of all establishments, and churning flows Granger cause job flows in 20% of all establishments (these are generally different establishments). We discuss this result further below. In manufacturing, the figures are 23% and 21%. Given the maximum time dimension of 33, this seems impressive evidence of the interactions in the data for at least a large subset of establishments.

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Figures 4 through 6.

In Table 6 we report the long run elasticities derived from estimating (1) establishment-by-establishment: the lower quartile value, upper quartile value and the median. These are, for cfr,  $\alpha_2(1)/[1 - \alpha_1(1)]$  and for jfr  $\beta_1(1)/[1 - \beta_2(1)]$ , where  $\alpha_2(1)$  indicates the sum of the  $\alpha_{2s}$  values. The results suggest that in most establishments, lagged job flows positively affect churning flows. This is as we expected. It supports the idea that when establishments have recently expanded, there is a group of workers with uncertain match value. As the true value is revealed, churning increases. Conversely, if employment has fallen, it is likely that those with the lowest match values will have left, reducing the need for further churning. Interestingly, the results also suggest that in most establishments, lagged churning flows are negatively associated with job flows. Recall that these are establishment-by-establishment time series regressions, so this is all time series variation that is being captured here. This appears to be a new result. How is it to be interpreted? It may not be causal: it could be that workers perceive that the establishment will shortly decline and quit. This story seems plausible; however, if the decline was expected by workers it seems reasonable to assume it would be expected by managers, and they might take advantage of the natural wastage to reduce employment in a relatively costless way. In fact, churning flows are by definition *replaced* quits, so this story needs to explain why new workers are hired. A causal story is the efficiency wage argument that excess worker turnover is costly and damaging to the establishment. The question then is why the establishment did not choose the optimum wage/turnover policy. The optimum policy would imply that time series variation in churning should already be accounted for and be orthogonal to employment growth. It may be that the establishment faces constraints on its choice of compensation or personnel policies, or that churning flows develop in an unforeseen manner quicker than the establishment can change policy. The cross-section evidence given above, however, tends to suggest that differences in average churning across establishments tend to persist. These seem to us to be questions worth pursuing further.

In view of the heterogeneity of the coefficients reported, we did not re-estimate imposing the same coefficients across cross-section units<sup>18</sup>.

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<sup>18</sup> We did do this in an earlier version of this paper (Burgess, Lane and Stevens, 1994), though

#### ***4. Conclusions***

The reallocation of labour involves both the reallocation of workers amongst a fixed set of jobs, and the reallocation of jobs. Davis and Haltiwanger (1990) and others have demonstrated the considerable establishment heterogeneity underlying job reallocation; in this paper we have shown considerable match heterogeneity over and above establishment heterogeneity. Using an establishment-level panel dataset, we are able to separate these out over time, establishment-by-establishment. We confirm recent findings regarding the size of gross job flows and the importance of the idiosyncratic component. More importantly, we provide new evidence on the nature of churning flows and their relationship to job flows. Briefly, we summarise our main results here.

The difference between labour reallocation and job reallocation is indicated by the magnitude of the gross churning flows. In non-manufacturing, the quarterly churning rate is 19%, and 11% in manufacturing. While the rate declines with size and age of the establishment, it remains around 10% in the oldest and biggest establishments. Furthermore, churning flows dominate job reallocation as the source of worker reallocation. This is true in two senses: churning flows account for over 70% of worker flows in nonmanufacturing (46% in manufacturing), and the ratio of churning flows to worker flows averages over 60% across establishments and time. This suggests that for most establishments most of the time, most of the flows they have to deal with are churning flows. There are high churning flows throughout the labour market. There are no industries in which churning flows are unimportant. High levels of worker flows are characteristic of some establishments and industries, and these effects are persistent.

Labour reallocation and job reallocation appear to be characterized by different processes: a much higher proportion of the variation in churning flows than job flows is explained by establishment fixed effects. The difference in the importance of establishment effects between

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without dealing properly with the fixed effects issue.

job flows and churning flows is striking.

The dynamic relationship between worker flows, churning flows and job flows appears to be quite complex. Aggregate labour reallocation is procyclical and aggregate job reallocation is countercyclical. We investigate these dynamics at the establishment level. We find that churning flows depend positively on recent job flows. This fits well with the idea that churning arises as recently made matches are re-evaluated and some are terminated. We show that an establishment's employment growth depends negatively on its recent churning flows. There does not appear to be a good explanation for this phenomenon, and we believe it merits further attention.

Turning to the broader picture, these findings have a number of implications. First, models of labour reallocation must take account of the substantial churning flows. These are clearly important in their own right, but also appear to have an effect on gross job flows (employment growth). This finding introduces a whole new range of issues into the job creation and destruction literature, and indeed the labour demand literature. Second, the sheer magnitude of churning flows suggests that further research is required on the applicability of models based on establishments paying high wages to (successfully) avoid high worker turnover. Finally, the importance of churning flows suggests that these must be taken into account in employment adjustment cost functions: most of the worker flows that establishments have to cope with do not change the size of the establishment.

## *Data Appendix*

### *(a) Data Structure*

These are confidential records. The agreement between the University of Baltimore and Maryland's Department of Economic and Employment Development specifies the uses that can be made of these data and stipulates that the identities of individuals and establishments cannot be revealed to the public. The data are encrypted upon arrival and then stored and processed in a secure facility. Staff members who have access to the data sign an oath indicating their awareness of the law's requirements and their personal intention to abide by these stipulations

The micro records used in this paper represent both single-establishment firms, multiple-establishment firms that report each of the subordinate establishment's information separately and multiple-establishment firms that combine all of the subordinate unit information into a single entity. In fact, this last problematic group account for a very small proportion of employment and observations. This raises issues about the differences between firms and establishments and the consequences of firm changes in the employer identification number. These are clearly addressed in Anderson and Meyer (1994) and have also been addressed in Lane, Isaac and Stevens (1993). The data is certainly not dominated by many take-overs and mergers: for example, in 1992 there were 1600 successor firms out of a total of around 100,000 firms.

Errors that might arise from late reporting are minimized by acquiring each quarter of Maryland data twice: when it first becomes available three months after the end of the reference quarter, and then again two quarters later. Non-reporting and erroneous reporting of individual employee's affiliation do affect the estimates that are reported here. However, these administrative records are used in the day-to-day management of the state's unemployment compensation program. This results in a high rate of compliance, as is the case in any mandatory reporting situation that involves recurring and unpredictable accessing of the records for eligibility and payment determination purposes. Late reporting occurs, because of the quarterly timing of required submission. This does not affect the archival records because they are routinely updated to reflect such cases.

### *(b) Construction of Dataset*

We are primarily interested in this paper in looking at employment spells which exist for at least a quarter. We therefore define people as being employed for a full quarter by making quarter-to-quarter matches of employer/employee pairs for three consecutive quarters. We assume that a worker who shows up as working for the same employer for three consecutive quarters is employed for the entire middle quarter. We define hires as people who were not with the establishment in the preceding quarter (in the above definition) but who were there in the current quarter and exits analogously (this requires five quarters of data). The coding error rate of social security numbers is .003% which will result in incorrect identification of hires and exits in a commensurate number of cases.

We only include establishments which are alive for more than 10 quarters, since we are primarily interested in describing employment dynamics, and want to exploit the longitudinal nature of the database. In addition, the focus on rates led us to restrict the sample further to establishments which average more than 20 employees during their existence; this reduces the volatility in the variables of interest which are an artefact of a small denominator. Finally, we eliminated the observation of the quarter of birth and death from the sample.

These restrictions on the sample mean that we are focussing on the employment dynamics of established establishments which are medium sized and above. The employment described is employment which has lasted at least a quarter: we are not addressing any very short-term churning issues. We plan to extend the research by relaxing each and all of these restrictions in later work.

*(c) Representativeness*

Appendix Table 1 compares the industrial distribution of employment in Maryland to the nation's industry mix of employment in 1990 and as projected by the Bureau of Labor Statistics for the Year 2005. Maryland's employment mix is more like that projected for the turn of the Century, which makes the analysis reported here of particular interest from a policy importance and replication standpoint. In particular, it is evident that the move from manufacturing to nonmanufacturing, which has been so marked in the 1980's, is projected to continue into the next century. This would suggest that studies which focus only on the manufacturing sector will be of less interest to policy makers than studies which provide data on every sector of the economy.

Appendix Table 1: Employment by Sector

|                                   | US(1990) | US(2005) | Maryland |
|-----------------------------------|----------|----------|----------|
| Agriculture, Mining, Construction | 8.1 %    | 7.2%     | 9.9%     |
| Manufacturing                     | 16.9 %   | 13.6%    | 10.4%    |
| Transportation, Communication     | 5.2 %    | 4.9%     | 5.7%     |
| Wholesale, Retail Trade           | 22.3 %   | 23.6%    | 27.5%    |
| Finance, Insurance, Real Estate   | 6.0 %    | 6.0%     | 6.5%     |
| Services                          | 24.5 %   | 28.8%    | 33.1%    |
| Government                        | 16.3 %   | 15.9%    | 6.9%     |

Source: Monthly Labor Review, November, 1991 (moderate); Authors' Tabulations

Table 1: Manufacturing: Basic Facts

|                                | WFR           | JRR           | CFR           | CFR/WFR       |
|--------------------------------|---------------|---------------|---------------|---------------|
| ALL                            | 0.240         | 0.130         | 0.110         | 0.629         |
| $N \leq 50$                    | 0.289         | 0.146         | 0.144         | 0.594         |
| $50 < N \leq 100$              | 0.269         | 0.138         | 0.131         | 0.697         |
| $100 < N \leq 500$             | 0.232         | 0.112         | 0.119         | 0.725         |
| $500 < N \leq 1000$            | 0.199         | 0.095         | 0.104         | 0.637         |
| $1000 < N$                     | 0.160         | 0.093         | 0.067         | 0.494         |
| age $\leq 5$ years             | 0.250         | 0.126         | 0.124         | 0.711         |
| $5 < \text{age} \leq 12$       | 0.254         | 0.118         | 0.136         | 0.721         |
| $12 < \text{age} \leq 25$      | 0.221         | 0.114         | 0.106         | 0.663         |
| $25 < \text{age}$              | 0.207         | 0.103         | 0.104         | 0.572         |
| Range among 2 digit industries | 0.329 - 0.110 | 0.182 - 0.067 | 0.165 - 0.043 | 0.687 - 0.482 |

Table 2: NonManufacturing: Basic Facts

|                                | WFR         | JRR         | CFR         | CFR/WFR     |
|--------------------------------|-------------|-------------|-------------|-------------|
| ALL                            | 0.273       | 0.078       | 0.194       | 0.665       |
| EMP $\leq 50$                  | 0.349       | 0.109       | 0.240       | 0.645       |
| $50 < \text{EMP} < 100$        | 0.340       | 0.097       | 0.238       | 0.710       |
| $100 < \text{EMP} < 500$       | 0.315       | 0.083       | 0.232       | 0.736       |
| $500 < \text{EMP} < 1000$      | 0.264       | 0.069       | 0.195       | 0.758       |
| EMP $> 1000$                   | 0.169       | 0.047       | 0.122       | 0.743       |
| age $\leq 5$ years             | 0.369       | 0.106       | 0.263       | 0.673       |
| $5 < \text{age} < 12$ years    | 0.223       | 0.067       | 0.156       | 0.660       |
| $12 < \text{age} < 25$ years   | 0.274       | 0.071       | 0.203       | 0.670       |
| $25 < \text{age}$              | 0.212       | 0.063       | 0.149       | 0.663       |
| Range among 2 digit industries | 0.054-0.588 | 0.015-0.295 | 0.035-0.449 | 0.338-0.811 |

Notes: Quarterly Rates. The first three columns are calculated by summing the numerator variable and summing the denominator variable and taking the ratio. This is equivalent to an employment-weighted

average, provided the base for the weights is specified as in the text. An establishment's age and size are defined at the first date in the sample. The final column takes the employment weighted average of the ratio (CFR/WFR) over all observations.

Table 3: Cyclicalty of the Aggregate Flows

|                   | JRR         | CFR          | JRR          | CFR          |
|-------------------|-------------|--------------|--------------|--------------|
| Unemployment Rate | 0.013 (2.1) | -0.022 (8.5) | 0.009 (1.2)  | -0.020 (6.1) |
| Interest Rate     | -           | -            | -0.007 (0.8) | 0.004 (1.1)  |

Notes: All regressions have 32 observations, and also include a constant and seasonal dummies. t statistics in parentheses. The unemployment rate is the Maryland unemployment rate, and the interest rate is a Treasury Bill rate.

Table 4: Aggregate, Industry and Idiosyncratic Components

|                     | JRR   |      | WFR   |      | JFR   |      | CFR   |      |
|---------------------|-------|------|-------|------|-------|------|-------|------|
|                     | N'Man | Man  | N'Man | Man  | N'Man | Man  | N'Man | Man  |
| ESTABLISHMENT       | 0.21  | 0.17 | 0.56  | 0.35 | 0.04  | 0.05 | 0.57  | 0.37 |
| IND                 | 0.22  | 0.17 | 0.56  | 0.35 | 0.06  | 0.06 | 0.57  | 0.37 |
| ESTABLISHMENT, TIME | 0.23  | 0.21 | 0.59  | 0.40 | 0.07  | 0.09 | 0.60  | 0.41 |
| IND, TIME           | 0.24  | 0.21 | 0.59  | 0.40 | 0.08  | 0.09 | 0.60  | 0.41 |
| TIME                | 0.02  | 0.04 | 0.04  | 0.05 | 0.03  | 0.03 | 0.03  | 0.04 |

Note: These are the  $R^2$ 's from regressing the variable at the head of the column on the dummies indicated in the left hand column, where TIME means aggregate time dummies, IND means 3-digit industry dummies and ESTABLISHMENT means a set of (fixed effect) establishment dummies. The regressions are done separately for manufacturing and non-manufacturing.

Table 5: Idiosyncratic Churning and Wages

Dependent Variable is ICFR(t):

|       | 1987:3        |               | 1990.3        |               | 1993.3        |
|-------|---------------|---------------|---------------|---------------|---------------|
|       | Contemp.      | Lagged 1      | Contemp.      | Lagged 1      | Contemp.      |
| IWAGE | -0.202 (11.1) | -0.180 (13.4) | -0.097 (16.1) | -0.086 (14.9) | -0.109 (20.4) |
| Size* | 0.082 (0.6)   | 0.120 (1.3)   | 0.050 (1.1)   | 0.055 (1.3)   | 0.043 (1.1)   |
| Obs   | 18511         | 18498         | 18580         | 18556         | 17147         |
| $R^2$ | 0.01          | 0.01          | 0.01          | 0.01          | 0.02          |

Notes: Contemp means ICFR(t) is regressed on IWAGE(t); Lagged 1 means ICFR(t) is regressed on

$IWAGE(t-1)$ . \* Size/10000. ICFR and IWAGE are idiosyncratic churning flows and wages, as defined in the text. Note that we do not have data for 1993:4.

Table 6: Long Run Elasticities from VARs

A. Manufacturing

| Dep. Var.:     | jfr    |        | cfr    |        |
|----------------|--------|--------|--------|--------|
|                | (1)    | (2)    | (1)    | (2)    |
| Lower Quartile | - 0.56 | - 0.57 | - 0.21 | - 0.44 |
| Median         | - 0.10 | - 0.05 | 0.14   | 0.22   |
| Upper Quartile | 0.23   | 0.30   | 0.62   | 0.62   |

Notes: (1) The numbers are the long run elasticities as defined in the text for the effect on the dependent variable of the other variable. These are calculated for each establishment, and the numbers reported are the quartiles from that distribution of elasticities.  
(2) VAR with 4 lags  
(3) VAR with 4 lags and allowing for AR(1) error process

B. Non-Manufacturing

| Dep. Var.:     | jfr    |        | cfr    |        |
|----------------|--------|--------|--------|--------|
|                | (1)    | (2)    | (1)    | (2)    |
| Lower Quartile | - 0.71 | - 0.74 | - 0.27 | - 0.43 |
| Median         | - 0.16 | - 0.14 | 0.22   | 0.19   |
| Upper Quartile | 0.30   | 0.34   | 0.60   | 0.62   |

Notes: (1) The numbers are the long run elasticities as defined in the text for the effect on the dependent variable of the other variable. These are calculated for each establishment, and the numbers reported are the quartiles from that distribution of elasticities.  
(2) VAR with 4 lags  
(3) VAR with 4 lags and allowing for AR(1) error process

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