Abstract
The paper will cover experiences from the Job Churn Explorer project at CSO with a particular focus on a sectoral flow analysis of job separations - where do those leaving jobs get re-employed. The project adapts and develops the underlying methodology outlined to date to the situation in Ireland to provide a detailed insight into the dynamics of job churn and its components as Ireland entered the current recessionary period.

The analysis datasets used are derived from linking the following three sources

- Business register
- Employer tax returns
- Social Protection records

The comprehensiveness of the resulting analysis dataset, containing attributes on both workers and enterprises, provides for significant new opportunities to inform policy and decision making with respect to the labour market.

While the data integration employed for this project is simple and straightforward, there are significant opportunities with these datasets through record linkage and data integration techniques with other sources such as the Labour Force Surveys (person based surveys) and other business registers/surveys (business based attributes).

It should be noted also that the resulting analysis datasets from this project also provide a key link between business and social statistics.
Introduction and Background

- **Demand from users**

Ireland has, in recent times, experienced an unprecedented period of sustained growth followed by a sharp downturn at the end of 2007. This sharp downturn has had a significant effect on employment in Ireland with the unemployment rate rising from 4.6% in Q3 2007 to 13.9% in Q3 2010. GDP at constant market prices fell nearly 12% from just over €186bn in 2007 to just under €165bn in 2010.

Jobs and any insights that can be obtained about the labour market that can inform decisions is, therefore, of significant value to government, business, workers and work seekers (Fox, 2009).

In particular, survey vehicles such as Labour Force Surveys are limited in their ability to track the flow of workers between jobs.

The work presented in this paper is informed by that in international literature and builds on the increasing relationship between CSO and Government organisations with respect to exploiting administrative data for statistical purposes. In particular, this work allows for significant insights into job churn and its components in the Irish jobs markets, in other words the work provides information about those leaving, staying or taking new jobs and the firms in which these jobs are located.

- **Strategic context**

In developing the Irish Statistical System, significant emphasis is put on exploiting the untapped statistical potential of administrative records. This project serves to demonstrate this potential by delivering an example. Furthermore, the work done in this project also provides for a key linkage between business and social statistics through linking persons with businesses through an employment relationship.

**Summary review of literature**

There is a significant amount of literature available with respect to investigation of job churn and its respective components. Significant challenges are presented in much of the literature with respect to bringing the firm based components, job creation (JC) and job destruction (JD) together with the person based components,hirings (H) and separations (S) as typically they are derived from different sources. However, with the increasing recognition of the value of administrative data for statistical purposes, the use of employer-employee returns to tax authorities is of high value due to the ‘single source’ nature of the data when calculating and comparing the various components. Work has been identified in the US (Burgess, Lane, & Stevens, 2000), Finland (Ilmakunnas & Maliranta, 2001), Germany (Guertzgen, 2007) and Norway (Li, 2010) where employer-employee linked data sources has been able to facilitate a more comprehensive and in-depth insights into both job and worker components of job churn and how they interact with each other. The

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1 Chain linked and referenced to year 2008
potential of such linked datasets is significant for obtaining insights into the movements of jobs and workers. These insights are of particular value to evaluating and informing policy analysts with respect to market dynamics for both jobs and workers.

Bassanini et al (2009) brings together from key papers and presents the underlying theory (including calculations and how they are derived) with respect to job churn in a clear manner with a view to bringing together results from many different studies and countries to undertake cross-country comparisons. The theory as presented has formed the basis of how the author has developed and calculated the various job churn components in this work.

Definitions and Methodology

The definitions and methodology used are adapted from those in (Bassanini & Marianna, 2009) to take account of methodology used in Eurostat-OECD Manual on Business Demography Statistics and shortcomings in the available data sources. The available data source does not have point in time measurements. Business Demography Statistics manual uses a methodology where year t is compared with year t-1.

The business unit of observation is that of an enterprise as defined in statistical legislation. Where administrative units have not been properly profiled into statistical units a one to one correspondence is assumed.

The primary variables for analysis at the business unit level are obtained by comparing data between two periods (calendar years) such that the following identity holds for each business unit

\[ \Delta E_{t+} = JC_{t+} - JD_{t+} = H_{t+} - S_{t+} \]

where E, JC, JD, H and S represent employment, job creation, job destruction, hirings and separations and \( \Delta \) for differences between period t-1 and t.

Employment for the business unit in period t is estimated as the number of valid employment records with non zero reckonable pay\(^2\) for that business unit in the period. This estimate does not factor in duration of employment or whether an employment is part-time or full-time in nature.

Job creation is measured as the difference in the number of employment records with non zero reckonable pay between two periods, t and t-1, if that difference is positive, zero otherwise and is assigned to period t.

Conversely, job destruction is measured as the difference in the number of employment records with non zero reckonable pay between two periods if that difference is negative, zero otherwise and is assigned to period t. In order for the identity to hold the jobs destructed figures are assigned to period t even though technically the jobs were lost in period t-1.

Hirings for the business unit are calculated as the number of employment records assigned to an individual in period t for which a corresponding employment record for that individual did not exist in period t-1 with respect to the business unit.

Conversely, separations for the business unit are calculated as the number of employment records assigned to an individual in period t-1 for which a corresponding employment record for that individual did not exist in period t.

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\(^2\)The primary difference between reckonable pay and gross pay is that reckonable pay excludes any payments to a pension schemes or permanent health insurance schemes recognised by the Irish Tax Authorities.
period t with respect to the business unit. Again, while technically the separations occur sometime in period t-1, for the identity to hold the estimated separations figure is assigned to period t.

Job stayers (JS) for the business unit are calculated as the number of employment records assigned to an individual in period t-1 for which a corresponding employment record exists for that individual in period t.

Job destruction figures for a group of business units is obtained by summing the figures for the business units in that group (i.e., for a group of business units classified to a specific sector). Job creation, hirings, job stayers and separations for a group of business units are also obtained in the same way.

Total job reallocation (REALJ) refers to the sum of job creation (JC) and job destruction (JD) for a group of business units. Excess job reallocation (EXCJ) for a group of business units is defined as the difference between total job reallocation (REALJ) and the absolute net change in total employment (|JC - JD|), for group j at period t.

\[ E\text{X}\text{C}\text{J}_{jt} = R\text{E}\text{A}\text{LJ}_{jt} - |AE_{jt}| = JC_{jt} + JD_{jt} - |JC_{jt} - JD_{jt}| \]

Excess job reallocation provides a measure of the offsetting job creation and job destruction within a group of firms.

When aggregating over a group of business units with similar characteristics, generally speaking, job creation (JC) can be considered as the sum of employment growth from all expanding and new firms, while job destruction (JD) can be considered as the number of jobs lost from contracting or exiting firms. It should be noted that expanding and contracting business units are assigned these attributes based on volume or number of weeks work paid – therefore it is possible for contracting firms to have job creation and expanding firms to have job destruction (i.e., two employees each with 16 recorded weeks paid compared with one employee with 52 recorded weeks paid).

Worker reallocations are dealt with in a similar manner. Total worker reallocation (REALW) by summing hirings (H) and separations (S) over all members of a specified group, the group can be defined either by a group of firms or on a particular demographic characteristics (age, gender etc). Excess worker reallocation (EXCW) for a group is defined as the difference between total worker reallocation (REALW) and the group’s absolute net change in employment (|H - S|). So for group j at period t,

\[ E\text{X}\text{C}\text{W}_{jt} = R\text{E}\text{A}\text{LW}_{jt} - |AE_{jt}| = H_{jt} + S_{jt} - |H_{jt} - S_{jt}| \]

Excess worker reallocation provides a useful measure of the number of job matches over and above the minimum necessary to accommodate net employment growth; in other words, it reflects the reallocation of job matches (reshuffling of jobs and workers) within the same group (Bassanini & Marianna, 2009).

At the business unit level, churning flows (CH) is the difference between excess worker reallocation and excess job reallocation. Churning flows represent labour reallocation arising from firms churning workers through continuing jobs or employees quitting and being replaced on those jobs. So for group j in period t

\[ C\text{H}_{jt} = E\text{X}\text{C}\text{W}_{jt} - E\text{X}\text{C}\text{J}_{jt} = R\text{E}\text{A}\text{LW}_{jt} - R\text{E}\text{A}\text{LJ}_{jt} = H_{jt} + S_{jt} - JC_{jt} - JD_{jt} \]

All flow measures from period t-1 to period t are expressed as rates by dividing flow totals by relevant average employment figures in period t-1 and period t.

In adhering to recommendations in the literature, an average of the number of employments at year t and t-1 is used as the denominator in the calculation of rates with respect to reference period t.
Data sources
The datasets used in this analysis come from merging three separate sources as follows

- P35L data source from the Revenue Commissioners on employment records
- CRS Client Record System from the Department of Social Protection related to Personal Public Service Numbers (PPSN)
- CBR Central Business Register at CSO

The P35L is the primary source of data and contains a record for each registered employment i.e., employer/employee relationship, in the given year. The dataset contains an Employer Registration Number (PREM number) that facilitates merging with the CBR to assign business based attributes and also contains the Personal Public Service Number and CRS to assign person based attributes. The P35L file also contains some records relating to Pension payments and these are excluded from the analysis. The P35L also contains information on number of weeks paid and reckonable pay (for tax purposes) for each employment record which can be used as indicators of job volume and value (and can be combined to give mean reckonable pay or an indicator of job quality). The P35L also contains the PPSN or person based public service identifier\(^3\). While this source can in general be considered exhaustive there are a small number of quality issues with respect to statistical purposes worth noting. In particular, the personal identifier when validated showed that for a small number of records (< 5%) an invalid number was recorded. However no significant pattern was identified to these invalid records. An interim decision was taken to work solely with records where the person number is identified to keep the methodology as simple as possible.

The CBR is the Business Register of enterprises maintained by CSO to support the compilation of statistics on business as laid down in EU statistical legislation. The business register became fully aligned to administrative data sources for reference year 2007. In general there is a one to one relationship between the enterprise as defined by the CBR ID and the employer registration number. However in a small number of cases an enterprise group may pass all of its employment through a single PREM number attached to a single enterprise. Another type of exception occurs where an enterprise can comprise of a number of legal units and hence have multiple PREM numbers. The CBR also does not have comprehensive coverage of all employment sectors. These difficulties arise due to the lack of a Unique Business Identifier across all public administration systems and also the lack of a standard methodology to profile enterprises in the Public Sector.

The CRS is a master register of all PPSNs assigned and contains information collected at registration on date of birth, sex and nationality as declared by the applicant. Nationality has only been collected since 2002. Any PPSNs assigned prior to this period are assumed a nationality of Irish for the purposes of creating the analysis datasets. This is done on the basis that prior to 2002 Ireland did not have the same influx of foreign nationals as it did after the enlargement of the EU to EU25. The PPSN came into being in 1998 and replaced the old RSI number used for tax and social welfare purposes. The purpose of the PPSN is to uniquely identify persons/customers when engaging or transacting with the state and is assigned when a person first interacts with the State. For those born in Ireland the PPSN is assigned shortly after birth (and is required to avail of child benefit). It is acknowledged that there are some quality issues with respect to PPSNs inherited from the old RSI number such as duplicate numbers, persons being assigned more than one RSI number or an identical RSI number (with a suffix of M or F) for husband and wife. However for statistical purposes these quality issues are not considered significant.

\(^3\) In line with its data protocols, CSO replaces the official PPSN on analysis based datasets with a proxy for PPSN called the CSOPPSN. It is this proxy that is used to link person based data.
Two units of observation are available in the data for businesses, the first the Employer unit refers to the unique registration number of each employer while the second refers to the statistical definition of an enterprise in EU statistical legislation as applied in Ireland. The project uses the latter.

In summary, the CBR contributes the legal form and activity breakdown (NACE 1 and 2) attributes on the enterprise while the CRS contributes DOB, nationality and sex attributes on the person. This paper works with NACE Rev 2.

The P35 data source is available for reference years 2005 onwards. The CRS provides sufficient information on persons in the P35 files for reference year 2005 onwards.
Investigating worker flows between sectors

- Sectoral flow of workers in context – job churn

Looking at volume of work by sector (figure on top left), the largest and second largest sectors are the Wholesale and retail trade sector (G) and Manufacturing sector (C). The drop in employment since 2007 in the Construction sector (F) is also very apparent falling from approx 175,000 person years in 2007 to under 100,000 person years in 2009. For other significant sectors lesser declines in volume of employment are observed, commencing in 2007 for Manufacturing sector (C) and in 2008 for the Wholesale and retail trade sector (G) and the Accommodation and food sector (I). The figure at top right presents the absolute job churn figures or the movement of workers between firms above and beyond that required to satisfy the movement of jobs (job creation and job destruction) while the near left figure presents the job churn figures standardised as rates. The largest sector in terms of volume of work, Wholesale and retail trade (G) is also the sector providing the largest number of opportunities with respect to the movement of workers. The Accommodation and food
sector (I) provides more opportunities for job movers seekers than those in Manufacturing (C) despite being a significantly smaller sector in terms of volume of work. In fact when at churn rates, Accommodation and Food (I) has a significantly higher rate than all other sectors with the Wholesale and retail trade (G) having the second highest churn rate. The sectoral analysis of churn rates is further evidence to the assumption that job churn is pro-cyclical with decreases in the job churn rate evident in all sectors.

- **Sectoral flow of workers in context – re-employability of separations**

  Table 1 Analysis of separations\(^4\) by year and whether a new employment record was found

<table>
<thead>
<tr>
<th>Primary separations</th>
<th>No New employment</th>
<th>All</th>
<th>New employment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number %</td>
<td>Number %</td>
<td>Number %</td>
</tr>
<tr>
<td><strong>Business economy excluding activities of holding companies (B to N,-642)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>156,572 32</td>
<td>483,788 100</td>
<td>327,216 68</td>
</tr>
<tr>
<td>2007</td>
<td>163,820 31</td>
<td>532,238 100</td>
<td>368,418 69</td>
</tr>
<tr>
<td>2008</td>
<td>205,006 35</td>
<td>586,201 100</td>
<td>381,195 65</td>
</tr>
<tr>
<td>2009</td>
<td>281,253 47</td>
<td>600,740 100</td>
<td>319,487 53</td>
</tr>
<tr>
<td><strong>Business economy services excluding activities of holding companies (G to N,-642)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>113,296 31</td>
<td>362,803 100</td>
<td>249,507 69</td>
</tr>
<tr>
<td>2007</td>
<td>112,657 29</td>
<td>395,016 100</td>
<td>282,359 71</td>
</tr>
<tr>
<td>2008</td>
<td>137,166 32</td>
<td>431,906 100</td>
<td>294,740 68</td>
</tr>
<tr>
<td>2009</td>
<td>187,274 43</td>
<td>438,509 100</td>
<td>251,235 57</td>
</tr>
<tr>
<td><strong>Industry (B to E)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>19,053 36</td>
<td>52,830 100</td>
<td>33,777 64</td>
</tr>
<tr>
<td>2007</td>
<td>22,152 38</td>
<td>57,998 100</td>
<td>35,846 62</td>
</tr>
<tr>
<td>2008</td>
<td>24,416 41</td>
<td>59,436 100</td>
<td>35,020 59</td>
</tr>
<tr>
<td>2009</td>
<td>35,027 51</td>
<td>68,436 100</td>
<td>33,409 49</td>
</tr>
<tr>
<td><strong>Construction (F)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>24,223 36</td>
<td>68,155 100</td>
<td>43,932 64</td>
</tr>
<tr>
<td>2007</td>
<td>29,011 37</td>
<td>79,224 100</td>
<td>50,213 63</td>
</tr>
<tr>
<td>2008</td>
<td>43,424 46</td>
<td>94,859 100</td>
<td>51,435 54</td>
</tr>
<tr>
<td>2009</td>
<td>58,952 63</td>
<td>93,795 100</td>
<td>34,843 37</td>
</tr>
</tbody>
</table>

When looking at the reference year 2006 in table 1 above, of the 484,000 separations in the business economy for the previous year, 68% or 327,000 were identified as being employed in some sector whether in the business economy (B to N, - 642)\(^5\) or not. For 2009, this ‘re-employability’ figure of 68% had fallen to 53%. The drop in re-employability however is significantly greater for those in the Construction sector (F) compared to other sectors with the re-employability figure falling from 64% in 2006 to 37% in 2009.

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\(^4\) Note where a person is identified as having more than one separation, only the separation with the highest number of weeks paid is counted.

\(^5\) Note sectors A and O through U are excluded from the business economy analysis in this paper. The classification used is based on published Business Demography data for CSO, Ireland.
- Sectoral flow of separating workers

Table 2 Sectoral flow of separations in business economy finding re-employment

<table>
<thead>
<tr>
<th>Sector</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing (C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business economy excluding activities of holding companies (B to N,-642)</td>
<td>277,696</td>
<td>315,185</td>
<td>325,051</td>
<td>270,112</td>
</tr>
<tr>
<td>Number</td>
<td>26,175</td>
<td>28,565</td>
<td>28,114</td>
<td>25,792</td>
</tr>
<tr>
<td>%</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Sector G</td>
<td>66,045</td>
<td>74,205</td>
<td>80,333</td>
<td>78,360</td>
</tr>
<tr>
<td>Number</td>
<td>40,110</td>
<td>44,253</td>
<td>48,046</td>
<td>43,788</td>
</tr>
<tr>
<td>%</td>
<td>14</td>
<td>14</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Sector I</td>
<td>34,996</td>
<td>41,540</td>
<td>47,163</td>
<td>37,207</td>
</tr>
<tr>
<td>Number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>%</td>
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</tr>
</tbody>
</table>

The exception is the change sectors increases from 44% to 54% in the Accommodation and Food Sector (I), 29% to 40% in Manufacturing (C) and 45% to 58% in the Wholesale and retail trade sector (G). The exception is the
Construction sector which shows a decrease from 61% to 44% of workers finding re-employment in the same sector over the period 2006 to 2009. As the re-employability of Construction workers in the construction sector fell in 2008 and 2009 there was an increase in the proportionate flow of workers from the Construction sector into the Retail and Wholesale sector (G) up to 12% in 2009 from 8% in 2006, the Accommodation and food sector (I) up to 7% in 2009 from 3% in 2006 and the Administration and other activities sector (N) up to 14% in 2009 from 10% in 2006. In general the Wholesale and retail trade sector (G) is identified as the biggest recipient sector of cross sector flow of workers from other sectors. This is followed by Accommodation and food sector (I). The biggest cross sector flows happen between these two sectors, (G) and (I), with between 20% and 23% of re-employed workers from the Accommodation and food sector (I) finding re-employment in the Wholesale and retail trade sector (G) in any year and a reciprocal percentage flow of between 10% and 11% over the period 2006 and 2009. These are the two largest sectors in terms of job churn identified earlier.

Note the difference in the total number of primary separations in the business economy finding re-employment (eg Year 2006 = 327,216) in table 1 and the number of primary separations in the business economy finding re-employment (Eg year 2006 = 277,696) in table 2 is explained by those separations that find employment outside the business economy (i.e., in sectors A and O through U) when considering those separations that find re-employment. 

**Concluding remarks**

This paper has presented summary statistics from the Job Churn project at CSO with a particular focus on those leaving jobs and on whether and where they go back into employment. Detailed statistical information from this project is available through CSO online databases at [http://www.cso.ie/px](http://www.cso.ie/px) in order to facilitate further exploration by researchers and policy analysts. This detail includes

- An economic activity breakdown (150 codes) as per Business Demography system across all datasets
- Job churn components described in this paper for each economic activity code and employment size class
- Age, sex and economic activity breakdown for Hirings, Separations and Job Stayers (measures also include Employment records, Value of reckonable pay, Volume of Work)
- Separations analysis (as per table 1) by economic activity, whether re-employed or not (measures also include mean weekly reckonable pay from separating employment)
- Sectoral flow analysis (as per table 2) of those separations finding re-employment categorised by whether mean weekly reckonable pay increased or not.

Potential uses of this information include (but are not constrained to)

- Informing on the demographic structure of employees by sector
- Providing input to labour costs analysis
- Providing information on gender pay gaps
- Identification of sectors providing job opportunities (quality of those jobs in terms of pay)
- Contributing to longer term evaluation of jobs policy
Further enhancements of the information provided in the online database could include

- Geographical flow of workers through looking at county/location of employer
- Breakdown of analysis into contracting and expanding firms
- Analysis by Country of Ultimate Controlling Interest (UCI) – foreign ownership
- Investigation of exporting enterprises

The work undertaken in this project is an illustration of the untapped potential hidden in administrative data systems across Public Authorities. The project also demonstrates the considerable added statistical value that is available through the linking of such data sources.

The project to date has not explored the further potential value that can be derived through the use of record linkage and integration techniques to combine survey data with the linked employer employee datasets created as part of this project. However the project team recognise that there are significant opportunities through the deployment of such techniques and methodologies.

**Bibliography**


