Estimating the Impact of the Québec’s Work Incentive Program on Labour Supply: An Ex Post Microsimulation Analysis

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\textbf{Abstract}

In 2005, a wage subsidy program was established in Québec to encourage low-income individuals, particularly recipients of social assistance, to work, by offering them fiscal relief. We analyse the effect of this program (the \textit{Prime au travail}) with a microsimulation model which determines the impact on the labour supply. We estimate the variation in the labour supply at the extensive and intensive margins which allows us to grasp both the income effect and the substitution effect of the \textit{Prime au travail} on individuals’ willingness to work. On the other hand, our labour supply model has the necessary characteristics to link it to a general equilibrium model and offer an integrated macro-microsimulation analysis. Nonetheless, unlike the usual microsimulation models employed in integrated macro-microsimulation analysis, we provide a number of innovations, notably the analysis at the intensive margin so that it captures both the substitution effect and the income effect. Our results show that a number of individuals entered the labour market in response to the \textit{Prime au travail}, while others decided to work fewer hours, due to increased income linked to the program. Ultimately, the variation in labour supply was less in the intensive margin than in the extensive margin and it is positive for all types of households, with the exception of female single parents.

\textit{Key words:} Labour supply, reservation wage, public policy
\textit{JEL Codes:} J22, J39, J68

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Introduction

One goal of governments is to provide a social safety net for individuals who have difficulty finding work, as well as for low-income individuals and those with unstable employment situations. Consistent with this objective, governments seek to develop a vigorous labour market which allows for a reduction in unemployment insurance benefits and social assistance, as well as an increase in tax revenue. Today the use of wage subsidy programs is very popular as a means of helping households (Gradus and Julsing (2001); and Périvier (2003)), notably because studies on training programs have shown them to have very limited success in terms of their objectives of reducing dependence on transfer programs (Lacroix and Brouillette, 2011). Along the same lines, a number of countries have developed work incentive programs, for example, the American program Earned Income Tax Credit (EITC) and the British program Working Family Tax Credit (WFTC). Studies of the reforms of these programs conclude that, on average, they have increased the percentage of female single-parent activity by five percentage points. Furthermore, results show that single mothers would work one or two hours more a week.

Concerning the effects on couples, Eissa and Hoynes (2004) and Scholz (1996) conclude that the activity level of married women diminished by between two and four percentage points, while that of married men increased by one percentage point after the EITC reforms.

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6 See Eissa and Liebman (1996). Brewer and Bowne (2006) refer to three studies, including an analysis of hours worked (Blundell et al. (2005), Gregg and Harkness (2003) and Leigh (2005)).
Doubtless, an analysis of couples’ decisions is more complex than that of singles. The explanation for the declining female activity rate in Eissa and Hoynes (2004) is based on the fact that 73% of women have income in the declining segment of the tax credit. On the other hand, granting them a credit as a function of the incomes of the two spouses, added to the fact that the woman’s income is generally lower, means that the net gain for the couple is relatively minor. Indeed, for each dollar a wife earns, the credit decreases, thus reducing her incentive to work.

In 2005, the Québec government established its own wagework incentive program, the Prime au travail, replacing the APPORT program. This program aims to lessen the implicit rate of taxation of low-income individuals, including those on social assistance. Indeed, the shift from social assistance to low-paid employment involves a very high implicit rate of taxation, mainly due to the reduction of social assistance benefits. The Prime au travail, as a reimbursable tax credit, lessens this implicit rate of taxation when low-income individuals increase their employment income. Thus, it allows low employment income individuals to have more income available to them and, therefore, to raise themselves further above the low income cut-offs.

Several authors have studied the effects of the Prime au travail. Lafond-Bélanger (2007) concluded that women with partners and children were 3.15% more likely to choose not to work while there are 2.15% fewer women who choose to work 45 hours a week. Fortin, Lacroix and Parisé (2007) show that single women’s participation in the labour market
increased by 0.6 percent. Nonetheless, some women who were working fulltime now seem to be choosing part-time work (0.8%). When we consider only single mothers, they have increased their participation in the labour market by 1.9%. Godbout and Arseneau (2005) mention that they doubt the effectiveness of the tax credit on willingness to work, since, in addition to the amounts being small for most beneficiaries, the wait before receiving the tax credit is such that this measure would have to be significantly increased to have a major impact on individuals’ desire to work. Finally, the effect on men was estimated in the experimental study of Brouillette and Fortin (2008) and their results reveal that the *Prime au travail* does not encourage single people to accomplish more tasks.

The objective of this article is to assess and develop a microsimulation model of labour supply and then to determine the impact on the labour supply of the *Prime au travail* in two ways: first, at the extensive margin, that is the variation of labour supply in terms of participation in the labour market; and secondly, at the intensive margin, that is the variation in terms of number of hours worked. Subsequently, we would like to compare and verify whether there is a significant gap between the results of the two components of the variation. Indeed, the *Prime au travail* has an effect on income and a substitution effect on the labour supply of households. On one hand, the substitution effect is characterized by the increased implicit cost of leisure when an individual earns a better wage, which leads the individual to work more. On the other hand, the subsidy increases the net revenue of individuals, which allows them to indulge in more leisure activity and which potentially diminishes the supply in the number of hours of

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7 These results are associated with simulations where women had a 50% rate of participation in the APPORT program before the establishment of the *Prime au travail.*
work. It is uncertain what impact the combination of the two effects will have and the result depends on agents’ preferences.

Our analysis reveals the advantage of creating a microsimulation model which could be linked to a calculable general equilibrium model (CGEM), thus allowing to capture the effect of the Prime au travail for the entire economy. This process is interesting since the in and out movement to and from the labour market cannot be modelled with the CGEM as stated in Bourguignon, Robillard and Robinson, 2005. The macro-microsimulation analysis, therefore, offers the advantages of microsimulation models, that is, those arising from the disaggregation of data, and the advantages of the CGEM, which make it possible to obtain results for the economy of the province of Québec. Furthermore, our work is the first ex post analysis of the program using effective data associated with the program.

The rest of the article will be presented as follows. Section 1 presents the Prime au travail (work incentive), we continue with the presentation of the microsimulation labour supply model (Section 2), and then we have a brief section discussing the data used in the study (Section 3). Finally, we present the integration of a microsimulation model and a CGEM (Section 4) and then we analyse our results (Section 5), followed by a few concluding remarks.

1. The Prime au travail (work incentive)

The tax credit is allocated according to the type of household. (see Figure 1.) Single-parent families, as well as couples with children, receive more generous benefits than singles and
couples without children. The *Prime au travail* grows first with the increase in employment income, and then when it reaches a certain threshold, it declines. When it is in the increasing segment, the tax credit is based on employment incomes while, when it is in the decreasing portion, it is based on net income\(^8\) (Brouillette and Fortin, 2008). These benefit conditions were established by the Quebec Ministry of Finance to ensure that individuals with low employment incomes, but whose net income was larger, would not be eligible for the tax credit. Thus, the tax credit increases, up to a certain threshold, as a function of employment income and decreases according to net family income which includes other sources of revenue, for example investment income, as well as the incomes of partners, for those who are part of a couple. Finally, it is important to stress that the maximum amounts for the *Prime au travail* have been adjusted to be coherent with the amount corresponding to the exit of social assistance (welfare program).

\(^8\) For single-parent families, alimony must be considered when one is referring to net income.
Let us stress that the *Prime au travail* is a reform of the APPORT program (1988-2004). Three major differences distinguish these two programs. First, the APPORT program was only available for single and two-parent families, while the *Prime au travail* covers a wider range of individuals, including childless singles and couples. Another key difference between the two measures is the way in which they are administered. For the APPORT program, individuals had to know of its existence in order to request the benefits. There was also the risk of having to reimburse some or all of the benefits if the predicted incomes were wrong,
since the benefits were allocated according to incomes. Finally, tests of assets and complicated rules for application that were difficult to communicate were such that social assistance officers had trouble explaining them to the potential beneficiaries (Fortin et al., 2007). On the opposite, the *Prime au travail* is a reimbursable tax credit. In addition, the demand for the latter is processed when filing the income tax, which greatly simplifies its administration (Brouillette and Fortin, 2008). For all these reasons, approximately 30,000 benefitted annually from APPORT for an annual budget of 26 million dollars (Godbout and Arseneau, 2005), while in 2006, 566,000 people benefited from a tax credit from the *Prime au travail* for a total governmental expenditure of 351 million dollars (Quebec Ministry of Finance, 2006).

2. **The microsimulation model**

The construction of our labour supply model is based on the work of Heckman and Sédlacek (1985) who developed an empirical equilibrium model of self-selection, recognizing the existence of heterogeneous skills, some of which were observable (measured) and others not. This method allows us to estimate the reservation wage, that is, the wage starting from which individuals are ready to offer their labour. Thus, the authors represent Roy’s theoretical model (1951) based on heterogeneous skills. Furthermore, from an integrated macro-microsimulation analytical perspective, Boccanfuso and Savard (2012), as well as Cury, Coelho and Pedrozo (2009) inspired our microsimulation model design, with the difference that these authors’ work included a formal and an informal labour market. This characteristic is generally

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9 In 2007, the Canadian federal government established the Working Income Tax Benefit, a program to encourage individuals to enter the workforce, and which is also a reimbursable tax credit.
associated with the context of developing countries. Therefore, we have adapted their respective approaches so that it only includes a formal labour market.

Our objective with our microsimulation model is to estimate what the situation would have been in 2006 without the *Prime au travail*, and then to determine the variation between this hypothetical situation and the observed situation. First, we analyse the impact of the *Prime au travail* on the labour supply at the extensive margin and, secondly, at the intensive margin. As explained earlier, we determine the variation at the intensive margin because this tax credit produces a substitution effect due to the increased cost of leisure but also an income effect. Indeed, it is possible that there was an expansion of the labour force supply with the entry of certain individuals into the labour market. Nonetheless, for those already in the labour market when the *Prime au travail* was established, it may be that the tax credit encourages them to work fewer hours; in other words, we may be witnessing the income effect. Our model allows us to verify the extent of the two effects.

2.1 Variation in labour supply at the extensive margin

Our labour supply model can be presented in two stages. First, we must compute individuals’ reservation wage, and then compare this to the market wage to determine whether or not the individual would choose to work. We do this for the situation with and without the tax credit. The labour supply is a function of market wage, other sources of income and individuals’ observable and nonobservable characteristics. For those who are not employed, wage is an unobserved variable. Based on Heckman and Sedlacek (1985), it is possible to express the
reservation wage as a function of individual characteristics, as well as nonemployment income. Heckman’s method (1979) allows us to correct for any possible endogenous selection bias caused by the fact that individuals who work can have certain nonobservable characteristics different from individuals who do not work. Thus, the use of a probit equation allows us to model the selection mechanism and partially correct for the selection bias. This permits us to predict the wage of individuals who do not work by using both the observable characteristics of individuals active in the labour market and the information available, to determine the probability of individuals being in the labour market. Therefore, we have two equations to determine the reservation wage, the former (Equation 1) being linear and the second being a probit type equation (Equation 2). The model is estimated with the maximum likelihood method.

\[
\log w_i = \alpha + \beta_1 \log Z_i + \beta_2 \log P_i + \lambda^* D^j + \mu^* X_i + u_i, \quad \forall i = 1, \ldots, n \quad (1)
\]

\[
\Pr(L_i = 1|Z_i, P_i, D^j, S_i) = \Phi\left[\mu_i\left(Z_i, P_i, D^j, S_i\right)\right]. \quad (2)
\]

The variables in the first equation are: \(w_i\) the employment income of the individual \(i\)\(^{10}\), and \(Z_i\) the total gross income of the individual’s household. The matrix \(D^j\), comprised of four dummies, represents the different employment fields: i) professional; ii) commercial; iii) service and iv) manufacturing. \(P_i\) is the amount of the Prime au travail that the individual \(i\) may receive\(^{11}\) and \(X_i\) is a collection of observable characteristics. This matrix is composed of

\(^{10}\) Employment income is equal to the sum of gross salary and self-employed income.

\(^{11}\) We are very aware that there is a problem with endogeneity due to the fact that receiving the Prime au travail depends on the level of employment income. In other words, the independent variable of employment income
the following variables: years of education, age, age squared, experience, gender and a dummy variable indicating whether an individual in the household receives social assistance. The choice of variables of employment income, total gross household income, benefits from the program (la Prime au travail), age and age squared, was inspired by the model of Cury et al. (2009). We have added the matrix $D^i$ for all types of professions (professional, commercial, service, manufacturing), since we assume that the Prime au travail does not affect all sectors equally and we would like to measure this differentiated effect. Furthermore, to precisely determine the reservation wage, we use the gender variable, experience and the dummy variable for social assistance. Indeed, the individual’s gender allows us to recognize the wage differential between men and women, and work experience allows us to discern an effect on wage due to an increase in the skills and productivity while the presence of an individual in the household who receives social assistance benefits is used as an approximation of the influence of household work habits on the individual $i$.

Equation 2 captures the probability that the individual $i$ is employed ($L=1$), in contrast to the probability that the individual is unemployed ($L=0$). Here, we find $Z_i$, $P_i$ and $D^i$, as in the linear regression. Furthermore, we have constructed a matrix $S_i$, which shares some variables of $X_i$: a dummy variable to indicate whether there is an individual receiving social assistance in the household, the level of education and the age. The matrix $S_i$ includes two additional variables: the number of young children, and the number of months since the individual $i$ had

seems directly linked to the explanatory variable of the Prime au travail. This is extremely difficult to untangle since it is not easy to find valid instruments to counter the problem.
his or her last job. The number of young children (less than six years old) is frequently used in labour supply models, such as those of Heckman (1974) and Fortin et al. (2007), to assess the constraint of having children. The variable of the number of months since the individual \( i \) last worked is justified by the fact that this allows us to grasp several factors linked to the psychology of the individual, such as discouragement, the loss of confidence in his or her capacity to work, a loss of interest in employment, etc. We think that this variable captures a negative effect on the probability of employment when individuals have been inactive for a long time.

Thus, individuals working in 2006 compare their reservation wage (\( \bar{w}_i \)) with their employment income, as observed in the survey (\( w_i \)), that is the market wage. If the reservation wage is greater than the market wage, the individual does not wish to work. If it is inferior, the individual wishes to work. For example, some individuals decided not to work once the tax credit was offered in 2006 and that means that their reservation wages were then higher than those of the market. Therefore, our model could be synthesized in the following manner:

\[
\begin{align*}
    \text{If } \bar{w}_i & \leq w_i, \quad \text{then the individual } i \text{ wants to work} \\
    \text{If } \bar{w}_i & > w_i, \quad \text{then the individual } i \text{ does not want to work}
\end{align*}
\]

\[^{12}\] We have found that these variables have a greater impact on the probability of the individual working than on the level of employment income and this is the reason why these variables are only found in the probit equation and not in the OLS equation.
In order to be able to compare the reservation wage with the market wage, one must calculate the reservation wage. By adding up the predicted values ($\hat{\omega}_i$) and residuals ($u_i$), we obtain the reservation wage with the Prime au travail ($\bar{\omega}_i$) (Equation 3).

$$\bar{\omega}_i = \hat{\omega}_i + u_i, \text{ où } u_i \sim N(0,s^2).$$  

The residuals ($u_i$) of Equation 3 represents characteristics stemming from nonobservable factors. The values of our residuals were calibrated to reproduce the initial situation (Creedy and Kalb, 2005). For this procedure, we selected among many random draws of residuals, the one that has a normal distribution with an average of 0, and a variance equal to $s^2$ (variance of Heckman’s (1979) model). This situation is that of 2006 when the Prime au travail was established. It is characterized by the fact that the individuals who received employment income in 2006 necessarily had a reservation wage less than that, as noted previously. The choice of a somewhat random draw allows us to use the available information, whether the individual had decided to work or not. So, as explained in Equation 4, we have chosen $u_i$ so that the reservation wage will be less than that of the market for the individuals who decided to work.

$$\hat{\omega}_i + u_i < w_i, \text{ où } u_i \sim N(0,s^2).$$  

To illustrate the calibration of residuals, let us take, for example, an individual who earned employment income of $5,000 in 2006. We consider that this individual decided to work in a state of perfect information and that, for this reason, his or her reservation wage was necessarily inferior to $5,000. The use of the calibration method allows us to ensure that the draw amongst the residuals will not lead to a reservation wage above $5,000 in this particular
Eighteen draws on the normal distribution allow us to reproduce the initial sample quite well, that is to reflect the optimal work choice of individuals in the context of the *Prime au travail* program.

To determine the reservation wage in the situation without the tax credit ($\bar{w}_i^0$), we withdraw from the reservation wage with the tax credit ($\bar{w}_i^1$) the estimated coefficient associated with the tax credit ($\beta_2 \log P$) (Equation 5). In other words, we obtain the reservation wage for individuals in case they did not receive the tax credit in 2006.

$$\bar{w}_i^0 = \bar{w}_i^1 - \beta_2 \log P_i, \quad (5)$$

Finally, we simply have to determine the variation between the labour supply and the extensive margin produced by the *Prime au travail*. Subtracting the effect of the tax credit from the reservation wage allow individuals to change their labour employment status. The integration of the tax credit lowers the reservation wage of certain individuals to the point where their market wage is greater than their reservation wage and they decide to join the labour force when there is a *Prime au travail*. The variation in the reservation wage was obtained by subtracting the coefficient associated with the tax credit multiplied by the vector of the tax credit. This means that individuals receiving benefits equal to zero have no variation in their labour supply. Intuitively, we capture the variation of labour supply of individuals if the *Prime au travail* in 2006 had not existed.
2.2  The variation in labour supply at the intensive margin

The objective of this section is to present an estimation of the effect of the *Prime au travail* on labour supply in terms of number of hours worked. We are trying to determine whether the *Prime au travail* encourages individuals to work more or fewer hours if they benefit from the program. The first stage is to consider Heckman’s model (1979) to correct the endogeneity bias, since the number of hours worked, like employment income, depends of whether one works or not. The second stage is to estimate what would have been the number of hours worked if the tax credit had not been established.

The number of hours worked is taken from the Survey of Labour and Income Dynamics (SLID-2006) and is represented by the variable $h_i$. We used the same variables as those in Heckman’s estimates to determine reservation wages with the linear regression (Equation 6 below), with the exception of a new variable, the hourly wage rate $\omega$.\(^\text{13}\) The latter was suggested by Blundell and Macurdy (1999) and is justified by the increased opportunity cost of leisure time as the hourly wage increases.\(^\text{14}\)

Equation 7, the probit equation, allows us to calculate the probability that the individual $i$ has a job ($L=1$), as opposed to the probability that the individual is unemployed ($L=0$). Here we use $Z_i$ and $P_i$ from our previous equations. The matrix $K_i$ is comprised of the number of

\[^{13}\text{This variable, like the number of hours worked, is only available for individuals who worked during the year.}\]

\[^{14}\text{Nonetheless, we are aware that we are witnessing a shift in the labour supply so that, past a certain threshold, the opportunity cost of working sometimes becomes very high and individuals prefer to have more leisure. (See Hanoch (1965, p.639), Brazel and McDonald (1973, p.625) and Stern (1986)).}\]
completed years of schooling, the presence of an individual on social assistance in the household, and the number of months since that individual \( i \) last worked, as well as the square of that last variable.

\[
h_i = \alpha + \beta_1 \log Z_i + \beta_2 \log P_i + \beta_3 \log \sigma_i + \lambda^* D^i + \mu^* X_i + u_i, \quad \forall i = 1, \ldots, n \quad (6)
\]

\[
\Pr(L_i = 1|Z_i, P_i, K_i) = \Phi\left\{\mu_i(Z_i, P_i, K_i)\right\} \quad (7)
\]

With the estimation of these two equations with the maximum likelihood method, we obtain the adjusted number of hours worked. This calculation serves two purposes. First, it allows us to obtain a number of hours for the individuals who do not work. Secondly, the number of hours adjusted before the tax credit and the number of hours adjusted after the tax credit generate the variation in the number of hours worked. In calculating the number of hours adjusted, contrary to the calculation of the reservation wage, we are interested here in this level estimate and not as that of a threshold. By threshold, we are referring to the fact that the individual is choosing to work if his or her market wage is greater than the threshold of the reservation wage. In the present case, we use all the estimations for each individual to calculate the variation in the labour supply at the intensive margin.

The addition of an error term drawn from a normal distribution with an average of 0 and variance \( s^2 \) coming from our model (Equations 6 and 7) to predicted values \( \hat{h}_i^1 \) is equal to the adjusted number of hours worked \( \overline{h}_i^1 \) (Equation 8). In other words, \( \overline{h}_i^1 \) is the number of hours worked with the *Prime au travail*. In the model, the residuals represent the characteristics stemming from unobservable factors.
\[
\bar{h}_i = \hat{h}_i + u_i, \quad \text{où} \quad u_i \sim N(0, \sigma^2). \quad (8)
\]

To determine the number of hours worked in the situation without the tax credit, we subtract from the number of hours worked in the situation with the *Prime au travail* (\(\bar{h}_i\)) the estimated coefficient multiplied by the vector of the tax credit (\(\beta_2 \log P\)) (Equation 9). Thus, we obtain the adjusted number of hours for individuals in the hypothetical situation in which they would not have benefited from the tax credit in 2006.

\[
\bar{h}_i^0 = \bar{h}_i - \beta_2 \log P_i. \quad (9)
\]

The calculation at the intensive margin includes one more stage than the calculation of the variation in labour supply at the extensive margin. Indeed, in order to guarantee consistency throughout the model, the number of hours worked also depends on the individual’s decision to work. If the reservation wage is greater than the market wage, it is logical that the individual would not work and would be assigned 0 as the number of hours worked. On the other hand, if the individual wishes to work, he or she works an adjusted number of hours. These indications are valid for the situation with and without the tax credit.

The results of the microsimulation model are presented in Section 5 as a function of gender, as well as of the type of household to which the individual belongs (single without children, single-parent families, couples with children or couples without children).
3. The data

The Survey of Labour and Income Dynamics (SLID) of 2006, by Statistics Canada, is the data base used for this application. We retained the population aged 18 to 65 to analyse the Prime de travail. Indeed, on one hand, the tax credit is not available for individuals under 18. On the other hand, it seems plausible that individuals over 65 are little affected by the Prime au travail, since this is the usual age when government pensions start or when social assistance ends. Thus, the sample diminished from 10,197 observations to 8,186 observations.

With the data from SLID 2006, we have calculated the amount of Prime au travail associated with each individual for the year 2006. It is possible to find in the survey almost all the data needed for its calculation, while the missing data have only a minor influence on the amount of the tax credit. During the year, individuals might have been beneficiaries of unemployment insurance, employed or inactive, or a mixture of two of these characteristics. Employment incomes are the sum of wage payments and self-employment incomes. To compute the amount of the Prime au travail that each household received, we have done the necessary calculations relative to Annex P of the income tax report (“Crédits d’impôt relatifs à la prime au travail” [“Tax Credits Relative to the Prime au travail”]). Secondly, we weighted the individuals in the SLID to be able to extrapolate the results from our sample and apply them to the population of the province. The weighting led to a slight overestimation of the Prime au travail: in 2006, the Québec government spent 351 million dollars for the tax credit, while our calculation of the Prime au travail with the SLID sample is a total expenditure of 402 million
dollars. Once the tax credits were evaluated for each household, we separated, for those with a spouse, the couple’s total allocation proportional to their respective employment income. In other words, if an individual receives $5,000 in employment income and his or her spouse receives $10,000, the former will receive a third of the *Prime au travail* and his or her spouse will receive two thirds.\textsuperscript{15}

Finally, in using dummies associated with professional sectors, we note in Table 1 that the *Prime au travail*,\textsuperscript{16} while it does not depend at all on employment sectors, was distributed nonproportionally to various employment sectors. This fact is linked to the specific characteristics of work in these sectors. When we analyse descriptive statistics, we notice that the main beneficiaries, in terms of percentage of beneficiaries by sector, are individuals working in the commercial and service sectors. Nonetheless, in total, it is in the professional sector that exhibit the highest number of beneficiaries. Indeed, 33\% of individuals who receive the *Prime au travail* work in this sector.

\textsuperscript{15} We are aware that the allocation of financial resources within a household does not necessarily work that way. A literature has developed around labour supply models that consider the spouse’s role in decision-making process for labour supply (Chiappori (1988), and Browning \textit{et al.} (1994)). In our model, the only element considered is total household income. Nonetheless, it must be highlighted that consideration of the spouse’s decision in a labour supply model refers to complex models which simplification of other specifications (Creedy and Kalb, 2005).

\textsuperscript{16} The data from the *Prime au travail* were not available from SLID 2006. The estimation was inspired by data from the survey and is explained in Section 3.1.
Table 1 – Descriptive Statistics in the Four Sectors of Employment

<table>
<thead>
<tr>
<th>Sector</th>
<th>Number of obs.</th>
<th>% of Sample</th>
<th>Mean</th>
<th>Median</th>
<th>Beneficiaries amongst all recipients of the tax credit</th>
<th>Beneficiaries in this sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional</td>
<td>3119</td>
<td>38%</td>
<td>$39,080</td>
<td>$34,000</td>
<td>33%</td>
<td>12%</td>
</tr>
<tr>
<td>Commercial</td>
<td>494</td>
<td>6%</td>
<td>$21,850</td>
<td>$14,930</td>
<td>14%</td>
<td>33%</td>
</tr>
<tr>
<td>Service</td>
<td>896</td>
<td>11%</td>
<td>$18,200</td>
<td>$13,500</td>
<td>24%</td>
<td>33%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1,705</td>
<td>21%</td>
<td>$31,720</td>
<td>$29,000</td>
<td>26%</td>
<td>19%</td>
</tr>
<tr>
<td>Other</td>
<td>139</td>
<td>2%</td>
<td>$78,210</td>
<td>$34,000</td>
<td>3%</td>
<td>31%</td>
</tr>
</tbody>
</table>

Source: SLID 2006

4. Integration of the microsimulation model and the CGEM

It is important to stress that the microsimulation model that we have constructed will be integrated, in an extension, CGEM of the Ministry of Finance. In this section, we briefly explain the process which allows us to link the microsimulation model and the CGEM.\(^\text{17}\) In Figure 5, we present the way in which the two models are linked. The microsimulation model determines the variation in the labour supply and the total amount of the *Prime au travail* allocated to each individual. We feed the variation of the labour supply into the CGEM. The *Prime au travail*, as a transfer payment, will be provided by the Québec provincial government to Québec households. The integration of the *Prime au travail* then occurs by increasing a transfer within the CGEM.\(^\text{18}\)

\(^\text{17}\)This element is very important, since it conditioned the construction of our microsimulation model.

\(^\text{18}\)In the CGEM, the government must finance its policy with a distortionary tax. The distortionary effects are captured by the CGEM.

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According to the classification of CGEM-microsimulation framework proposed by Boeters and Savard (2012), this type would be classified in the *Bottom Up* framework. The advantage of these models is that the wealth of microeconomic data allows us to avoid the problem of aggregation error linked to the use of a representative agent in a CGEM (Savard, 2006). In addition, the microsimulation model with our labour supply allows us to take into account occupational switches\(^\text{19}\) (Bourguignon, Robillard and Robinson, 2005). Since one of the objectives of the *Prime au travail* is getting people off social assistance, it is important to incorporate occupational switches in the analysis. Indeed, the fact that certain individuals begin or finish with employment in the microsimulation model gives rise to a major variation in household income and well-being.

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\(^{19}\) By occupational switches, we mean the shift from the status of worker to that of a nonworker and vice-versa.
5. The results

First, we present an analysis of the estimation of the econometric model, and then we continue with the presentation of the results of the microsimulation model, with a decomposition by type of household, as well as of the individual’s gender. Subsequently, we do a comparative analysis at the intensive and extensive margin.

5.1 Estimation of the model

Without doing an exhaustive analysis of the results of econometric regressions, we stress the relevance of certain estimations, starting with the coefficient associated with the Prime au travail in the two models. In the first model where we determine the reservation wage of each individual, the estimated coefficient associated with the logarithm of the tax credit is negative (Table 2). This informs us that receiving the Prime au travail might contribute to diminishing the reservation wage, which is consistent with economic intuition. Indeed, the fact of receiving a tax credit is such that even if the individual earns less money in employment income, his or her income cannot remain unchanged, due to the tax credit. Thus, individuals have been ready to work for less salary after the establishment of the Prime au travail. Therefore, individuals whose reservation wage falls below the market wage choose to work. Analysis at the extensive margin showed an increase in tax credit recipients’ labour supply.
Table 2 – Results of the Regression Model with Employment Incomes

<table>
<thead>
<tr>
<th>Wage equation: log (employment income)</th>
<th>Coefficients</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log (tax credit)</td>
<td>-0.0344</td>
<td>** 0.0071</td>
</tr>
<tr>
<td>Professional (dummy)</td>
<td>1.5222</td>
<td>** 0.1377</td>
</tr>
<tr>
<td>Service (dummy)</td>
<td>1.1750</td>
<td>** 0.1357</td>
</tr>
<tr>
<td>Commercial (dummy)</td>
<td>1.2745</td>
<td>** 0.1454</td>
</tr>
<tr>
<td>Manufacturing (dummy)</td>
<td>1.3965</td>
<td>** 0.1350</td>
</tr>
<tr>
<td>Log (gross household income)</td>
<td>0.5046</td>
<td>** 0.0316</td>
</tr>
<tr>
<td>Presence of an individual on social assistance</td>
<td>-0.4967</td>
<td>** 0.1129</td>
</tr>
<tr>
<td>Number of years of education completed</td>
<td>0.0362</td>
<td>** 0.0058</td>
</tr>
<tr>
<td>Age</td>
<td>0.1409</td>
<td>** 0.0107</td>
</tr>
<tr>
<td>Sex</td>
<td>0.3275</td>
<td>** 0.0352</td>
</tr>
<tr>
<td>Years of work experience</td>
<td>0.0108</td>
<td>** 0.0020</td>
</tr>
<tr>
<td>Age squared</td>
<td>-0.0018</td>
<td>** 0.0001</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.1638</td>
<td>0.3891</td>
</tr>
</tbody>
</table>

| Equation of selection: Pr(L=1|z)                      | Coefficients | Standard deviation |
|-----------------------------------------------------------|--------------|--------------------|
| Log (tax credit)                                          | 0.7608       | ** 0.1356          |
| Professional (dummy)                                     | 2.2228       | ** 0.1022          |
| Service (dummy)                                          | 2.1240       | ** 0.1379          |
| Commercial (dummy)                                       | 2.3493       | ** 0.1739          |
| Manufacturing (dummy)                                    | 2.4803       | ** 0.1174          |
| Number of children aged 5 and under                      | -0.1478      | ** 0.0799          |
| Presence of an individual on social assistance            | -0.7670      | ** 0.1299          |
| Number of months since last job                          | -0.0033      | ** 0.0009          |
| Log (gross income of the household)                      | 0.4284       | ** 0.0446          |
| Number of years of education completed                   | 0.0172       | 0.0113             |
| Age                                                      | -0.0110      | ** 0.0029          |
| Constant                                                 | -4.6448      | ** 0.4999          |

| Number of observations                                    | 8185         |
| Number of censored observations                          | 1497         |
| Log pseudolikelihood                                     | -6183535     |

| Wald test (rho=0)                                         | chi2(1)=56.06| Prob>chi2=0        |

Note: ** coefficient significant at 1%; * significant at 5%, Source: authors’ estimates
Table 3 – Results of the Regression Model with Number of Hours Worked as the Dependent Variable

<table>
<thead>
<tr>
<th>Equation of the number of hours</th>
<th>Coefficients</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log (tax credit)</td>
<td>-27.0882</td>
<td>** 5.9580</td>
</tr>
<tr>
<td>Log (gross hourly wage)</td>
<td>43.7992</td>
<td>27.5289</td>
</tr>
<tr>
<td>Professional (dummy)</td>
<td>928.0679</td>
<td>** 82.7283</td>
</tr>
<tr>
<td>Service (dummy)</td>
<td>762.7553</td>
<td>** 78.4104</td>
</tr>
<tr>
<td>Commercial (dummy)</td>
<td>841.5636</td>
<td>** 84.6738</td>
</tr>
<tr>
<td>Manufacturing (dummy)</td>
<td>953.7392</td>
<td>** 78.6177</td>
</tr>
<tr>
<td>Log (gross household income)</td>
<td>61.6168</td>
<td>** 20.2040</td>
</tr>
<tr>
<td>Presence of an individual on social assistance</td>
<td>-281.3345</td>
<td>** 59.8857</td>
</tr>
<tr>
<td>Number of years of education completed</td>
<td>-13.5490</td>
<td>** 3.9602</td>
</tr>
<tr>
<td>Age</td>
<td>78.9089</td>
<td>** 6.5966</td>
</tr>
<tr>
<td>Gender</td>
<td>248.5974</td>
<td>** 25.5152</td>
</tr>
<tr>
<td>Years of work experience</td>
<td>7.5573</td>
<td>** 1.3409</td>
</tr>
<tr>
<td>Age squared</td>
<td>-0.9931</td>
<td>** 0.0789</td>
</tr>
<tr>
<td>Constant</td>
<td>-1412.7650</td>
<td>** 253.5886</td>
</tr>
</tbody>
</table>

**Equation of selection: Pr(L=1|z)**

<table>
<thead>
<tr>
<th></th>
<th>Coefficients</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log (tax credit)</td>
<td>0.6036</td>
<td>** 0.1151</td>
</tr>
<tr>
<td>Presence of an individual on social assistance</td>
<td>-1.0077</td>
<td>** 0.0939</td>
</tr>
<tr>
<td>Number of months since last employment</td>
<td>-0.0345</td>
<td>** 0.0024</td>
</tr>
<tr>
<td>(Number of months since last employment)^2</td>
<td>0.0001</td>
<td>** 0.0000</td>
</tr>
<tr>
<td>Log (gross household income)</td>
<td>0.4221</td>
<td>** 0.0355</td>
</tr>
<tr>
<td>Number of years of education completed</td>
<td>0.0363</td>
<td>** 0.0096</td>
</tr>
<tr>
<td>Constant</td>
<td>-3.5555</td>
<td>** 0.3849</td>
</tr>
</tbody>
</table>

Number of observations: 8170
Number of censored observations: 1497
Log pseudolikelihood: -33,100,000

**Wald Test (rho=0)**

<table>
<thead>
<tr>
<th>chi2(1)</th>
<th>Prob&gt;chi2=0</th>
</tr>
</thead>
<tbody>
<tr>
<td>102.19</td>
<td>0.00000</td>
</tr>
</tbody>
</table>

Note: ** coefficient significant at 1%; * significant at 5%; Source: authors’ estimates
As for the intensive margin analysis (Table 3), that is, the number of hours offered on the labour market, the econometric results generate a negative coefficient with the *Prime au travail*. In other words, for individuals who were already working without the *Prime au travail*, the fact of benefiting from the tax credit lessens the number of hours offered on the labour market. The economic reasoning behind this is based on the fact that these individuals, once they receive the tax credit, have a tendency to want to have more leisure time. Thus, those that benefit from the *Prime au travail* diminish the hours they offer on the labour market. However, it is important to note that that this is not always possible. The rigidities of the labour market are such that a good number of individuals are forced to work the number of hours required by their employer and not the opposite.²⁰

As for the other coefficients, we consider the econometric results associated with three characteristics: i) the professional sectors; ii) the presence of an individual on social assistance in the household; and iii) the number of months since the individual \( i \) last worked.

In Section 3 on descriptive statistics, we highlighted the differences between sectors of employment. Nonetheless, the estimated coefficients associated with these dichotomous variables might exhibit collinearity. However, we observe that, for the two analyses (intensive and extensive margins), the variables are significant at the 99% level. Therefore, it seems that the sector of occupation influences both the wage and the number of hours worked.

²⁰ The interaction between labour supply and labour demand will be performed in an extension to this paper when a link between the microsimulation model and the CGEM will be implemented.
The estimated coefficient for the presence in the household of a recipient of social assistance is, as we expected, negative in the linear equation, as in the probit equation. In other words, it lessens the reservation wage and the probability of an individual entering the labour market. Finally, the number of months since the individual $i$ last worked also proved to be a significant negative variable, as anticipated. Thus, we note that this variable, as well as the variable of the presence of an individual on social assistance in the household, allows us to take into account certain more psychological and sociological effects not directly found in the database, enabling us to improve the model.

The validity of our model requires us to reject the null hypothesis of the Wald test. Indeed, the choice of the Heckman model (1979) is based on the fact that we believe that the residuals of the wage equation are correlated with the residuals of the selection equation, that is, the probit equation. Similarly, the residuals of the equation for the number of hours should be correlated with the residuals of the selection equation. Therefore, it is important to verify this correlation in the two models, since if the residuals are not correlated, it is better to use a model of simple selection. The chi-squared statistic associated with the model that determines the reservation wage is $\chi^2(1) = 56.06$ and should be compared to $\chi^2_{0.99}(1) = 10.828$. Thus, the test reveals that the null hypothesis $\rho = 0$, where $\rho$ is the correlation between the residuals of the two equations, is rejected at the 99.9% confidence level.

As for the second regression, that is, the model whose dependent variable is the number of hours worked, the relevant chi-squared statistic is $\chi^2(1) = 102.19$, as compared to
\[ \chi^2_{0.999}(1) = 10,828. \] Thus, this test tells us that the null hypothesis \( \rho = 0 \) is also rejected at the 99.9% confidence level. The two Wald tests demonstrate a very significant correlation between the residuals of the linear equation and the probit equation, and justify the use of the Heckman model (1979) to analyse the extensive, as well as the intensive, margin.

5.2  

The results of the microsimulation model

Our analysis with the microsimulation model generates a variation of 3.1% in the labour supply at the extensive margin of Quebeckers aged 18 to 65. For these individuals, the addition of the *Prime au travail* lowered their reservation wage below the market wage.

Now, our intensive margin analysis model allows us to distinguish the respective impacts of the income effect and the substitution effect which are of opposite signs. If we consider only the individuals for whom the *Prime au travail* has led to a substitution of employment for leisure, we obtain a diminution in the number of hours offered by 1.31%. As far as the cumulative effect is concerned, we estimate an increase of 1.26% in the number of hours offered on the labour market, which represents the shift from the hypothetical situation where there would not have been the *Prime au travail* in 2006 and the situation observed in 2006.

At the disaggregated level, we present the effects at the intensive and extensive margin of the *Prime au travail* by type of household in Table 4. The effects are presented in the table by gender and type of household. We compare our results with those obtained by Fortin et al.
(2007) for single women, with or without children, and with the results obtained by Lafond-Bélanger (2007) with women who are part of a couple, with or without children. These two studies were done with discrete choice model of labour supply. In addition, we use the results associated with the hypothesis that stipulates that 50% of individuals who could benefit from the APPORT program have, in fact, benefited, for the reasons explained in the introduction.

Table 4 – The Impact of the *Prime au travail* by Type of Household and Gender

<table>
<thead>
<tr>
<th>Type of household</th>
<th>Variation</th>
<th>Gender</th>
<th>Variation</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intensive margin</td>
<td>Extensive margin</td>
<td>Intensive margin</td>
<td>Extensive margin</td>
</tr>
<tr>
<td>Single without children</td>
<td>1.32%</td>
<td>3.04%</td>
<td>Woman</td>
<td>0.73%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Man</td>
<td>1.68%</td>
</tr>
<tr>
<td>Single parent</td>
<td>-1.51%</td>
<td>3.59%</td>
<td>Woman</td>
<td>-2.66%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Man</td>
<td>1.05%</td>
</tr>
<tr>
<td>Childless couple</td>
<td>0.55%</td>
<td>0.84%</td>
<td>Woman</td>
<td>0.27%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Man</td>
<td>0.77%</td>
</tr>
<tr>
<td>Couple with children</td>
<td>1.71%</td>
<td>3.57%</td>
<td>Woman</td>
<td>1.89%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Man</td>
<td>1.59%</td>
</tr>
</tbody>
</table>

For single without children, our results show that the *Prime au travail* is an important incentive to work, with an increase in the labour supply of 3.04%. The increase in the labour supply for women was 2.78%. Fortin *et al.* (2007) find an increase of 0.34% in labour market participation of single women, an increase in the rate of single women working part-time of 1.19% and a decrease in the fulltime labour supply of 0.33%. Concerning the results of the intensive margin analysis, singles without children increased their (intensive) labour supply by

21 In Fortin *et al.* (2007), there were three modalities to choose from : do not work, work part time or work fulltime, \( H = \{0, 20, 40\} \). In Lafond-Bélanger (2007), there were seven, that is \( H = \{0, 10, 20, 25, 30, 35, 45\} \).
1.32%. Women increased their hours worked by 0.73% while in Fortin et al. (2007), there is no effect. According to our results and contrary to those of Fortin et al. (2007), the Prime au travail encourages single women to enter the labour market. Nonetheless, the tax credit also encourages women already in the labour market to diminish their hours worked. According to our results, the latter effect is weaker for men.

The increased labour supply of male and female single parents at the extensive margin is 3.59%. For women, this increase of employment supply is 3.47%. In Fortin et al. (2007), they obtain a stronger result (1.9 percentage points that is 6.49%) concerning the increased participation in the labour market of female single parents. On the other hand, these authors estimate an increase in the rate of female single parents who work part-time of 17.55% and a decrease in the fulltime labour supply of 3.87%. According to our results at the intensive margin, the single parents dropped their hours of work by 1.51%. Let us now look at the differences between variations in the labour supply of women and men. Male single parents increased their labour supply by 0.58% at the intensive margin, while female single parents decreased their number of hours worked by 2.66%. Further investigation would be necessary to explain this difference. For female single parents, Fortin et al. (2007) estimated an effect of 0.17% on the average number of hours worked per week. Finally, we must stress the extensive difference between the analysis at the intensive margin and the extensive margin analysis. These differences could be explained by the fact that the financial incentive of the Prime au travail is sufficiently interesting that the single parent wants to enter the labour market.
Nonetheless, a number of single parents are benefiting more room in their budget constraint to work fewer hours. We find results similar to those of Fortin et al (2007) in this respect.

As for couples, those who are childless increase their extensive margin labour supply by 0.84% while those with children increase it by 3.57%. This difference is intuitive since the tax credit is much more generous for couples with children. The net effect on their hours offered on the labour market is positive for women and for men. This positive result for labour supply of women in couples, contrasts with the results obtained by Lafond-Bélanger (2007). Indeed, the main conclusion of this study is that the Prime au travail subsidizes women to reduce their hours of employment. To give an idea of her results, let us mention that 3.15% of women in the situation with the Prime au travail choose to stop working compared to a situation where there is no APPPORT program. In addition, 2.15% of women decide to stop workin 45 hours per week and prefer one of six other options, that is amongst the range Hours = {0, 10, 20, 25, 30, 35} once the Prime au travail is established.

5.3 A comparison between intensive and extensive margin analysis

First, let us recall that the objective of the analysis of the Prime au travail at the intensive margin was to determine the net effect on labour supply while considering both the income effect and the substitution effect. Our results show that the overall income effect is weaker than the substitution effect, such that the Prime au travail has a net positive effect on the aggregate labour supply.
Secondly, we can confirm our initial hypothesis concerning the importance of including the income effect in the analysis. Indeed, the results at the extensive margin analysis are closer to 2.5 times greater than the results of the analysis at the intensive margin, the latter, allows us to include both the substitution effect and the income effect. Thus, we have developed an extension of the microsimulation model that can be used in the CGE macro-micro framework that allows us to consider both the income effect and the substitution effect. This significant development presents more realistic depiction of households’ behaviour reacting to work-incentive programs both by entering the labour market and by choosing to work fewer hours once they are recipients of such a program.

**The conclusion**

In 2005, the Québec government established the *Prime au travail*, replacing the APPORT program which also had the objective to increase incentives to work but which contained administrative complexities. The objective of this research was to construct a microsimulation model to estimate the effect at the intensive and extensive margins of the *Prime au travail* on the labour supply. Our results led us to conclude that the *Prime au travail* positively affects the labour supply of all types of households except those of female single parents. The analysis at the extensive margin allows us to observe that there is an increase in the labour supply caused by a reduction of reservation wages below the market wages for many individuals. On the intensive margin, the individuals who are already working and who received the *Prime au travail* in 2006 reduced the hours they were willing to work and hence reduce their labour supply. The net effect of the tax credit on the labour supply is positive and this is consistent
with the empirical literature (Fortin et al., 2007; Brewer et al., 2005; and Blundell et al., 2000) for this type of program.

This paper offers three main contributions to the literature. First, we have adapted a microsimulation model, originally designed for developing countries, to the situation in Québec by eliminating the informal labour market. Secondly, our analysis of the Prime au travail is ex post while previous analyses of this type of policy were ex ante. Our work thus allows us to use the data from 2006 to estimate econometrically the coefficients associated with the situation when individuals had already reacted to the introduction of the tax credit. Thirdly, we have extended the current microsimulation model of integrated macro-micro models, allowing us to capture the income effect and the effect of substitution following the introduction of a fiscal measure.

Nonetheless, it is possible that non-consideration of the APPORT program in the situation simulating the absence of the Prime au travail led to an exaggerated effect of the measure. However, we need to highlight that, in terms of comparison, Québec studies all include a scenario where APPORT participation in the program is nil. Indeed, since this program had significant administrative constraints, eligibility did not necessarily involve receiving a government subsidy, which gives credibility to our hypothesis.
As mentioned in the introduction, the construction of the microsimulation model is the first stage of an overall macro-micro integrated analysis. Future research will allow us to analyse the links between the microsimulation model and the CGEM in greater depth. The goal will be to further our analysis of the links between the microsimulation model and the CGEM, both in terms of the aggregation of microeconomic data and in modelization in the CGEM. This modelling context has the advantage of considering the effects of the policy on labour demand, the financing cost, and the effects of general equilibrium of all these elements. Finally, an interesting extension of this analysis would be the application of a distributive analysis to the effect of the Prime au travail on poverty and inequality.
Bibliography


