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Abstract

In Canada, temporary workers account for 14 per cent of jobs in the non-farm business sector, are present in a range of industries, and account for 40 per cent of the total job reallocation. Yet most models of job reallocation abstract from temporary workers. This paper evaluates the importance of temporary workers in job reallocation in a multi-sector model with costly labour adjustment and temporary workers. The calibrated model captures some features of job reallocation in Canada. The paper shows that the adjustment cost parameters for permanent workers are underestimated if temporary workers are ignored. It also shows that when a shock occurs where permanent workers bear the brunt of reallocation (e.g. the 2005-2008 commodity price boom and the appreciation of the Canadian dollar), aggregate adjustment costs are underestimated if temporary workers are not accounted for.

*JEL classification: D24, J32*
*Bank classification: Labour markets; Productivity*

Résumé

Au Canada, les travailleurs temporaires occupent 14 % des emplois dans le secteur des entreprises non agricoles, sont présents dans plusieurs branches d'activité et constituent 40 % des effectifs touchés par les redistributions d'emplois. Malgré cela, ils sont absents de la plupart des modèles utilisés pour formaliser la redistribution des emplois. Les auteurs évaluent l'importance de ces travailleurs dans le phénomène à partir d'un modèle multisectoriel comportant des coûts d'ajustement élevés du travail et une main-d'œuvre temporaire. Ce modèle étalonné reproduit certaines des caractéristiques de la redistribution des emplois observées au Canada. Comme le montrent les auteurs, faire abstraction des travailleurs temporaires amène à sous-estimer les paramètres des coûts d'ajustement calculés pour les travailleurs permanents. Les auteurs montrent également que lorsque les travailleurs permanents font les frais de la redistribution des emplois après un choc (envolée des prix des matières premières entre 2005 et 2008, appréciation du dollar canadien, etc.), les coûts globaux d'ajustement sont sous-estimés si la main-d'œuvre temporaire n'est pas prise en compte.

*Classification JEL : D24, J32*
*Classification de la Banque : Marchés du travail; Productivité*

## 1. INTRODUCTION

Studies have shown that labour adjustment costs play important roles in dynamic factor demands.[1] Labour adjustment costs at the firm-level also figure prominently in a number of economic models used for policy evaluation.[2] This paper examines the role of temporary employment in labour adjustment in Canada. It uses a Canadian matched employee-employer data set to document the amount of job reallocation due to temporary workers, the characteristics of workplaces that uses temporary workers, the change in the intensity of use of temporary workers as the workplace grows, and the patterns of adjustment of temporary and permanent workers at the establishment level. It then introduces a multi-sector, general equilibrium model with costly labour adjustment and temporary workers to help explain how and why temporary employment is used. The calibrated model is able to capture many of the features of the Canadian data documented in the paper.

In contrast to permanent employees who have an indefinite contractual relationship, that is protected by employment protection legislation, with their employers, workers on temporary fixed-term contracts can be removed from payrolls inexpensively when their contracts are completed. Differences in severance costs are not the only thing that distinguishes permanent workers from temporary ones. Since fixed-term employees are usually hired for their portable skills and because of their tenure with the firm is expected to be short, firms are less likely to provide training to fixed-term employees.[3] These training costs can be viewed as an adjustment cost because some of this training might include a firm-specific aspect that is necessary for new employees to learn before they become fully functional at their particular firm.

The case in Canada is interesting because of the importance of temporary workers (employees with a fixed termination date - contract employees, casual and seasonal workers, workers from temporary work agencies) has been increasing over time, from 6.9 per cent of paid employees in 1989 to 14.9 per cent in 2006. Furthermore, the in-

[1]See for example, Hamermesh (1989), Caballero, Engel, and Haltiwanger (1997), Cooper, Haltiwanger, and Willis (2004) and Varejão and Portugal (2007).

[2]See for example, Hopenhayn and Rogerson (1993), Alonso-Borrego, Fernandez-Villaverde, and Galdon-Sanchez (2006) and Tapp (2007).

[3]See http://human-resources-management.suite101.com/article.cfm/employees_contract_vs_temporary and J. Turcotte and Montmarquette (2002).

corporation of fixed-term employment is also interesting because temporary workers account for a large fraction of job reallocation. It is shown in this paper that the share of job reallocation accounted for by temporary jobs is more than three time their share in employment in Canada. This suggests that an analysis that does not distinguish between permanent and temporary workers will tend to underestimate the importance of adjustment costs when a shock that necessitates the reallocation of permanent workers occurs.

An example of a shock in which permanent workers would arguably bear the brunt of the labour reallocation is the commodity price boom and the associated appreciation of the Canadian dollar in the 2005-2008 period. This shock is approximated in the model by increasing the dispersion in sectoral shocks. To ascertain the importance of incorporating fixed-term employment, the change in the aggregate adjustment costs to such a change in a model with fixed-term employment can then be compared to the response in a model without such contracts.

This is not the first paper to incorporate temporary employment in the labour adjustment cost literature. Previous studies focused on the impact of eliminating temporary contracts on unemployment, output, productivity and welfare in Europe. Alonso-Borrego, Fernandez-Villaverde, and Galdon-Sanchez (2006) incorporate temporary contracts into a general equilibrium model with labour adjustment cost and heterogeneous firms. Aguirregabiria and Alonso-Borrego (2009) estimate a structural model of dynamic labour demand (including temporary work) at the firm level. Cabrales and Hopenhayn (1997) examine the response of employment to an aggregate productivity shock, but in a partial equilibrium model with temporary workers. Our model studies the firm's employment decisions in Canada, where labour employment protection law is less stringent than in European countries.

There are not many papers studying the costs of labour adjustment in Canada. Amano (1995) estimates the adjustment cost parameters in a structural model with the Euler equation. He finds that significant adjustment costs are an important feature of Canadian labour demand. Tapp (2007) examines the impact of labour adjustment costs in Canada following a large sectoral shock (the recent commodity price boom) in a general equilibrium framework, but does not take into account temporary workers.

This paper finds that ignoring temporary workers leads to estimates of adjustment costs parameters for permanent workers that are much lower than when temporary workers are taken into account. Mimicking the impact of a large sectoral shock by increasing the dispersion of the sectoral shock in the model economies, it is found that while job reallocation rises in the model with temporary workers and in the model without temporary workers, aggregate adjustment costs as a fraction of total output only rises significantly in the model with temporary workers. The main reason for this difference is that the model with temporary workers allows permanent workers to account for a higher fraction of job reallocation when there is an increase in the dispersion of sectoral shocks.

Furthermore, we find that an increase in the volatility of firm-level growth rates is a good candidate to explain the increase in the temporary employment rate in Canada. This result, however, depends greatly on the nature of the increase in dispersion. While more persistent shocks encourage the use of permanent workers, an increase in the standard deviation of the error term in the shock process raises uncertainty and the use of temporary workers.

The rest of the paper is organized as follows. Section 2 introduces the Canadian data sources used in this paper, and presents key facts about temporary workers in Canada. Section 3 presents the model and section 4 describes the equilibrium. The calibration of the model is discussed in section 5 and the results are presented in section 6.

## 2. JOB REALLOCATION IN CANADA

### 2.1. *Data and Definitions*

The data used to calculate job creation and destruction in this paper comes from the employer section of Statistics Canada's Workplace Employee Survey (WES).[4] It is an annual, longitudinal, matched employer-employee survey at the establishment level. Currently, data from 1999-2005 is available for use. The target population for the employer component is all establishments in Canada that have paid employees in March, with the exception of employers in the territories and employers in crop and animal production, fishing, hunting and trapping, private households, religious

[4]For a comprehensive description of the survey see *Guide to the Analysis of the Workplace and Employee Survey - 2004*, Statistics Canada, Catalogue no. 71-221-GIE.

organizations and public administration. The initial sample of 6322 establishments was drawn from the Business Register (BR) maintained by Statistics Canada in 1999 and has been followed over time. In every odd year after 1999, this initial sample was supplemented with a sample of newborn establishments that were added to the BR since the last supplement.

Information on the number of permanent and temporary workers in each establishment is taken from the employer part of the survey. Employees are also asked their terms of employment, but only a sample of employees are surveyed from each establishment.[5] Although better than the employee-based measure, the employer-based measure is not perfect. Workplaces may differ in who they consider temporary workers. Temporary workers could be employees with a fixed termination date, seasonal workers, casual workers, workers from a temporary employment agency or independent contractors. The effect on the incidence of temporary employment due to the change in the WES employer questionnaire between 2000 and 2001 is evidence of this uncertainty. Between the 2000 and 2001 survey, there is a significant change in both the composition of temporary workers and temporary workers as a fraction of all workers.

To address this uncertainty, data only from 2001 forward is considered and the most encompassing definition of temporary work is used. In the 2001 survey and beyond, establishments are first asked their number of employees in the last pay period of March, where employee is defined as workers who received a T-4 slip (a slip for income tax purposes given to the worker by his employer that denotes employment income, payroll taxes paid, etc.). The establishment is then immediately asked to split the total number of employees into permanent (those who have no set termination date) and non-permanent (those with a set termination date or a specific period of employment.[6] The questionnaire then asks, "During the month of March how many independent contractors (a person providing products or services under contract with the establishment, but do not receive a T-4 from the establishment; workers

[5]Specifically, all employees in establishments with less than four employees are surveyed, while in larger workplaces a sample is selected. A maximum of 24 employees from each workplace are selected.

[6]Establishments are also asked to categorize their employees by full or part time status, by union status, by occupation, and by on or off-site. An examination of job turnover along these lines did not turn up results as striking as the ones between permanent and temporary workers.

from temporary employment agencies would be included here) provided products or services to the establishment." When dealing with data from the WES, both non-permanent and independent contractors are considered as temporary employees.

In this paper, only data from establishments that operated in every year during the 2001-2005 period are used. In other words, the target population is firms that existed in 2001 that survived until 2005. This subset of the data is used mainly because the sample of workplaces is only supplemented every second year and weights in 2002 and 2004 do not take into account the absence of new workplaces in those years. Therefore, the calculation of reallocation rates for all workplaces would not be possible. First, the jobs created by entrants between 2001 and 2002, and 2003 and 2004 are not observed. Second, jobs lost by firms that entered in 2002 and 2004, but exited before they could be interviewed in 2003 and 2005, respectively, would also not be observed. Third, since the weights are not updated in 2002 (2004), the 2002 to 2003 (2004 to 2005) reallocation rate would not be for establishments in 2002 (2004), but for establishments in *2001* (*2003*) that survived until 2003 (2005). There are 6207 workplaces in the 2001 WES sample, and 4146 of those workplaces were still in existence in 2005. This gives a 33.2 per cent cumulative exit rate, or a 9.6 per cent geometric average exit rate.

Job creation and destruction rates presented in this paper follow the standard of Davis and Haltiwanger (1999). A job is created (destroyed) in a workplace, if the net change in employment over the year in that workplace is positive (negative). The job creation (destruction) rate for a workplace is the number of jobs created (destroyed) over the average number of jobs in the workplace in the current and previous year:

$$\begin{aligned} c_{jt} &= \frac{EMP_{jt} - EMP_{jt-1}}{0.5(EMP_{jt} + EMP_{jt-1})} \;\; if \;\; EMP_{jt} - EMP_{jt-1} > 0 \;\; and \;\; 0 \;\; otherwise, \\ d_{jt} &= \frac{|EMP_{jt} - EMP_{jt-1}|}{0.5(EMP_{jt} + EMP_{jt-1})} \;\; if \;\; EMP_{jt} - EMP_{jt-1} < 0 \;\; and \;\; 0 \;\; otherwise, \end{aligned}$$

where $EMP_{jt}$ is number of jobs in workplace $j$ at time $t$, $c_{jt}$ is the workplace's job creation rate, and $d_{jt}$ is the workplace's job destruction rate. As noted by Davis and Haltiwanger (1999), the advantage of using the average of the number of jobs in the denominator is that the creation and destruction rates are bounded by -2 and 2.

Note that although there may be some hiring and separations in the workplace between two periods, as long as the net change in jobs is zero, job creation and destruction will be zero. Therefore, a temporary worker who has his fixed contract renewed every year or a temporary worker who is replaced with another temporary worker after the end of the former worker's contract would not lead to job creation or destruction. Furthermore, since these rates are calculated annually it does not capture the creation and destruction of temporary seasonal worker.

The aggregate job creation and destruction rates are the weighted sum of each workplace's rates where the weights are the workplace's share in total jobs:

$$JC_t = \sum_j \left( \frac{EMP_{jt} + EMP_{jt-1}}{EMP_t + EMP_{t-1}} \right) c_{jt},$$
$$JD_t = \sum_j \left( \frac{EMP_{jt} + EMP_{jt-1}}{EMP_t + EMP_{t-1}} \right) d_{jt}.$$

The creation and destruction of permanent and temporary jobs at the establishment level can be similarly defined:

$$c_{jt}^N = \frac{n_{jt} - n_{jt-1}}{0.5(EMP_{jt} + EMP_{jt-1})} \;\; if \;\; n_{jt} - n_{jt-1} > 0 \;\; and \;\; 0 \;\; otherwise,$$
$$d_{jt}^N = \frac{|n_{jt} - n_{jt-1}|}{0.5(EMP_{jt} + EMP_{jt-1})} \;\; if \;\; n_{jt} - n_{jt-1} < 0 \;\; and \;\; 0 \;\; otherwise,$$
$$c_{jt}^L = \frac{l_{jt} - l_{jt-1}}{0.5(EMP_{jt} + EMP_{jt-1})} \;\; if \;\; l_{jt} - l_{jt-1} > 0 \;\; and \;\; 0 \;\; otherwise,$$
$$d_{jt}^L = \frac{|l_{jt} - l_{jt-1}|}{0.5(EMP_{jt} + EMP_{jt-1})} \;\; if \;\; l_{jt} - l_{jt-1} < 0 \;\; and \;\; 0 \;\; otherwise,$$

where $n$ is the number of permanent jobs, $l$ is the number of temporary jobs, $c_{jt}^N$ and $c_{jt}^L$ are the creation rates of permanent and temporary jobs for workplace $j$ at time $t$, respectively, and $d_{jt}^N$ and $d_{jt}^L$ are the destruction rates of permanent and temporary jobs for workplace $j$ at time $t$, respectively. Note that job creation equals the job creation of permanent workers plus the job creation of temporary workers ($c_{jt} = c_{jt}^N + c_{jt}^L$ and $d_{jt} = d_{jt}^N + d_{jt}^L$) only for workplaces where both permanent and temporary jobs are rising ($n_{jt} - n_{jt-1} \geq 0$ and $l_{jt} - l_{jt-1} \geq 0$ ).

Similarly at the aggregate level, wwe define:

$$
\begin{aligned}
JC_t^N &= \sum_j \left( \frac{EMP_{jt} + EMP_{jt-1}}{EMP_t + EMP_{t-1}} \right) c_{jt}^N, \\
JD_t^N &= \sum_j \left( \frac{EMP_{jt} + EMP_{jt-1}}{EMP_t + EMP_{t-1}} \right) d_{jt}^N, \\
JC_t^L &= \sum_j \left( \frac{EMP_{jt} + EMP_{jt-1}}{EMP_t + EMP_{t-1}} \right) c_{jt}^L, \\
JD_t^L &= \sum_j \left( \frac{EMP_{jt} + EMP_{jt-1}}{EMP_t + EMP_{t-1}} \right) d_{jt}^L.
\end{aligned}
$$

Then, $JC_t < JC_t^N + JC_t^L$ and $JD_t < JD_t^N + JD_t^L$ unless the sample of workplaces is restricted to those where the net change in permanent and temporary positions are of the same sign.

In addition to the WES, this paper also provides some statistics from the General Social Survey. The General Social Survey (GSS) 1985-2006 is an annual survey of social trends in Canada. Trends in work, education, retirement, time use, health, family support, victimization, social networks and use of communications technology are captured in cycles that rotate in and out of the survey at regular intervals. A question asking whether one's current job was permanent or temporary was asked in the Education, Work and Retirement cycles in 1989 and 1994, and in every GSS since 2006. The main reason for looking at the GSS is that it asks temporary workers whether they would prefer a permanent position. This gives some information about whether the existence of temporary employment is due to the need for flexibility among workers or firms. Self-employed independent contractors are not included in the calculation of the temporary employment rate using the GSS.

## 2.2. *Temporary Jobs and Job Turnover in Canada: Evidence from the WES*

Evidence from the WES in Table 1 suggests that temporary jobs affected a non-trivial number of workers and establishments over the 2001-2005 period. Temporary jobs as a percentage of all jobs was 13.5 per cent, the percentage of establishments with temporary jobs was 34.9 per cent and the rate of temporary jobs for establishments with temporary jobs was 33.2 per cent. Temporary jobs exist in each of the three broad industry groupings presented, but they are more concentrated in other goods (forestry, mining, oil and gas, construction, and communication and utilities) [7], less concentrated in manufacturing, and close to average for services.[8] The percentage of jobs that are temporary is high in other goods because a large fraction of establishments have temporary workers (46.8 per cent) and the average rate of temporary jobs for those establishments with temporary jobs is also relatively high (38.8 per cent). In manufacturing, the percentage of establishments with temporary jobs is also relatively high (42.4 per cent), but the average rate of temporary jobs is much lower (23.1 per cent). For services, the percentage of establishments with temporary jobs is relatively low (32.4 per cent) but the average rate of temporary jobs (33.8 per cents) falls between the other two industry groups. Overall, temporary employment is used by many establishments in a large number of industries. The pervasiveness of temporary workers across all industries gives support to our idea that temporary workers play an important role in cross-sector reallocations. Our model, however, is not used to try to explain cross-industry differences in temporary work.

The plant characteristics that are associated with having at least one temporary workers are identified in a probit regression (Table 2, column 1). Consistent with the notion that businesses use temporary workers to respond better to demand fluctuations, the use of temporary workers is positively related to direct measures of business volatility,[9] the coefficient of variation of the growth of profits and the coefficient of variation of the level of profits. The probability of using temporary workers is also related to indirect measures of volatility. Younger plants, that likely face more uncertainty than older plants, tend to use temporary workers. Likewise, plants that report having seasonal peaks in output also are more likely to use temporary workers. Temporary workers are also more likely to be found in larger plants with unions. Ono (2009) argues that larger plants may have more advantages in negotiating with temporary work agencies and that larger plants may face greater penalties when they dismiss workers. Indeed, Friesen (2005) shows that Canadian employers must give

[7] Evidence from the LFS presented in Galarneau (2005) suggests that temporary workers were over represented in agriculture, forestry, fishing, and hunting, and mining, oil and gas, but not utilities.

[8] Galarneau (2005) also shows that within the service industry, temporary workers were under represented in finance, insurance and real estate, trade, and professional, scientific and technical services, and over represented in education, and business, building and other support services.

[9] See Ono and Zelenev (2003), Jin, Ono, and Zhang (2007) and Ono (2009), for example.

more notice when they lay off a greater number of workers, something that is more likely to occur in larger plants than in smaller plants. The positive correlation between the use of temporary workers and the presence of a collective bargaining unit is at odds with past findings. However, while unions may resist the use of temporary workers, adjustment costs may also be higher in the presence of unions.

Table 2, column 2 shows that, conditional on having at least one temporary job, younger plants, with seasonal peaks in output, with a higher coefficient of variation in their level of revenues tend to have a higher temporary worker employment rate. The OLS regression (without fixed effects) also suggests that, conditional on having at least one temporary job, the temporary employment rate falls with plant size. That is to say, the number of temporary workers employed does not grow proportionately with plant size.

Table 3 shows the distribution of workplaces across net change in permanent and temporary job categories. Even at an annual frequency, there is a high percentage of establishments that do not change the number of permanent jobs. For all industries, 29.1 per cent of establishments do not alter the number of permanent jobs over the year. Manufacturing and other goods exhibit less inaction at 22.1 per cent and 24 per cent respectively, while services exhibit slightly more at 30.6 per cent. The percentage of establishments that do not change the number of temporary jobs is even higher, but this is not surprising as the majority of establishments do not have any temporary jobs. The pattern across industries in the fraction of establishment not changing both permanent and temporary workers is similar to the one for inaction in permanent jobs alone.

The 8.9 per cent of establishments that change the number of temporary, but not the number of permanent jobs are roughly equally distributed among those that increase and decrease temporary jobs. This is in line with the notion that temporary jobs are used to help establishments deal with transitory, idiosyncratic fluctuations in their demand. Among the establishments that increase the number of permanent workers, more than one-half increase both permanent and temporary jobs, approximately one-third only increase permanent jobs and the remainder decrease temporary jobs. The finding that there are some establishments that decrease temporary jobs while increasing permanent ones could be the result of changing perceptions on the nature of a shock. For example, perhaps last year's positive shock is now viewed as more long lasting. Interestingly, among establishments that decreased the number of permanent jobs, the fraction that also increased and decreased temporary jobs is roughly equal. The asymmetry seen among the group of establishments that increased permanent jobs does not exist here perhaps because many establishments do not have any temporary jobs to begin with. The model presented in this paper is able to replicate most, but not all of these situations.

Overall, the correlation between the change in the number of permanent jobs and the change in the number of temporary jobs is -0.38. This negative correlation at the mirco level is another feature our model is able to reproduce.

Table 4, column 1 gives the median growth in revenues for three types of plants: plants that increase permanent workers, plants that do not adjust permanent workers, and plants that decrease permanent workers. Plants that increase the number of permanent workers they employ have a median revenue growth of 8.4 per cent. This is 6.1 percentage points higher than the median growth rate for plants that do not change, and 9.4 percentage points higher than the median growth rate of plants that decrease the number of permanent workers they employ. The range of revenue growth rates is much narrower in the case of temporary workers (4, column 2). It is 5.3 per cent for plants that increase, 3.4 per cent for firms that do not change and 2.8 per cent for firms that decrease the number of temporary workers they employ. This is consistent with the notion that adjustment costs make it difficult for plants to adjust to smaller fluctuations by changing the number of permanent workers, so they use temporary workers instead. The number of permanent workers is only changed in face of larger shocks, when the benefit of increasing or decreasing the number of permanent employees outweighs the effect of adjustment costs.

The top panel of Table 5 presents the job creation and job destruction numbers for all industries. Over the 2001-2005 period, the average annual rate of job creation was 10.2 per cent while the rate of job destruction was 9.2 per cent. These figures are similar in magnitude to the ones found by Balakrishnan (2008) and Cao and Leung (2010) using Canadian firm-level data. [10] The rates of permanent job creation and

[10] Balakrishnan (2008) reports a job creation rate of 10.8 per cent and a job destruction rate of 8.8 per cent in the total economy of the 1999-2004 period. Cao and Leung (2010) find a job creation rate

destruction (8.1 per cent and 6.4 per cent, respectively) are higher than the rate of temporary job creation and destruction (5.3 per cent and 6.2 per cent, respectively). This is to be expected because the majority of establishments do not have temporary jobs and the share of temporary jobs in total jobs is relatively small.

As noted in the previous section, the job creation rates for permanent and temporary workers do not sum to the overall job creation rate. This is due to the existence of establishment-year observations where the change in the number of permanent and temporary jobs do not have the same sign. To obtain a sense of the importance of temporary workers to reallocation, one could calculate $\frac{JC^L}{JC^L+JC^N}$, $\frac{JD^L}{JD^L+JD^N}$, and $\frac{JC^L+JD^L}{JC^L+JC^N+JD^L+JD^N}$. These calculations suggest that, temporary jobs account for 40 per cent of the job creation, 49 per cent of the job destruction, and 44 per cent of the job reallocation. Alternatively, one could restrict the sample of establishment-year observations to the ones where the net change in permanent and temporary jobs have the same sign. The results of this exercise are shown in the bottom panel of Table 5 and lead to the same conclusions. The creation of temporary jobs accounts for 3.1 percentage points of the 8.2 per cent job creation rate, or 38 per cent. Similarly, the destruction of temporary jobs account for 42 per cent of the job destruction rate. Although temporary jobs only account for 13.5 per cent of all jobs, temporary jobs account for roughly 40 per cent of job reallocation. In other words, the reallocation accounted for by temporary jobs is three times their share in the total number of jobs. [11]

Tables 6, 7, and 8 present similar numbers for manufacturing, other goods and services. The reallocation rate in other goods is much higher than in manufacturing, but the rate in services is close to the aggregate rate. Recall that this is the same pattern as exhibited in the fraction of temporary jobs in total jobs. In each of the three industry groups and using both type of calculations, the reallocation of temporary jobs account for a large share of the industry job reallocation rates. Temporary jobs account for

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of 10.0 per cent and a job destruction rate of 8.6 per cent in the business sector over the 2001-2005 period. These two studies use firm-level data, so one might expect the rates based on plants to be higher. However, this paper concentrates on continuing plants and reallocation due to entry or exit is not captured.

[11]The finding that the reallocation accounted for by temporary jobs is three times their share in the total number of jobs holds even when the definition of temporary employment excludes independent contractors.

roughly 34, 50 and 42 per cent of the job reallocation in manufacturing, other goods and services, respectively. The share of reallocation accounted for by temporary jobs is approximately four times its share in total jobs in manufacturing, two times its share in other goods, and three times its share in services.

### 2.3. *Temporary Employment in Canada: Evidence from the GSS*

According to the GSS, the rate of temporary employment rose from 6.9 per cent to 8.9 per cent between 1989 and 1994, and from 8.9 per cent to 14.9 per cent between 1994 and 2006.[12] This compares to the rate of 13.5 per cent rate in the WES (2001-2005) where temporary work was defined more broadly. Thus the data from the WES is broadly in-line with data from other sources. As mentioned in the previous section, the 1989 and 1994 GSS also asks whether the individuals with temporary jobs would prefer a permanent one. The majority of temporary workers reply that they would prefer a permanent position and that fraction is rising over time. In 1989, 61 per cent of temporary workers desired a permanent position, and in 1994 that fraction increased to 72.3 per cent. This supports our decision to model temporary employment as something demanded by firms to improve flexibility rather than something demanded by workers. In addition, a recent paper by Zeytinoglu, Cooke, and Mann (2009) using the WES data also concludes that flexible work schedules (long workweeks, flextime, compressed workweek, variable workweek length and/or variable workweek schedules) are created for business reasons rather than individual worker interests.

## 3. MODEL

In this section, we provide a simple model of firm hiring and firing to replicate findings presented in the previous section. In the model economy, one homogeneous good, which can be used for consumption or investment, is produced by a large number of firms distributed across sectors. Firms rent capital from individuals on

[12]The 14.9 per cent in 2006 from the GSS is larger than the 13.2 per cent calculated using the 12-month average of temporary employment rates from the 2006 Labour Force Survey. The discrepancy is due to the fact that the 2006 GSS collected information between June and October, months when seasonal work is more prevalent. Data for the 1989 and 1994 GSS was collected throughout the year.

the capital market and choose the optimal employment. The profit residual is distributed equally to individuals. Let $\mathcal{E}, \mathcal{Z}, \mathcal{K}$ be subsets on the real line consisting of non-negative values. The production function is given by[13]

$$f(\varepsilon, k, n, l, z_j) = z_j \varepsilon^{\gamma} k^{\alpha} (n + \theta l)^{\gamma},$$

where $\varepsilon \in \mathcal{E}$ is the idiosyncratic productivity shock at the firm level, $z_j \in \mathcal{Z}$ is the sectoral shock in sector, $j$, $k \in \mathcal{K}$ are physical capital, $n \in \mathbb{R}_+ \cup \{0\}$ is the number of permanent workers with indefinite-term contracts, and $l \in \mathbb{R}_+ \cup \{0\}$ is the number of temporary workers with fixed-term or temporary contracts. The production function exhibits decreasing return to scale, $\alpha + \gamma < 1$, which is needed for a non-degenerate size distribution of firms. The firm's state is defined on the product space $\mathcal{E} \times \mathcal{Z} \times \mathbb{R}_+ \cup \{0\}$. The idiosyncratic shock follows an AR(1) process as follows

$$\ln \varepsilon_t = \rho_\varepsilon \ln \varepsilon_{t-1} + \eta_t,$$

where $\rho_\varepsilon < 1$ and $\eta_t \sim N(0, \sigma_\eta^2)$. Let $J$ be the number of sectors. The transition of sectoral shocks follows a discrete Markov chain. Idiosyncratic shocks and sectoral shocks are uncorrelated.

We assume that the permanent workers and temporary workers are paid the same wage rate. Ex ante all workers are the same. The trade-off between the two types of worker is made based on differences in efficiency and differences in labour adjustment costs. We assume that $\theta < 1$, and temporary workers are less efficient than permanent workers. While the efficiency of the two types of workers differs, the average labour productivity of the two types of worker are equal. However, the marginal productivity of permanent workers is larger than that of temporary workers when the amounts of the two types are equal.

There is no entry and exit in this model. However, we allow firms to be inactive by choosing zero employment. This assumption is based on the fact that capital is generally not scrapped when plants and firms exit, rather the plants and firms are sold to new owners.

[13]The labour structure specified here is the same as that used in models by Alonso-Borrego, Fernandez-Villaverde, and Galdon-Sanchez (2006), Cabrales and Hopenhayn (1997), and Campbell and Fisher (2004).

There is ample evidence in previous studies that non-convex adjustment is necessary to match job turnover patterns at the firm level. In our model, the adjustment cost for permanent workers consists of a fixed and variable costs as follows

$$g(n_{t-1}, n_t) = \begin{cases} \tau_{f_1} + \tau_{f_2} w[(1-q)n_{t-1} - n_t], & \text{if } n_t < (1-q)n_{t-1}, \\ 0, & \text{if } (1-q)n_{t-1} \leq n_t \leq (1+q)n_{t-1}, \\ \tau_{h_1} + \tau_{h_2}[n_t - (1+q)n_{t-1}], & \text{if } n_t > (1+q)n_{t-1}. \end{cases}$$

Since worker initiated separations, such as quits and retirements, are observed in reality, we assume that the firm does not pay adjustment costs if the employment change is less than $qn_{t-1}$. The above adjustment cost structure is consistent with the literature.[14]

Labour adjustment costs not only include the cost of setting up a hiring team, severance payments for fired workers and job posting costs, they may also include production disruptions, and the cost of training. Costs may be incurred even when employment levels do not change. For example, it may take some time for a new worker to reach the same level of efficiency as the departed worker, see Hamermesh and Pfann (1996) and Cooper and Willis (2009) for more detailed interpretations.

The essential distinction between temporary and permanent employment relationships in our model is not the length of the contract but rather the difference in the cost of hiring and firing. This difference creates different contract terms between permanent workers and temporary workers. In the model, firms do not incur adjustment costs when they change their levels of temporary employment per se. Instead, firms pay a cost (in addition to the wage) to use temporary workers, and this cost is proportional to the number of temporary workers it uses, $\tau l_t$. This cost of using temporary workers may be due to the organizational differences of production when one mixes permanent workers and temporary workers. It may also arise from additional human resources costs required to continually roll-over temporary employment contracts.

[14]Abowd and Kramarz (2003) estimate the shape of hiring and separation costs with matched French data. They find that both retirement and termination costs are increasing and mildly concave in the number of separated workers. Fixed costs are very large. Hiring costs also have a large fixed component and are mildly concave. Hiring costs are much smaller than separation costs. Estimates from other papers also find that non-convexity is present, see Hamermesh (1989), Cooper and Willis (2009), among others.

The implicit assumption here is that temporary employment contracts hold only for one period, which sounds extreme. For example, some temporary contracts may be renewed after one period. This assumption nevertheless is a simplification of fixed-term employment contracts. By restricting the model to one-period employment, we implicitly assume that contract renewal is taken as a new contract and must be signed at a cost that equals to the cost of hiring a new temporary worker.

We ignore the promotion of temporary workers to permanent jobs. If costless promotion is allowed, firms have an incentive to first hire temporary workers, and then promote them to permanent workers, thereby avoiding the adjustment costs of hiring permanent workers. For example, in the calibrated model of Alonso-Borrego, Fernandez-Villaverde, and Galdon-Sanchez (2006), the majority of new hires are temporary workers.

Finally, to close the model, a representative household exists to make consumption and saving decisions. The household's preferences are

$$E_0 \left[ \sum_{t=0}^{\infty} \beta^t [u(c_t) - \xi(L_t + N_t)] \right],$$

where $c_t > 0$ is consumption in period $t$. The instantaneous utility function satisfies $u'(c_t) > 0, u''(c_t) < 0$ and $\lim_{c_t \to 0^+} = \infty$. The household supplies $L_t$ and $N_t$ amounts of temporary and permanent work, respectively.

## 4. EQUILIBRIUM ANALYSIS

Before studying the model's equilibrium properties, it should be noted that the sectoral shocks are important for both the stationarity of the long-run equilibrium and for how the equilibrium is computed. We assume that sectoral shocks are uncorrelated and that the model economy has a sufficient number of sectors such that the law of large numbers applies. Since one particular sector is too small to influence the equilibrium prices, the equilibrium is stationary. In contrast, if the economy consists of only a small number of sectors or the sectoral shocks move together, the equilibrium price is likely to fluctuate, because co-moving sectoral shocks influence the model economy in a way similar to that of an aggregate shock.

4.1. *Firm's optimal decisions*

Since there are no adjustment costs associated with temporary workers, the optimal choice on temporary workers is obtained by solving the following static problem:

$$R(\varepsilon, n, z_j) = \max_{k,l} f(\varepsilon, k, n, l, z_j) - rk - (w+\tau)l.$$

The optimal choice for temporary worker is

$$\theta l^*(\varepsilon, n, z_j) = \begin{cases} \left[\left(\frac{\theta\gamma}{w+\tau}\right)^{1-\alpha}\left(\frac{\alpha}{r}\right)^{\alpha} z_j \varepsilon^{\gamma}\right]^{\frac{1}{1-\alpha-\gamma}} - n, & \text{if } l^* > 0, \\ 0, & \text{otherwise.} \end{cases}$$

Similarly, the optimal capital choice is

$$k^*(\varepsilon, n, z_j) = \begin{cases} \frac{\alpha(w+\tau)}{\theta\gamma r}[n + \theta l^*(\varepsilon, n, z_j)], & \text{if } l^* > 0, \\ \left[\frac{\alpha}{r} z_j \varepsilon^{\gamma} n^{\gamma}\right]^{\frac{1}{1-\alpha}}, & \text{otherwise.} \end{cases}$$

Let $n_{-1}$ be the employment level of a firm at the beginning of the current period before decisions are made. Define the firm's profit function as

$$\pi(\varepsilon, n, n_{-1}, z_j) = R(\varepsilon, n, z_j) - g(n_{-1}, n) - wn.$$

The recursive formulation of the firm's dynamic problem is

$$V(\varepsilon, n_{-1}, z_j) = \max_{n} \pi(\varepsilon, n, n_{-1}, z_j) + \frac{1}{1+i} E_{z,\varepsilon} V(\varepsilon', n, z_j') \tag{1}$$

where $i$ is the real interest rate. It should be noted that the adjustment of employment has no time to build.

PROPOSITION 1 *There exists a lower threshold value $\underline{n}$ and an upper threshold value $\overline{n}$ such that the optimal policy function $n$ is as follows:*

$$n(\varepsilon, n_{-1}, z_j; \mu) = \begin{cases} \underline{n}(\varepsilon, n_{-1}, z_j; \mu), & \text{if } n_{-1} < \underline{n}(\varepsilon, n_{-1}, z_j; \mu), \\ n_{-1}, & \text{if } n_{-1} \in [\underline{n}(\varepsilon, n_{-1}, z_j; \mu), \overline{n}(\varepsilon, n_{-1}, z_j; \mu)], \\ \overline{n}(\varepsilon, n_{-1}, z_j; \mu), & \text{if } n_{-1} > \overline{n}(\varepsilon, n_{-1}, z_j; \mu) \end{cases}$$

*Conditional on adjusting employment, the optimal employment adjustment is independent of the current level of employment.*

The proof is in Appendix A. This proposition shows that a firm's decision on the number of permanent workers to employ follows an (S,s) rule. If the marginal value of employing another permanent worker is lower than some cut-off value, a firm changes the number of permanent workers employed such that the marginal value of permanent workers at the new employment level is equal to the hiring cost $\tau_h$. Conditional on hiring, the marginal cost of hiring is independent of the current employment level. Thus, the optimal number of permanent workers to employ is also independent of the current employment level, and determined by the particular shock it has drawn. The firing decision of a firm is similar. Given the monotonicity of a firm's value function (without firing and hiring costs), a firm will not adjust its amount of permanent workers if the current employment level of these workers is between the cut-off values. This is because the marginal firm values are not equal to the constant marginal costs. Finally, due to the fixed cost of changing permanent workers, firms that are not able to hire or fire permanent works will resort to temporary workers.

The distribution over the firm's state space is a measure $\mu$ defined on the $\sigma$-algebra of all the open sub-sets of the product space $\mathcal{Z} \times \mathbb{S}$ where $\mathbb{S} = \mathcal{E} \times \mathbb{R}_+ \cup \{0\}$. Let $Q(s, z_j; s', z'_j)$ be the transition matrix from state $(s, z_j)$ to state $(s', z'_j)$, and let $P(\varepsilon, z_j; \varepsilon', z'_j)$ be the transition matrix of the exogenous shocks. The law of motion for the distribution of firms is

$$(2) \qquad \mu(s', z'_j) = \int_{s,z_j} Q(s, z_j; s', z'_j) d\mu(s, z_j),$$

in which

$$(3) \qquad Q(s, z_j; s', z'_j) = \begin{cases} P(\varepsilon, z_j; \varepsilon', z'_j) 1_{\{n = n(s, z_j; \mu)\}}, & \text{if } n \in R_+ \cup \{0\}; \\ 0, & \text{otherwise.} \end{cases}$$

The wage rate and the interest rate are determined by the distribution of firms. The optimal policy function for permanent workers is $n = n(s, z_j; \mu)$.

The aggregate demand for permanent workers is given by

$$N^d = \sum_{j=1}^{J} \int n(\varepsilon, n_{-1}, z_j) d\mu_j(\varepsilon, n_{-1}).$$

Gross job reallocation for permanent workers is

$$JR^N = \sum_{j=1}^{J} \int [\max\{0, n(\varepsilon, n_{-1}, z_i) - n_{-1}\} + |\min\{0, n(\varepsilon, n_{-1}, z_i) - n_{-1}\}|] \, d\mu_j(\varepsilon, n_{-1}).$$

The demand for temporary workers is given by

$$L^d = \sum_{j=1}^{J} \int l(\varepsilon, n_{-1}, z_j) d\mu_j(\varepsilon, n_{-1}).$$

Finally, the gross job reallocation for temporary workers is

$$JR^L = \sum_{j=1}^{J} \int [\max\{0, l(\varepsilon, l_{-1}, z_i) - l_{-1}\} + |\min\{0, l(\varepsilon, n_{-1}, z_i) - l_{-1}\}|] \, d\mu_j(\varepsilon, n_{-1}),$$

where $l_{-1} = l(\varepsilon, n_{-1}, z_j)$ is the demand for temporary workers at the beginning of the current period, before the firm makes its decision on the number of permanent workers to employ.

4.2. *Households*

We assume that the period utility function of the household is $u(c) = \frac{c^{1-\psi}}{(1-\psi)}$. The household cannot borrow, but it owns the capital used by firms. The household's consumption and saving decisions are made in the following recursive problem:

$$H(K, \mu) = \max_{c, K'} \{u(c) - \xi(L + N) + \beta H(K', \mu')\} \tag{4}$$

subject to:

$$c + K' \leq w(L + N) + (1 + r - \delta)K + Tr + \sum_{j=1}^{J} \int \pi(\varepsilon, k, n_{-1}, z_j) d\mu_j(\varepsilon, k, n_{-1}) \tag{5}$$

where $Tr$ is the lump sum transfer from the government, and $w$ is the wage rate. Members of the representative household have the same labour productivity. The fraction of members that become permanent or temporary workers is determined by the firm's production technology and by labour adjustment costs. Members also move freely from one sector to another.[15]

4.3. *Steady-state equilibrium*

In steady state, the aggregate state of the economy $(K, N, \mu)$ and the equilibrium prices $(i^*, r^*, w^*)$ are constant over time. A steady-state competitive equilibrium is defined as:

[15] An extension to the current setup is to impose costly sectoral reallocation of permanent workers. In this case, the worker distribution across sectors becomes a state variable.

- Firms solve equation (1), taking equilibrium prices as given. The policy functions are $n = n(s), l = l(s), k' = k'(s)$.
- The household solves equation (4), taking equilibrium prices as given. The policy function is $K' = K'(K, \mu)$, $L^*$, and $N^*$.
- The markets for capital, labour and consumption clear as following

$$L^* = L^d, N^* = N^d$$

$$K' = K^*$$

$$C + \delta K = \sum_{j=1}^{J} \int_s z_j \varepsilon^\gamma k^\alpha (n + \theta l)^\gamma - a(k, k'(s)) d\mu_j(s)$$

- Tax revenue equals to the lump sum transfer $Tr$.
- The firm distribution evolves as

$$\mu(s, z_j) = \int_{s, z_j} Q(s, z_j; s', z_j') d\mu(s, z_j).$$

In the steady state, $(1 + i) = \frac{1}{\beta}$. From the household's first-order necessary conditions, $u_c = \frac{\xi}{w}$ and $(1 + r - \delta) = \frac{1}{\beta}$.

In this steady-state competitive equilibrium, the only unknown aggregate variable is the wage rate $w$. The equilibrium is computed in two loops. First, for a given value of the wage rate, the value of a firm is obtained by solving Equation (1). When solving the firm's problem, the interest rate and capital rental rate are given by the first-order conditions of the representative household. The invariant distribution of the firms is then obtained. Second, aggregate consumption is calculated and then the aggregate resource feasibility constraint is checked.

## 5. CALIBRATION

### 5.1. *Parameters*

The model is calibrated to annual Canadian data. Parameter values are chosen to replicate the main features of the Canadian economy. The capital-output ratio and investment output ratio are, respectively, 1.69 and 0.12 (see Baldwin, Fisher, Gu, Lee, and Robidoux (2008)). In the steady state, investment just replenishes depreciated capital, so this implies a depreciation rate of capital of 0.071. The interest rate $i$ is set to the commonly used value of 4 per cent, which means that the discount factor for the household is $\beta = 0.9615$. The share of labour in Canadian national income is 0.62, hence $\gamma = 0.62$. The capital share $\alpha$ is proportional to the capital stock to output ratio, as shown in the following equation

$$\alpha = (i + \delta)\frac{K}{Y}.$$

Together with the values for the interest rate and the depreciation rate mentioned above, this implies that $\alpha = 0.19$. We choose $\theta = 0.865$, so that temporary workers are less productive than permanent workers.

The preference parameter $\xi$ is chosen so that the fraction of the working-age population that is employed in Canada is 74 percent. Given production parameters, this implies that $\xi = 0.9367$.

The idiosyncratic shock process is estimated using WES.[16] The idiosyncratic shock has an estimated serial correlation of 0.736, and the standard deviation of the error term in the AR(1) process is 0.614. The estimated standard deviation is high compared to that found in other studies using U.S. plant-level data. Therefore, a lower standard deviation of 0.300 was chosen. We discretize the firm-level shock following the method of Adda and Cooper (2003). The transition matrix for the sectoral shocks is estimated using the Canadian KLEMS data. The estimated serial correlation of sectoral shocks is 0.811, and the standard deviation of the error term is 0.015.[17]

For labor adjustment costs, we set $\tau_{f_2}$ to be 0.25, so that the severance payment is equivalent to 3 months of salary. Furthermore, we assume that the fixed costs of hiring and firing are equal, $\tau_{f_1} = \tau_{h_1}$, as we focus on the steady state equilibrium in which hiring and firing must be equal. We then estimate $\tau_{h_1}$, $\tau_{h_2}$ and $\tau$ using the method of moments. The set of moments includes the fraction of plants hiring temporary workers, the share of temporary workers in total employment, the job creation and destruction rates for all workers, temporary workers and permanent workers, and the fraction of plants that do not change their numbers of permanent workers.

[16]The production function is first estimated using Levinsohn and Petrin (2003). Since capital stock is not available in the WES, industry capital stock is used in the place of plant-level capital. Plant-level multifactor productivity estimates are then obtained. An AR(1) process for multifactor productivity is then estimated. Industry dummies are entered into this final regression to capture sectoral shocks.

[17]The estimated transition matrix only takes into account changes within a given sector. Cross-sector differences were picked up using sector-specific constants and trends.

The estimated parameter values are $\tau_{h_1} = 0.347$, $\tau_{h_2} = 0.129$ and $\tau = 0.105$. These parameter values are used for the results of the baseline model.

5.2. *Baseline calibration*

The baseline model performs well in matching all the moments of job turnover. Table 9 compares the moments of job reallocation in the model and those in data. Compared to the data, the model has a higher job reallocation rate for temporary workers, but a smaller temporary employment rate. The aggregate labour adjustment cost is 4.2 per cent of total output in the steady state, which is consistent with other empirical estimates. It should be noted that in our model the adjustment cost for capital is zero. The labor adjustment cost can be lower than 4 percent if we think that some portion of job reallocation arises from the firm's investment decisions, and the firm's capital adjustment cost is not zero.

Unlike the data, the job creation and destruction rates are equal in the model because the model focuses on the steady state equilibrium. Furthermore, as in the data, the sum of the job reallocation rates for permanent and temporary workers is less than the total job reallocation rate. The model also reproduces the negative correlation between the changes in permanent and temporary workers at the micro level. This means that the model does have firms that simultaneously increase the number of one type of worker and decrease the number of the other type of worker. This is mainly caused by the heterogeneity in productivity levels of firms and the fixed cost of hiring temporary workers. Due to the non-convexity of adjustment cost, firms can change the number of permanent employees without changing the number of temporary employees, and vice versa.

The job turnover for both types of employment is jointly determined by the nature of productivity shocks and the structure of the adjustment costs. For example, the fixed labour adjustment cost for permanent workers is crucial in order to match the job reallocation rates for both types of workers and the fraction of temporary employment. If we turn off the fixed adjustment cost by setting $\tau_{f_1} = \tau_{h_1} = 0$, firms no longer hire temporary workers and the fraction of firms that do not hire and fire permanent workers is much smaller than seen in the data. The importance of the fixed adjustment cost for permanent workers is intuitive. When a firm is hit by a productivity shock, it tends to hire or fire more temporary workers because hiring and firing permanent workers is more costly than temporary workers. If the adjustment cost for permanent worker is eliminated, firms tend to hire or fire permanent workers, and stop hiring temporary workers because temporary workers are less effective in production.

To better understand the workings of the model, Figure 1 presents an average firms choice of permanent and temporary workers for different idiosyncratic shocks, given a particular sector shock. The average firm in the calibrated model hires n = 0.71 permanent workers. The presence of adjustment costs means that there is a range of idiosyncratic shocks, 0.53 to 2.6, where the firm will not change its number of permanent workers. However, there are shocks within this range of inaction in terms of permanent works, where temporary workers are employed. An idiosyncratic shock between 1.62 and 2.6 is not large enough for the firm to increase their permanent workforce, but it is sufficient to cover the costs of employing temporary workers. If the average firm receives a shock that is greater than 2.6, it will employ more permanent workers, and drop all its temporary workers if any were being employed (it would have had temporary workers if its previous shock was between 1.62 and 2.6). If the average firm receives a shock below 0.53, it would fire permanent workers and not reemploy any temporary workers. Note that the model captures all of the employment change situations shown in Table 3 except two. Firms in the model do not increase temporary and permanent workers in the same year, and they do not fire permanent workers and hire temporary workers in the same year.

The role of temporary employment can be examined by supposing that all workers are permanent. With no temporary workers, in order to match the total job reallocation rates, the adjustment cost parameters fall significantly, $\tau_{h_1} = 0.17$ and $\tau_{h_2} = 0.068$. This generates the same job reallocation rates as those in the baseline, as shown in the last column of Table 9. The value of the hiring cost needed to match the job creation and destruction rates for all workers is much smaller, close to the half of the hiring cost parameters of the baseline calibration. This demonstrates that although temporary workers are a small fraction of the total employment, treating temporary workers as permanent significantly downward biases the estimates of labour adjustment costs for permanent workers. This implies that, to properly evaluate the change in welfare when permanent workers are affected disproportionately (because of labour market policy or a shock), a model must take into consideration the role of temporary employment.

Finally, the equilibrium total adjustment cost in the model without temporary employment is 4.7 per cent of total output, a small increase relative to the 4.2 per cent in the baseline model. Although the adjustment cost parameters are lower in the model without temporary workers, these costs now apply to every worker that is reallocated. In the model with temporary workers, the higher adjustment costs only applied to a fraction the reallocation.

## 6. MODEL IMPLICATIONS FOR JOB REALLOCATION

In this section, we depart from the baseline model and examine the changes in job reallocation for both permanent and temporary employment in response to the changes in firm-level and sectoral shocks, as well as the adjustment costs.

### 6.1. *Labour adjustment costs and temporary workers*

When the hiring and firing of permanent workers becomes more costly, our model suggests that firms should increase the use of temporary workers. The share of temporary workers in total employment is expected to increase if adjustment costs for permanent workers increase. In this sub-section, we increase the firing cost for permanent workers by 10 percent from the baseline case. Table 10 summarizes the changes in the moments generated by the model. The marginal cost of hiring permanent worker is the wage, the adjustments costs today, and the change to the expected adjustment costs tomorrow. An increase in the variable cost of firing, raises the last of these terms, the cost of adjusting permanent employment downward in the future. For each state (previous permanent employment, and sector and idiosyncratic shock), the number of permanent workers employed is lower than in the baseline case. Therefore, aggregate permanent employment and the equilibrium wage rate falls. The temporary employment rate increases because the decrease in the wage and fewer permanent workers per firm means firms will hire more temporary workers as per section 4.1.[18] Naturally, greater firing costs increase the range of shocks firm are willing to face without changing permanent workers, and when they do need to hire more permanent workers they do not hire as many. This leads to a lower reallocation rate of permanent workers. The greater number of temporary workers per firm in firms that have temporary workers leads to more reallocation in temporary workers. Finally, although there is an increase in the variable firing cost parameter ($\tau_{f_2}$), total adjustment costs as a fraction of output does not change. This is because firms make less frequent adjustments in permanent workers and because the equilibrium wage has fallen. Recall that the variable firing cost is a proportion of the wage.

### 6.2. *Firm-level volatility and job reallocation*

In this section we study how productivity shocks at the firm-level affect the amount of job reallocation. In particular, we examine the change in the incidence of temporary employment and change in job reallocation when there is an increase in the volatility of the firm's idiosyncratic shock process. The volatility of the shock can increase because of an increase in the serial correlation coefficient of the productivity shock and an increase in the standard deviation of the error term in the shock process. Empirical evidence from the Report on Business shows that, between the mid 1990s and the early 2000s, the standard deviation of the sales growth among Canadian firms increased by roughly 10 per cent. The change in the serial correlation of the shock process and the change in the standard deviation of the error term needed to obtain a 10 per cent increase in the standard deviation of the shock process are calculated.[19] For each of the changes, the effects on the moments generated by the model is then

[18] Table 10 also shows that there is no change in the number of firms that hire temporary workers. It would be expected that greater firing cost would increase the range of shocks firm face could face before changing their number of permanent workers. This would increase the number of situations where a firm would use temporary workers and hence the number of firms that hire temporary workers should rise. The fact that no increase is shown in Table 10 is likely due to the coarseness of the grid for idiosyncratic and sector shocks.

[19] Empirical evidence from the Report on Business data set shows that between the mid-1990s and the early 2000s, the volatility of the sales growth among Canadian firms increased by roughly 10 per cent. The Report on Business data set covers publically-trade and large private firms in Canada. The volatility of sales growth is calculated following Davis, Faberman, and Haltiwanger (2006).

obtained, as shown in Table 11.

In either case, there are more firms in the outer parts of the distribution of idiosyncratic shocks. The convex nature of the policy function, as shown in Figure 1, means that the increase in the number of permanent workers due to firms with higher productivity shocks outweighs the decrease in the number of permanent workers due to firms with lower productivity shocks. Hence, the equilibrium wage and aggregate employment rises.

Greater serial correlation in the shock process implies further that firms receiving a positive productivity shock are more likely to have good productivity in the future, and firms receiving a bad productivity shock are more likely to stay at lower levels of productivity. This lowers the expected cost of firing for firms that receive positive productivity shocks, and lowers the expected cost of hiring for firms that receive negative productivity shocks. As a result, the range of shocks where firms do not adjust their number of permanent workers shrinks at both ends. Firms are more likely to both hire and fire than in the baseline case. Furthermore, given the same previous level of permanent workers and the same change in productivity, firms will adjust by more than in the baseline case. The larger, more frequent changes in the number of permanent workers raises the reallocation rate of permanent workers. Firms that have temporary workers use fewer temporary workers because given the same state, the number of permanent workers per firm is higher than in the baseline case, and because the equilibrium wage is higher. As suggested by Figure 1, the higher fraction of firms with temporary workers is due to the greater number of firms with higher productivity shocks.[20] Overall, however, the temporary employment rate falls because of the increase in permanent employment and the decrease in temporary employment among firms with temporary workers.

If the volatility of the idiosyncratic shock rises because of an increase in the standard deviation of the error term in the shock process, then the mechanics are slightly different. The probability of maintaining either a high or low productivity level into

[20]Note, however, that this result depends on how the distribution of shocks change, as firms with the highest productivity shocks do not hire temporary workers. As long as the increase in the mass of firms in the highest productivity classes is smaller proportionately than the increase in firms in the higher productivity classes, there should be an increase in the fraction of firms with temporary workers.

the future falls. Firms that draw a positive productivity shock, hire less often and hire less when they do hire because the expected cost of firing in the future rises. Similarly, firms that receive a low productivity draw, fire less often and fire less when they do fire because the expected cost of hiring in the future rises. As a result, given the same combination of shocks and the same previous level of permanent employment, a lower level of permanent employment relative to the baseline model is chosen.[21] The greater uncertainty raises the probability of getting a low or a high productivity shock, but it also raises the range of shocks that firms are willing to face before they make a change in permanent workers. The former effect out weighs the latter, as job reallocation of permanent workers rises relative to the baseline. The temporary employment rate rises in the case of an increase in the standard deviation of the error term in the shock process because given the same state, fewer permanent workers are employed than in the baseline and hence more temporary workers are employed. The incidence of using temporary workers also rises because the range of inactivity widens. Both the greater incidence and intensity of temporary worker use (the rate of temporary employment for firms that have temporary employees) leads to more job reallocation of temporary workers.

Overall, the results in this section suggest that a rise in the volatility faced by firms may play a role in the increase in temporary employment over time. To confirm this hypothesis, measures of firm volatility covering a broader range of firms need to be found.

### 6.3. *Effects of sectoral shocks*

In recent decades, the Canadian economy experienced large changes in relative prices across sectors. Cao and Leung (2010) find that the dispersion of industry employment growth rates have been elevated since 2005, and that this increase is largely accounted for by the appreciation in the real exchange rate and increase in commodity prices. Cyclical factors account for little of the increased dispersion. In this experiment, we examine the effects of sectoral shocks on job reallocation. We choose the dispersion of sectoral shocks to match the 25 per cent increase in the sectoral job re-

[21] Aggregate permanent employment is still higher because there are more firms with higher productivity shocks.

allocation rate post-2005 (compared to the years immediately prior to this period). In the baseline calibration, the job reallocation rate measured with sectoral employment changes is 3.4 per cent. We find that increasing the standard deviation of sectoral shocks from 0.031 to 0.044 will generate a 4.3 per cent sectoral job reallocation rate in the new steady-state equilibrium. The increase in the standard deviation of sectoral shocks is achieved by increasing the highest productivity level a sector can realize and decreasing the lowest productivity level a sector can realize. Unlike the previous experiments involving the idiosyncratic shock, the transition probabilities are not altered.

The results are shown in Table 12. Firms in the most productive sector have become more productive relative to the baseline scenario, and firms in the least productive sector have become less productive. Once again, because of the convexity of the firm's profit function in shocks, permanent employment rises more in the most productive sector than it falls in the least productive sector. As a result, aggregate permanent employment increases, as does the equilibrium wage rate. The increase in the wage rate and the increase in the average number of permanent workers per firm in the most productive sector leads to a decline in the number of temporary workers.

Greater dispersion in the sectoral productivity shock leads to more job reallocation in permanent workers than in the baseline. The rate of job reallocation for temporary workers declines slightly because there are relatively fewer temporary workers. The change in the composition of job reallocation leads to a 5 per cent increase (from 0.042 to 0.044) in the aggregate adjustment costs as a fraction of output. This relatively small increase in aggregate adjustment costs is not surprising as idiosyncratic shocks remain the main driver of reallocation, even with the increased dispersion in sectoral shocks.

However, the model with temporary workers still shows some increase in adjustment costs when sectoral shocks become more disperse. This is not the case in the model with no temporary workers (Table 12).[22] An increase in the dispersion of sector shocks in this model hardly increases the aggregate adjustment costs at all. This

[22]In the baseline experiment with no temporary workers, the sectoral job reallocation rate is 4.0 per cent. Thus the new steady state sectoral reallocation rate should be 5.0 per cent. We find that the standard deviation of sectoral shocks needs to rise from 0.031 to 0.044 to generate this increase.

is despite the fact that job reallocation for all workers does rise in response to more sectoral dispersion, albeit not as much as in the model with temporary workers. This demonstrates that to properly evaluate changes in welfare when permanent workers are disproportionately affected, one must take temporary workers into account.

## 7. CONCLUSIONS

This paper documents the role of temporary employment in labor adjustment at the micro level, as well as job turnover in general. The data shows that temporary workers normally account for a disproportionate amount of reallocation. We demonstrate in a simple model of infrequent labor adjustment that ignoring temporary workers leads to estimates of adjustment costs parameters that are much lower than when temporary workers are taken into account. We also show that aggregate adjustment costs will be underestimated when temporary workers are not accounted for in situations where a change in the economic environment disproportionately affects permanent workers. An example of such a change is the increased sectoral reallocation in Canada due to the commodity price boom and the appreciation of the Canadian dollar.

Furthermore, we find that an increase in the volatility of firm-level growth is a good candidate for explaining the increase in the temporary employment rate in Canada. More evidence on the change in firm volatility, however, needs to be examined. First, a more representative sample of firms must be used to calculate the change in the volatility of firm growth rates. Second, the nature of the increase in the volatility must be determined. This paper shows that an increase in dispersion due to more persistent shocks does not increase temporary employment. More persistence actually encourages the use of permanent workers. Temporary employment increases only when the standard deviation of the error term in the idiosyncratic shock process increases. This change leads to greater uncertainty and more use of temporary workers.

Of course, more work also needs to be done to further understand the role of temporary workers. We point out two possible directions for further study. First, our model has ignored the role of worker flow and search frictions. The model assumes that all workers are the same ex-ante and that the workers are indifferent between taking a permanent job and a temporary job. This certainly neglects the question of why a worker is willing to take a temporary job. Second, job turnover in our model is mainly driven by the labour adjustment costs, given the productivity shock processes. A complementary approach would be to better model how the firm manager's expectations on future productivity shocks are formed. As Ono and Sullivan (2006) show, a firm is more likely to hire temporary workers if the firm manager thinks the firm's profitability shock is transitory. A better understanding of the interaction between productivity shocks and labor adjustment costs is expected to bring us closer to the true story behind the existence of temporary employment in the economy.

## APPENDIX A: PROOFS

### A.1. *Proposition 1*

PROOF: Let the value function without hiring and firing costs be $\widetilde{V}(z, \varepsilon, k, n, n_{-1})$. First, $\widetilde{V}$ is concave in $n$, by the assumption production function. We first obtain the first order necessary conditions. Suppose the establishment hires permanent workers. The first-order necessary condition is

$$\widetilde{V}_n(z, \varepsilon, k, n, n_{-1}) - \tau_{h_2} = 0,$$

from which we obtain optimal $n(z, \varepsilon, k, n_{-1}) > n_{-1}$. By concavity of $\widetilde{V}$, $\widetilde{V}_n(z, \varepsilon, k, n_{-1}, n_{-1}) > \tau_h$. If the establishment fires permanent workers, the first-order necessary condition is

$$\widetilde{V}_n(z, \varepsilon, k, n, n_{-1}) + \tau_{f_2} w = 0,$$

from which we obtain optimal $n(z, \varepsilon, k, n_{-1}) < n_{-1}$. By concavity of $\widetilde{V}$, $\widetilde{V}_n(z, \varepsilon, k, n_{-1}, n_{-1}) < -\tau_{f_2} w$. *Q.E.D.*

## APPENDIX B: TABLES AND FIGURES

TABLE 1. Summary Statistics From the Workplace Employee Survey (2001-2005)

| | All | Manufacturing | Other goods | Services |
|---|---|---|---|---|
| Temporary job rate (%) | 13.5 | 8.3 | 23.4 | 13.7 |
| % of establishments with temporary jobs | 34.9 | 42.4 | 46.8 | 32.4 |
| Average temporary job rate across establishments (%) | 11.6 | 9.8 | 18.2 | 11.0 |
| Average temporary job rate for establishments with temporary jobs (%) | 33.2 | 23.1 | 38.8 | 33.8 |

TABLE 2. Incidence and Rate of Temporary Workers on Plant Characteristics

| | Presence of temporary worker [1] | Temporary worker rate [2] |
|---|---|---|
| Age | -0.003 | -0.002 |
| | (0.001) | (0.001) |
| Age squared/100 | 0.004 | 0.000 |
| | (0.002) | (0.001) |
| 1-19 workers | -0.449 | 0.140 |
| | (0.027) | (0.019) |
| 20-99 workers | -0.201 | 0.064 |
| | (0.023) | (0.016) |
| 100-499 workers | -0.135 | 0.000 |
| | (0.022) | (0.0) |
| 500+ workers | — | — |
| Union | 0.066 | -0.020 |
| | (0.025) | (0.016) |
| Seasonal peak | 0.088 | 0.061 |
| | (0.021) | (0.016) |
| CV revenue | -0.033 | 0.101 |
| | (0.039) | (0.033) |
| CV profits | 0.001 | 0.001 |
| | (0.0008) | (0.001) |
| CV revenue growth | 0.000 | 0.000 |
| | (0.001) | (0.001) |
| CV profits growth | 0.0002 | -0.000 |
| | (0.0001) | (0.001) |

Note: Standard errors in parentheses. Both regression includes year and industry dummies.
1. Probit model; indicator variable is 1 if plant has temporary workers; marginal effects are shown.
2. OLS regression for plants with temporary workers.

TABLE 3. Distribution of Establishments Across Employment Change Regimes (%)

| | All | Manufacturing | Other goods | Services |
|---|---|---|---|---|
| $\Delta Permanent < 0, \Delta Temporary < 0$ | 4.5 | 6.4 | 7.0 | 3.9 |
| $\Delta Permanent < 0, \Delta Temporary = 0$ | 12.8 | 14.2 | 10.0 | 13.0 |
| $\Delta Permanent < 0, \Delta Temporary > 0$ | 5.9 | 7.4 | 7.4 | 5.5 |
| $\Delta Permanent = 0, \Delta Temporary < 0$ | 4.1 | 4.7 | 4.6 | 4.0 |
| $\Delta Permanent = 0, \Delta Temporary = 0$ | 20.2 | 14.0 | 15.2 | 21.6 |
| $\Delta Permanent = 0, \Delta Temporary > 0$ | 4.8 | 3.4 | 4.2 | 5.0 |
| $\Delta Permanent > 0, \Delta Temporary < 0$ | 8.0 | 7.8 | 10.3 | 7.8 |
| $\Delta Permanent > 0, \Delta Temporary = 0$ | 14.4 | 15.5 | 12.5 | 14.5 |
| $\Delta Permanent > 0, \Delta Temporary > 0$ | 25.3 | 26.5 | 28.9 | 24.7 |

TABLE 4. Median Revenue Growth by Employment Change Regimes (%)

| | Permanent | Temporary |
|---|---|---|
| Decrease | -1.0 | 2.8 |
| No change | 2.3 | 3.4 |
| Increase | 8.4 | 5.3 |

TABLE 5. Job Creation and Destruction Rates (%), All industries

*Conventional definition*

| | All workers | Permanent | Temporary |
|---|---|---|---|
| Job creation | 10.2 | 8.1 | 5.3 |
| Job destruction | 9.2 | 6.4 | 6.2 |
| Job reallocation | 19.4 | 14.5 | 11.5 |

*Rates excluding cases where permanent workers increase (decrease) and temporary workers decrease (increase)*

| | All workers | Permanent | Temporary |
|---|---|---|---|
| Job creation | 8.2 | 5.1 | 3.1 |
| Job destruction | 7.1 | 4.1 | 3.0 |
| Job reallocation | 15.3 | 9.2 | 6.1 |

TABLE 6. Job Creation and Destruction Rates (%), Manufacturing

| *Conventional definition* | | | |
|---|---|---|---|
| | All workers | Permanent | Temporary |
| Job creation | 7.8 | 6.5 | 3.4 |
| Job destruction | 8.2 | 6.3 | 4.0 |
| Job reallocation | 16.0 | 12.8 | 7.4 |

| *Rates excluding cases where permanent workers increase (decrease) and temporary workers decrease (increase)* | | | |
|---|---|---|---|
| | All workers | Permanent | Temporary |
| Job creation | 6.0 | 4.0 | 2.0 |
| Job destruction | 6.3 | 4.3 | 2.0 |
| Job reallocation | 12.3 | 8.3 | 4.0 |

TABLE 7. Job Creation and Destruction Rates (%), Other goods

| *Conventional definition* | | | |
|---|---|---|---|
| | All workers | Permanent | Temporary |
| Job creation | 14.4 | 9.9 | 8.6 |
| Job destruction | 12.3 | 7.2 | 9.2 |
| Job reallocation | 26.7 | 17.1 | 17.8 |

| *Rates excluding cases where permanent workers increase (decrease) and temporary workers decrease (increase)* | | | |
|---|---|---|---|
| | All workers | Permanent | Temporary |
| Job creation | 11.8 | 6.4 | 5.4 |
| Job destruction | 9.0 | 4.2 | 4.8 |
| Job reallocation | 20.8 | 10.6 | 10.2 |

TABLE 8. Job Creation and Destruction Rates (%), Services

*Conventional definition*

| | All workers | Permanent | Temporary |
|---|---|---|---|
| Job creation | 10.3 | 8.4 | 5.4 |
| Job destruction | 9.1 | 6.2 | 6.4 |
| Job reallocation | 19.4 | 14.6 | 11.8 |

*Rates excluding cases where permanent workers increase (decrease) and temporary workers decrease (increase)*

| | All workers | Permanent | Temporary |
|---|---|---|---|
| Job creation | 8.3 | 5.2 | 3.1 |
| Job destruction | 7.1 | 4.0 | 3.0 |
| Job reallocation | 15.4 | 9.2 | 6.2 |

TABLE 9. Baseline results

| Moment | Data | Baseline | No temporary workers |
|---|---|---|---|
| Adjustment cost/output | — | 0.042 | 0.047 |
| Correlation (ΔPermanent, ΔTemporary | -0.378 | -0.136 | — |
| Fraction of plants with temporary workers | 0.35 | 0.153 | — |
| Temporary employment rate | 0.135 | 0.092 | — |
| Job creation permanent workers | 0.081 | 0.086 | 0.139 |
| Job destruction permanent workers | 0.064 | 0.086 | 0.139 |
| Job creation temporary workers | 0.053 | 0.064 | — |
| Job destruction temporary workers | 0.062 | 0.064 | — |
| Job creation all workers | 0.102 | 0.139 | 0.139 |
| Job destruction all workers | 0.092 | 0.139 | 0.139 |

TABLE 10. Effects of a 10 percent increase in firing cost

| Moment | Data | Baseline | $\tau_{f_2}$ |
|---|---|---|---|
| Adjustment cost/output | – | 0.042 | 0.042 |
| Correlation (ΔPerm., ΔTemp.) | -0.378 | -0.136 | -0.134 |
| Fraction of plants with temporary workers | 0.35 | 0.153 | 0.153 |
| Temporary employment rate | 0.135 | 0.092 | 0.096 |
| Job creation permanent workers | 0.081 | 0.086 | 0.083 |
| Job destruction permanent workers | 0.064 | 0.086 | 0.083 |
| Job creation temporary workers | 0.053 | 0.064 | 0.067 |
| Job destruction temporary workers | 0.062 | 0.064 | 0.067 |
| Job creation all workers | 0.102 | 0.139 | 0.139 |
| Job destruction all workers | 0.092 | 0.139 | 0.139 |

Note: Firing cost parameter $\tau_{f_2}$ is increased by 10 percent.

TABLE 11. Shock volatility and job Reallocation

| Moment | Data | Baseline | $\rho$ | $\sigma_\eta$ |
|---|---|---|---|---|
| Adjustment cost/output | – | 0.042 | 0.050 | 0.052 |
| Correlation (ΔPerm., ΔTemp.) | -0.378 | -0.136 | -0.164 | -0.151 |
| Fraction of plants with temporary workers | 0.35 | 0.153 | 0.174 | 0.182 |
| Temporary employment rate | 0.135 | 0.092 | 0.085 | 0.112 |
| Job creation permanent workers | 0.081 | 0.086 | 0.110 | 0.114 |
| Job destruction permanent workers | 0.064 | 0.086 | 0.110 | 0.114 |
| Job creation temporary workers | 0.053 | 0.064 | 0.056 | 0.077 |
| Job destruction temporary workers | 0.062 | 0.064 | 0.056 | 0.077 |
| Job creation all workers | 0.102 | 0.139 | 0.153 | 0.175 |
| Job destruction all workers | 0.092 | 0.139 | 0.153 | 0.175 |

Changes in plant-level shocks are made by respectively by increasing $\rho$ and $\sigma_\eta$ so that the standard deviation of the plant-level shock increases by 10 per cent.

TABLE 12. Sectoral shock and job Reallocation

| Moment | Data | Baseline | $z$ | No Temp. worker | $z$ |
|---|---|---|---|---|---|
| Adjustment cost/output | — | 0.042 | 0.044 | 0.047 | 0.047 |
| Correlation (ΔPermanent, ΔTemporary | -0.378 | -0.136 | -0.137 | | |
| Fraction of plants with temporary workers | 0.35 | 0.153 | 0.148 | — | – |
| Temporary employment rate | 0.135 | 0.092 | 0.091 | — | – |
| Job creation permanent workers | 0.081 | 0.086 | 0.090 | 0.139 | 0.140 |
| Job destruction permanent workers | 0.064 | 0.086 | 0.090 | 0.139 | 0.140 |
| Job creation temporary workers | 0.053 | 0.064 | 0.063 | — | – |
| Job destruction temporary workers | 0.062 | 0.064 | 0.063 | — | – |
| Job creation all workers | 0.102 | 0.139 | 0.141 | 0.139 | 0.140 |
| Job destruction all workers | 0.092 | 0.139 | 0.141 | 0.139 | 0.140 |

Changes in sectoral shock $z$ are made so that in each case the sectoral job reallocation rate increases by 25 percent.

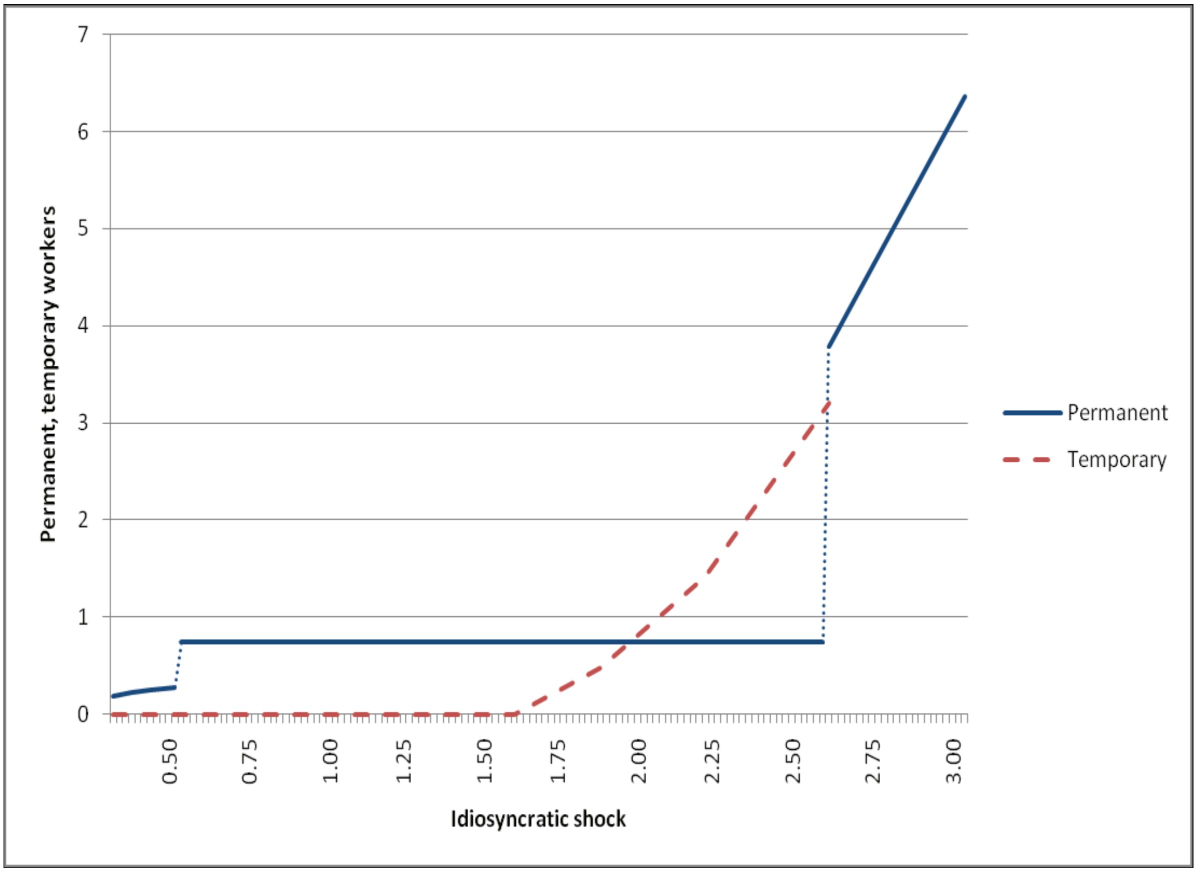


FIGURE 1. Policy function

**REFERENCES**


ABOWD, J. M., AND F. KRAMARZ (2003): "The costs of hiring and separations," *Labour Economics*, 10(5), 499–530.

ADDA, J., AND R. W. COOPER (2003): *Dynamic Economics: Quantitative Methods and Applications*. The MIT Press.

AGUIRREGABIRIA, V., AND C. ALONSO-BORREGO (2009): "Labor Contracts and Flexibility: Evidence from a Labor Market Reform in Spain," Working Papers tecipa-346, University of Toronto, Department of Economics.

ALONSO-BORREGO, C., J. FERNANDEZ-VILLAVERDE, AND J. E. GALDON-SANCHEZ (2006): "Evaluating Labor Market Reforms A General Equilibrium Approach," Unpublished, University of Pennsylvania.

AMANO, R. A. (1995): "Empirical Evidence on the Cost of Adjustment and Dynamic Labour Demand," Working Papers 95-3, Bank of Canada.

BALAKRISHNAN, R. (2008): "Canadian Firm and Job Dynamics," IMF Working Papers 08/31, International Monetary Fund.

BALDWIN, J. R., A. FISHER, W. GU, F. C. LEE, AND B. ROBIDOUX (2008): "Capital Intensity in Canada and the United States, 1987 to 2003," The Canadian Productivity Review 2008018e, Statistics Canada, Micro-economic Studies and Analysis Division.

CABALLERO, R. J., E. M. R. A. ENGEL, AND J. HALTIWANGER (1997): "Aggregate Employment Dynamics: Building from Microeconomic Evidence," *American Economic Review*, 87(1), 115–37.

CABRALES, A., AND H. A. HOPENHAYN (1997): "Labor Market Flexibility and Aggregate Employment Volatility," *Carnegie-Rochester Conference Series on Public Policy*, 46, 189–228.

CAMPBELL, J. R., AND J. D. M. FISHER (2004): "Idiosyncratic Risk and Aggregate Employment Dynamics," *Review of Economic Dynamics*, 7(2), 331–353.

CAO, S., AND D. LEUNG (2010): "Labor flows, relative prices and productivity," Working paper 2010-2, Bank of Canada.

COOPER, R., AND J. WILLIS (2009): "The Cost of Labor Adjustment: Inferences from the Gap," *Review of Economic Dynamics*, 12(4), 632–647.

COOPER, R. W., J. C. HALTIWANGER, AND J. WILLIS (2004): "Dynamics of Labor Demand: Evidence from Plant-level Observations and Aggregate Implications," NBER Working Papers 10297, National Bureau of Economic Research, Inc.

DAVIS, S. J., R. J. FABERMAN, AND J. HALTIWANGER (2006): "The Flow Approach to Labor Markets: New Data Sources and Micro-Macro Links," *Journal of Economic Perspectives*, 20(3), 3–26.

DAVIS, S. J., AND J. HALTIWANGER (1999): "Gross job flows," in *Handbook of Labor Economics*, ed. by O. Ashenfelter, and D. Card, vol. 3 of *Handbook of Labor Economics*, chap. 41, pp. 2711–2805. Elsevier.

FRIESEN, J. (2005): "Statutory firing costs and lay-offs in Canada," *Labour Economics*, 12(2), 147–168.

GALARNEAU, D. (2005): "Earnings of Temporary Versus Permanent Employees," *Perspectives on Labour and Income*, 6(1), 3–18.

HAMERMESH, D. S. (1989): "Labor Demand and the Structure of Adjustment Costs," *American Economic Review*, 79(4), 674–89.

HAMERMESH, D. S., AND G. A. PFANN (1996): "Adjustment Costs in Factor Demand," *Journal of Economic Literature*, 34(3), 1264–1292.

HOPENHAYN, H., AND R. ROGERSON (1993): "Job Turnover and Policy Evaluation: A General Equilibrium Analysis," *Journal of Political Economy*, 10(5), 915–38.

J. TURCOTTE, A. L., AND C. MONTMARQUETTE (2002): "New Evidence on the Determinants of Training in Canadian Business Locations," Evolving Workplace Series Paper W-02-93, Applied Research Branch, Strategic Policy, Human Resources Development Canada.

JIN, S., Y. ONO, AND Q. ZHANG (2007): "Demand volatility and the lag between the growth of temporary and permanent employment," Working Paper Series WP-07-19, Federal Reserve Bank of Chicago.

LEVINSOHN, J., AND A. PETRIN (2003): "Estimating Production Functions Using Inputs to Control for Unobservables," *Review of Economic Studies*, 70(2), 317–341.

ONO, Y. (2009): "Why do firms use temporary workers?," *Chicago Fed Letter*, (Mar).

ONO, Y., AND D. G. SULLIVAN (2006): "Manufacturing plants' use of temporary workers: an analysis using census micro data," Working Paper Series WP-06-24, Federal Reserve Bank of Chicago.

ONO, Y., AND A. ZELENEV (2003): "Temporary help services and the volatility of industry output," *Economic Perspectives*, (Q II), 15–28.

TAPP, S. (2007): "Lost in Transition: The Costs and Consequences of Sectoral Labour Adjustment," Working Papers 1142, Queen's University, Department of Economics.

VAREJÃO, J., AND P. PORTUGAL (2007): "Employment Dynamics and the Structure of Labor Adjustment Costs," *Journal of Labor Economics*, 25, 137–165.

ZEYTINOGLU, I. U., G. B. COOKE, AND S. L. MANN (2009): "Flexibility: Whose Choice is it Anyway?," *Industrial Relations*.