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Immigration and internal mobility in Canada

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Abstract We analyse the impact of temporary foreign workers (TFWs) and permanent immigrants on interprovincial mobility in Canada. Empirical results are analysed through the lens of a theoretical model that incorporates a job-matching framework in a migration model à la Harris and Todaro. The effect of the inflow of TFWs in interprovincial mobility is negative, substantial and significant. This is not the case for the inflow of permanent immigrants selected through the Canadian point system. The robustness of these empirical results to issues of endogeneity is assessed through a classical instrumentation approach as well as through a diff-in-diff analysis taking advantage of a pilot project facilitating the admission of TFWs in two Western provinces over the 2007–2010 period. Our paper suggests that, in general, the impact of immigration on labour market conditions depends critically on the way immigration policy is set.

Keywords Internal mobility · Immigration policy · Foreign workers · Displacement effect

JEL codes F220 · J080 · J290 · J610

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1 Introduction

In most developed countries, the control over immigration remains one of the clear signs of national sovereignty in this era of globalization. Country-specific contexts have put the question of immigration policy on the front stage of the policy scene. One of the most important preoccupations of interest of policy-makers deals with the effect of immigrants on domestic labour markets. In this respect, economic tools should be viewed as essential guides for policy design. Fortunately, the issue has been a major subject of investigation by economists for decades.

Following the work of Grossman (1982), Borjas (1987) and Card (1990), an extensive literature has concentrated on the effect of incoming foreign workers on the local wages of domestic workers in the immigrant settlement area. The general results of the 'area analysis' approach have suggested that the impact of international immigration on wages is either non-existent or quite modest. If an effect is discernible, the typical elasticity of wages with respect to inflows of immigrant workers is estimated to be around 0.1, which might indicate that the impact of immigration on labour markets should not be a major policy concern.

However, this approach and its results have been questioned by Borjas et al. (1996, 1997) on the grounds that the range of effects of immigration on domestic labour markets goes beyond their mere impact on local wages.[1] As showed initially in Filer (1992) and Frey (1995), another possible effect might be that inflows of immigrants into a particular area might lead, because of competition, to outflows of natives or former immigrants to other locations within the country. The contribution of this paper is to show that the way in which international immigrants are selected might have a significant effect on the reaction of domestic workers in terms of internal mobility. We show that the main effect materializes in a decrease in the gross immigration of natives to the provinces that receive TFWs. This effect is stronger than the one leading to native outflows and therefore explains a greater share of the decrease of the net interregional immigration of natives.

One important aspect of our analysis is that we investigate the respective effects of two types of international immigrants. The two categories are subject to very different selection criteria. The first deals with permanent immigrants (landed immigrants) who are mostly selected through the Canadian point system of immigration. This point system tends to favour skilled migrants irrespective of regional and national imbalances between supply of and demand for specific skills in Canada[2] The point system belongs to an 'immigrant-driven' type of policies in which a prospective immigrant is admitted without a job offer provided he or she complies with a set of desirable attributes.[3]

The second category concerns TFWs. In contrast to permanent immigrants, TFWs are hired directly by employers through a variety of programs in which provincial

[1] Subsequent studies of the influence of immigration on wages include Borjas (2003), Ottaviano and Peri (2012), and Docquier et al. (2014). D'Amuri et al. (2010) consider the impact of immigration in Germany on wages and employment rates. Recently, Braun and Mahmoud (2014) look specifically at the impact of forced immigration from Eastern Germany to post-war Western Germany on native employment.

[2] Recent immigration reforms that were implemented since the end of 2014 put more emphasis on labour market demand.

[3] See Bertoli et al. (2012) for a detailed description of the immigration systems in developed countries for skill selection policies.

authorities are more or less involved, in order to fill vacancies. The policies regarding the admission of TFWs in Canada fall into the broad category of 'employer-driven' systems, in which the prospective immigrant needs to have a job offer from a native employer in order to enter the country. The Canadian experience provides some kind of natural experiment to look at the role of different immigration programs in shaping the labour market impact of immigrants.

In this paper, we take advantage of the good Canadian immigration data to analyse the reaction of interprovincial migration (both net and gross flows) to permanent immigrant and TFW inflows. We pool annual data for the 10 provinces over the 1981–2011 period. We find compelling evidence that the inflow of TFWs into Canada leads to a significant and substantial decrease in the mobility of Canadians across provinces. The displacement effect holds across all segments of the relevant population under investigation. The effect also survives IV estimations dealing with several endogeneity concerns. Furthermore, we conduct a diff-in-diff analysis taking advantage of a pilot project facilitating the admission of TFWs in two Western provinces over the 2007–2010 period. The result of this diff-in-diff approach also are consistent with the idea of a causality running from TFWs to the mobility of interprovincial migrants.

Unsurprisingly, the effect is found to be stronger for young people than for older persons and for males than females. Once again, the variation of the findings by age group is consistent with a causality mainly running from TFWs to the interprovincial mobility. An extension including some information about the skill level of TFWs over a subperiod of time (2000–2011) suggests that the impact on the youngsters is more driven by unskilled TFWs. In contrast, the effect of permanent migrants on interprovincial mobility is generally not significant. These results are consistent with the analysis of Beine et al. (2015) who show that the inflows of TFWs (contrary to those of permanent migrants) could alleviate the potential Dutch disease at the regional level that is associated with the resource boom between 2001 and 2008.

Our analysis is related to two major strands of the economic literature on immigration. If one follows the 'Borjas critique', the emigration of local workers might well be the most important consequence of the arrival of international migrants in terms of labour market adjustments. The existing literature exhibits very differing results in that respect.[4] The Canadian experience provides an interesting natural experiment for the econometrician to identify the potential effects of immigration on internal mobility. There are many reasons for this. The first is related to the minimization of measurement errors of the key variables. Second, interprovincial mobility of natives is measured precisely in Canada. The annual tax returns filled by residents allow the capture of the internal mobility of workers on an annual frequency, in a very precise and consistent way. Third, given the immigration policy governing the inflow of TFWs and their allocation to vacant jobs in the economy, TFWs have by definition a maximum impact on the local labour market. This contrasts with inflows of the permanent immigrants who might display employment rates or participation rates well below 100%. Fourth, the size of the TFW program is significantly heterogeneous across the provinces and across time.

[4] Overall, evidence of the impact on native outflows is very mixed. A large number of papers find significant effects of immigration on natives' outmigration; see Filer (1992), Frey (1995) and Borjas (2006) in the case of the USA, among others. See Cortes and Pan (2013) on the specific case of native-born nurses in the USA. See also Hatton and Tani (2005) for the UK. In contrast, other papers find very little evidence of native displacement. See Card (2001), Card and Di Nardo (2000) and Kritz and Gurak (2001) among others.

Our paper is also related to the second major strand of literature that deals with the determinants of internal mobility of natives. An extensive literature, mainly concerned with the US situation, has looked at identifying the factors that explain the long-run decrease in the internal rates of mobility of natives.[5] Interestingly, the same pattern in the interprovincial mobility of residents has also been observed in Canada over the last 35 years. Our analysis suggests that inflows of a particular kind of international immigrant, such as the TFWs, can help to explain a significant part of the declining trend that has been observed.

The paper is organized as follows. Section 2 presents a small theoretical model that clarifies the mechanism(s) underlying the relationship between international immigration and internal mobility of natives. The econometric specification, the variables, and the data are presented in Sect. 3 with the features of the Canadian immigration systems receiving a special focus. Section 4 presents the econometric approach and the results, including some robustness checks. Section 5 concludes.

2 Theoretical background

In this section, we develop a small theoretical model aimed at explaining the expected impact of both types of immigrants on the internal migration of domestic agents. The model builds on earlier contributions to the theory of economic migration and labour economics. In the spirit of the work of Todaro (1969) and Harris and Todaro (1970), we assume a two-region world in which agents in each region assess the utility expected from migrating to the other region. To keep things simple, we assume that agents look forward only to the next period and do not optimize over their full living horizon. The model is static and abstract from any dynamic. It can be best viewed as one particular illustration of how the key variables come into the migration decision process of optimizing agents. In contrast with the simplified theoretical framework, the econometric strategy of the empirical part of this paper accounts for the dynamic features involve in the migration process.

The model assumes symmetry in the effects on internal emigration and internal immigration. The latter effect has obviously received the most attention in the literature devoted to the influence of international immigration on the domestic labour markets (Borjas 2006; Card 2001; Card and Di Nardo 2000; Filer 1992; Frey 1995; Hatton and Tani 2005, among many others).

Let us consider the impact of international immigrants on internal immigration into region *j*. We look at two types of international immigrants, namely TFWs and permanent immigrants. The total number of TFWs and permanent immigrants landing in province *j* is denoted by T_j and I_j respectively. The impact of both types differs in two respects. First, TFWs have a stronger effect in terms of reducing the number of total vacant jobs in region *j*, due to the way they are selected by immigration authorities and allocated to the local

[5] See Molloy et al. (2011) for a recent review. The investigated factors are numerous and related, for instance, to demographic trends (ageing), variation in unemployment rates, and housing factors such as home ownership. These factors also include technological progress that allows people to work at a distance. Kaplan and Schulhofer-Wohl (2013) argue that the fall in internal migration in the USA is due to a decline in the geographic specificity of returns to occupation as well as a reduction in information costs about alternative locations.

labour market. Second, while the TFWs have no impact on the total number of unemployed agents in region j (TFWs' participation and employment rates are, by definition, 100%), the impact of permanent immigrants is subject to discussion.

Each individual k of category c living in region i makes a decision about migrating or not to region j. Categories refer to age and skill. Each individual migrates to j ($m_{ij}^{k,c} = 1$) if the expected utility associated to migration is positive. This expected utility is denoted by $E\left(\Delta_{ij}^{k,c}\right)$. Hence, we have

$$m_{ij}^{k,c} = 1 \text{ if } E\left(\Delta_{ij}^{k,c}\right) > 0, \quad m_{ij}^{k,c} = 0 \text{ otherwise.} \tag{1}$$

The utility Δ induced by migration takes the form

$$\Delta_{ij}^{k,c} = E\left(y_j^{k,c}\right) - E\left(y_i^{k,c}\right) + A_j^{k,c} - A_i^{k,c} - C_{ij}^{k,c} + \epsilon_{ij}^{k,c} \tag{2}$$

where $E\left(y_l^{k,c}\right)$ denotes the expected income of this individual in location l ($l = i,j$), $A_l^{k,c}$ captures the role of amenities in location l on utility and $C_{ij}^{k,c}$ capture the cost of moving from i to j. $\epsilon_{ij}^{k,c}$ is a random shock that is identically distributed but uncorrelated across individuals k, with $E\left(\epsilon_{ij}^{k,c}\right) = 0$ and $E\left(\epsilon_{ij}^{k,c^2}\right) = \sigma_{ij}^2$.

We assume that income consists only of wage revenues and that the wage in each location l, $w_l^{k,c}$ is known by individual k. We assume no outside option and no replacement income such as access to family resources. Expected income at location l is given by the wage level that is conditional upon being employed:

$$E\left(y_l^{k,c}\right) = P_l^{k,c} \; w_l^{k,c} \tag{3}$$

where $P_l^{k,c}$ denotes the probability of being employed.

The literature on job matching (Pissaridès 1985, 2000) not only specifies matching functions but also relates the probability of finding a job to the number of vacant jobs (V_l^c) and unemployed people (U_l^c) of category c in location l that is consistent with the job-matching process and the Beveridge curve. Consistent with the literature on the job-matching function (Petrongolo and Pissaridès 2001), the probability of finding a job at the individual level (or the job-finding rate at the aggregate level) is positively related to the V–U ratio, i.e. the vacancy rate–unemployment rate ratio (also called the tightness ratio) at location l $\left({}^{V_l^c}/_{U_l^c}\right)$ where V_l^c and U_l^c denote respectively the number of vacancies and the number of unemployed workers.

Shimer (2007) shows that, in a mismatch model, the implied relationship between the job-finding rate and the tightness ratio takes a concave form. This form might be captured—for any value of the V–U ratio—by the following probability function:

$$P_l^{k,c} = \quad 1 - e^{-\left({}^{V_l^c}/_{U_l^c}\right)} \tag{4}$$

This function is increasing in the V–U ratio, takes a concave form and is bounded between 0 and 1, which ensures the consistency with the concept of probability.[6]

The dynamics of the job vacancy rate and the unemployment rate in region l are both driven by changes in the labour supply as well as by aggregate factors unrelated to the labour supply X_l, such as the economic cycles and the resource booms. Hatton and Tani (2005) show that accounting explicitly for the status of the regional economies is important for capturing the displacement effect of international immigration. The changes in the labour supply are driven by the inflows of international immigrants that are known by the prospective internal migrant. The flow of TFWs and permanent immigrants into province l is denoted respectively by T_l and I_l. Their respective impact on V_l and U_l is captured by the V and U functions with different sensitivities between the two flows. The other factors that might have an impact of the V and U functions are denoted by X_l and include those related to the business cycle in region l. To simplify the theoretical analysis, we assume in the following that the X_l is held constant.

$$V_l^c = V^c(T_l, I_l, X_l) \tag{5}$$

$$U_l^c = U^c(T_l, I_l, X_l). \tag{6}$$

Given the design of immigration policies involving TFWs and permanent immigrants, the impact of TFWs on the vacancy rate is higher in absolute terms than the impact of permanent migrants. Denoting $\partial V_l^c/\partial \mathrm{T}_l = \alpha_T^c$ and $\partial V_l^c/\partial \mathrm{I}_l = \alpha_I^c$, we have $\alpha_T^c < \alpha_I^c < 0$.[7] The impact on the unemployment rate also differs between the two categories of international migrants. For TFWs, since their visas are subject to the TFWs' allocation to a vacant job and give no rights in terms of family reunification, there is no impact on unemployment, i.e. $\partial U_l^c/\partial T_l = \gamma_T^c$=0. For permanent immigrants, in contrast, the net total impact is ambiguous, at least on a theoretical level. On one hand, some permanent migrants can be unemployed if there is some mismatch between their skills and the ones required in the local labour market. Furthermore, even if they find a job, some of their accompanying family members might be unemployed. On the other hand, permanent migrants can exert positive externalities on the aggregate unemployment rate. Indeed, given their skill level (the point system positively selects those with respect to their education level) and/or their profiles (permanent immigrants include special classes of investors and entrepreneurs), these permanent immigrants can create jobs and hence decrease unemployment. Furthermore, the inflow of family members such as the children can increase the demand for services such as education and health. The global impact is therefore the net impact of the direct effect on unemployment and the effect of these positive externalities and is a priori unknown. Hence, $\partial U_l^c/\partial I_l = \gamma_I^c$ might be negative, positive or close to zero if both effects offset each other.

[6] There is a direct connection between Eq, (4) and the matching function. See Petrongolo and Pissaridès (2001) for details. Indeed, if one denotes n the number of job matches and defines the matching function $n = n(U,V)$, the n/U ratio can be seen as the probability of finding a job for unemployed workers. n/U is characterized by Eq. (4) if one assumes that (a) each employer sends one job vacancy randomly to one single unemployed worker, (b) all unemployed workers are all the same, (c) the degree of matching is perfect, and (d) U is large enough with respect to V. The equivalence might be checked through a Taylor expansion.

[7] Given the design of the immigration policy regarding TFWs, α_T^c should be close to −1.

At the individual level, the impact of an increase of TFWs in region i on interprovincial migration into region i is captured by the effect on the probability of a positive differential expected utility $E\left(U_{ij}^{k,c}\right)$.

Denoting $\frac{\partial \text{Prob}\left(E\left(\Delta_{ij}^{k,c}\right)>0\right)}{\partial P_j^{k,c}}$ by $\mu_j^{k,c}$ and assuming a functional form such as (4) for the job-finding rate, we have:

$$\frac{\partial \text{Prob}\left(m_{ij}^{k,c}=1\right)}{\partial T_j}=\mu_j^{k,c}\alpha_T^c\,\frac{e^{\left(U_j^c/V_j^c\right)}}{U_j^c}. \tag{7}$$

This impact is unambiguously negative as $\alpha_T^c<0$. Its magnitude depends positively on the impact of the probability of job finding and on the impact on the expected differential utility of migration that is, for instance, a positive function of wages at destination, $w_j^{k,c}$. It also depends on the size of the negative impact on the job vacancy rate α_T^c, which should be proportional to the inverse of the size of the working force in region j. It also depends on the status of the provincial labour market, as reflected by the last term in (7).

The impact of permanent immigrants is given by

$$\frac{\partial \text{Prob}\left(m_{ij}^{k,c}=1\right)}{\partial I_j}=\mu_j^{k,c}\left[\frac{\alpha_I^c}{V_j^c}-\frac{\gamma_I^c}{U_j^c}\right]e^{\left(U_j^c/V_j^c\right)}\,\frac{V_j^c}{U_j^c}. \tag{8}$$

The sign of this expression is ambiguous. Three cases might be considered at the theoretical level.

First, if $\gamma_I^c=0$, i.e. if the positive externalities of permanent immigrants perfectly offset the direct negative effect on unemployment, then we have an expression that is similar to (7) for TFWs. $\frac{\partial \text{Prob}\left(m_{ij}^{k,c}=1\right)}{\partial I_j}$ is in this case unambiguously negative and the impact in absolute value of TFWs is higher than the one of permanent immigrants since $\left|\alpha_I^c\right|<\left|\alpha_T^c\right|$. Both types of immigrants tend to bring about a decrease in the individual immigration probability of prospective interprovincial immigrants because they decrease the V–U ratio and the expected probability of finding a job.

For instance, if $\gamma_I^c<0$, i.e. if positive externalities of permanent migrants dominate, then the direction of their impact on internal migration is unclear. If the impact on unemployment more than offsets the negative impact on the vacancy rate, then there is a possibility that the inflow of permanent migrants will foster rather than to deter internal migration. In this case, TFWs have unambiguously a more negative effect on internal migration than permanent migrants. As usual, the impact of each inflow of international migrants can be computed by summing up (7) and (8) over the total number of internal migrants belonging to category c, i.e. by summing up over k.

Two additional considerations are in order here. First, the model assumes symmetry in the effect on emigration and immigration. In practice, this assumption of symmetry might be rejected in practice for several reasons. Second, the main impact is likely to differ across categories of individuals, as they display different impacts on vacancies

and unemployment, different values of migration costs $C_{ij}^{k,c}$, of $\mu_j^{k,c}$. The expected impact on internal mobility should be higher for young individuals, and in practice, effects can be different between males and females. The econometric estimations will be therefore carried out disaggregating across types of internal migrants.

3 Econometric analysis

3.1 Benchmark econometric specification

The benchmark specification relates to the analysis of net interprovincial immigration. The key determinants of the level of internal migration rates predicted by theory are related to the level of expected income that, in turn, is a function of the probability of employment and the wages (respectively P_l and W_l in Sect. 2). The probability of employment is related to the *V*–*U* ratio, which depends on the inflows of international migrants, the provincial business cycle and provincial terms of trade (resource boom). One should emphasize that it is important to have the variables affecting the labour demand defined at the regional level.[8] Finally, the model identifies some roles for amenities as well as the bilateral migration costs.

In order to maximize the information coming from the Canadian provincial data, the predictions of the theoretical model are tested using a panel of annual data in the 1981–2011 sample for the 10 Canadian provinces. The key difference between the theoretical model and the empirical specification is that the latter includes the time dimension. Whereas the theoretical model of Sect. 2 is static, the regression model is a dynamic panel data model that allows us to capture short-run and long-run effects of international migration channels. The introduction of dynamics is needed to capture the mechanisms at stake in the real world. There are two main reasons for this. First, interprovincial mobility is highly persistent over time at the macroeconomic level. Failure to account for such persistence would lead to some omitted variable bias to the extent that past internal migration is correlated with some covariates of (9) such as unemployment *U* or the provincial terms of trade. Second, the model features migration decisions that are driven by variations in expected probability of employment in a static way. The real world is more complex. In the short run, some prospective internal migrants might be deterred from migrating simply because the vacant jobs they were targeting have been filled up by international migrants. In the medium run, other potential internal migrants may just stop searching for vacant jobs in provinces with large numbers of TFWs. Another dynamic mechanism at work comes from the fact that first-time migrants tend to move alone at first but, in the long run, they can attract their partner, some relatives or some friends (the so-called network effect). In this perspective, we can expect the short-run effect to be smaller (in absolute value) than in the long run. Potentially, the long-run displacement effect could even be larger than 1.

[8] In this respect, in an econometric model capturing the impact of immigration on domestic wages and internal migration, Hatton and Tani (2005) insist on the need to explicitly include regional proxies of labour demand shocks instead of nationwide ones. Omitting these variables is indeed likely to generate significant biases in the estimation of coefficients of an equation like ours, since they are obviously correlated with the key covariates $T_{j,t}$ and $I_{j,t}$.

The benchmark econometric specification for net immigration of Canadian of category c in province j at time t is given by

$$m^c_{j,t} = \gamma^c_j + t^c_t + \rho^c m^c_{j,t-1} + \beta^c_1 T_{j,t} + \beta^c_2 I_{j,t} + \beta^c_3 yc_{j,t} + \beta^c_4 u_{j,t} + \beta^c_5 R_{j,t} + \beta^c_6 A_{j,t} + \varepsilon^c_{j,t} \quad (9)$$

where $m^c_{j,t}$ captures the rate of net interprovincial immigration in the province j of agents of category c at time t.

In Eq. (9), $T_{j,t}$ and $I_{j,t}$ represent the total number of TFWs and landed permanent immigrants respectively coming into province j at time t. $yc_{j,t}$ and $u_{j,t}$ represent respectively the economic cycle and the unemployment rate of province j at time t. $R_{j,t}$ is a measure of the provincial terms of trade that is supposed to capture variations in wages at the aggregate level. We capture amenities $A_{j,t}$ through public expenditures and/or taxes as a share of provincial GDP at time t. $\varepsilon^c_{j,t}$ is an error term, and γ^c_j and t^c_t are fixed effects capturing unobserved factors that are specific to province j (like natural amenities) and specific to time t (like the national business cycle). Since our approach is monadic in nature, the time-invariant migration costs such as the ones related to geography, remoteness or different languages C^c_{ij} in expression (2) are fully captured by the provincial fixed effects γ^c_j. These provincial fixed effects also capture the role of province-specific, time-invariant factors such as differences in institutions. The time dummies t^c_t capture the overall variation in costs such as the general decrease in transport costs.

3.2 Definition of variables and data sources

3.2.1 Interprovincial migration data

The interprovincial data for a variety of age groups and by gender $m^c_{j,t}$ are available on a yearly basis from 1971 to 2011 from Statistics Canada CANSIM database (Table 510012) on a net basis (in-migration minus out-migration) and on a gross one. In the benchmark specifications, the interprovincial migration variables for any demographic group in province j during year t are measured as the ratio of net interprovincial migration (j, t) divided by the corresponding population stock in the same demographic group c at (j, t). Gross migration flows are also used for some specifications. Population estimates are taken from CANSIM (Table 510001) and pertain to the population of the demographic subgroup living in the province on 1 July of the given year.

In contrast to some earlier proxies used in the existing literature—such as variations in the resident population—the interprovincial net migration data refer directly to the net flows of interprovincial immigrants (in-migration minus out-migration) in a given province during year t.[9] These data are derived by Statistics Canada from income tax reports.

[9] Card and Peri (2016) discuss the importance of measuring mobility of natives and immigrants to avoid estimation biases of the relationship between the two. Hatton and Tani (2005) emphasize the benefits of such an analysis using direct measures of internal migration as opposed to proxies derived, for instance, from the variations in the population stocks. Hatton and Tani's measure of flows derived from the records of the British National Health Services is definitely a valuable step towards a better measurement of internal migration. An additional feature of the Canadian regional case is that, given the size of provinces, the share of interprovincial commuters is negligible, which minimizes the case of a systematic downward bias in the measurement of mobility.

The interprovincial migration flows are available for different age brackets. We use migrants between the ages of 18 and 64 as a measure of working-age migrants. Other subcategories involve migrants between 18 and 24, between 25 and 44 and between 45 to 64. The data are also available by gender for each subcategory.

3.2.2 International immigration

As noted before, international migrants involve two different categories: TFWs ($T_{j,t}$) and permanent immigrants ($I_{j,t}$). Both variables refer to the flows of immigrants coming into a province during a given year, divided by the population of the province. The international immigrant data that come from special tabulation data (computed at our request by the government department, Citizenship and Immigration Canada) for both the TFWs and the permanent immigrants refer to the total flow of new immigrants entering province i during year t. At our request, the data were also broken down by country of origin and by destination province on a yearly basis from 1980 to 2011.[10]

The TFWs come into Canada under a variety of programs that were set up mainly by the federal government to reduce labour shortages in the Canadian economy. Under these programs, employers need to contact the immigration authorities to be allowed to hire an international worker on a temporary basis to fill a vacant occupation. In some cases, immigration authorities require a labour market opinion test to be conducted to ensure that this particular position cannot be filled by a Canadian worker. According to Worswick (2013), TFW entries with labour market opinion accounted for 38% of the total number of TFWs admitted in 2012. Employers also need to pay some fees to cover part of administrative costs. The TFW is assigned to a specific job and comes to Canada on a temporary basis with limited rights compared with permanent immigrants, particularly with respect to social security benefits and possibilities of family reunification. Thorough descriptions of that program and its evolution over time can be found in Gross and Schmitt (2012) and Worswick (2013). The design of the program is such that the incoming TFWs are characterized by employment rates and participation rates of 100%.

The design of the permanent immigrant program is totally different from the one governing TFWs. Permanent immigrants arrive in Canada through three different channels. First, economic immigrants are selected under the Canadian immigration point system. Permanent immigrants also arrive in Canada under the family reunification program and as refugees. In our analysis, we will consider only the first category, i.e. economic migrants. Our results are robust to the inclusion of all permanent migrants.

While permanent immigrants are positively selected in terms of education levels, there is some prevalence of mismatches between their skills and what is needed in the short run in the Canadian provincial economies. For example, as of January 2013, data from the Labour Force Survey indicate that the participation rates of permanent immigrants across provinces vary between 55.9% in Newfoundland and Labrador and 70.6% in Alberta. Comparable numbers for the Canadian-born vary between 60.9 and 73.1%.

[10] In the benchmark analysis, we do not use the dyadic dimension of the migration data. The time-varying pair, country of origin and province of destination are nevertheless used later on for TFWs in the instrumental variable analysis.

The relatively low participation rate of permanent immigrants is due to at least three factors. First, permanent immigrants are known to concentrate in the big Canadian cities where they can benefit from the various externalities of their diaspora (see Beine et al. 2011). This means that their migration location choice is guided not only by the highest probability of employment (or, equivalently, by the highest level of the *V–U* ratio) but also by other considerations. Second, over our investigation period, the point system was designed to favour prospective candidates with the highest education level. This means that vacant occupations requiring specific skills but no university degree—such as carpentry and plumbing—can hardly be filled with immigrants using the point system. Furthermore, there is also a presumption that education levels are not comparable across origin countries and need to be adjusted with respect to the Canadian counterparts. Consequently, even for jobs requiring university education, permanent immigrants to Canada might have problems getting their credentials recognized in the Canadian labour markets. Finally, up to 2014, immigrants to Canada in the investor category were selected based on their net worth. The investors, and their family, were not required to engage in work or business activities in Canada.

The above characteristics of the point system have shed some doubts on its ability to select the most productive immigrants for the Canadian economy, at least in the short run. This has led to major changes to the immigration system in Canada that took effect at the end of 2014. An 'Express Entry' system is introduced to facilitate and accelerate the arrival of candidates with skills that match labour market demand. More weight is now given to skills that match Canadian credentials for education, work experience and language skills. Clearly, the new system is more employer-driven than the old point system.

3.3 Evolution over time

The annual numbers for the three immigration flows for Canada as a whole (interprovincial in-migrants, permanent immigrants and TFWs) are depicted in Fig. 1 for the 1980–2012 period. In 1980, the interprovincial migrant flow was much larger than the two international channels combined. The situation is reversed in 2012. The

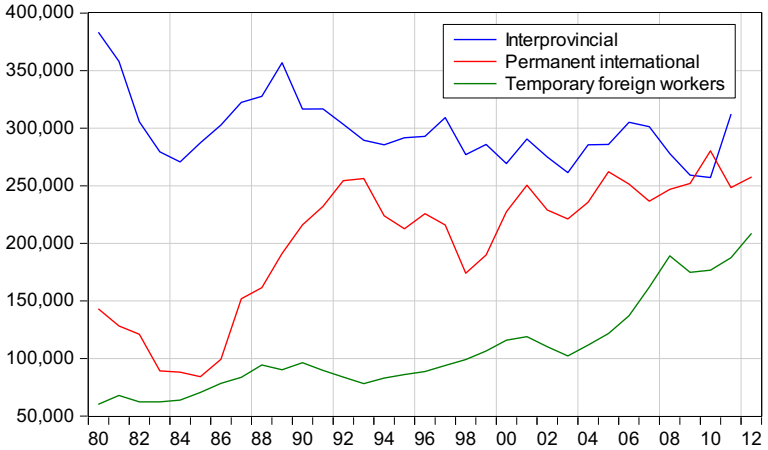

Fig. 1 Three immigration flows into Canada: 1980–2012

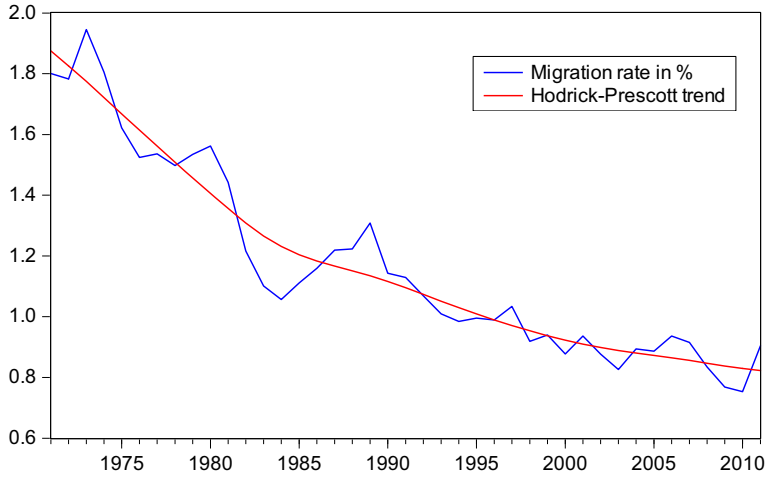

Fig. 2 Interprovincial migration rate: 1971–2011

permanent immigrant flow rose sharply between 1985 and 1993 and varied around 250,000 people per year thereafter. The flow of TFWs shows an upward trend during the whole period but accelerated after 2003, a period that coincides with the resource boom. The rate of TFWs (ratio to population) varies considerably across provinces and over time. In 2012, the TFW rate in relative terms was the largest in British Columbia (1.3%) and Alberta (1.2%) and the lowest at 0.3% in New Brunswick and Nova Scotia. In Alberta during the peak of the resource boom between 2003 and 2007, the TFW rate increased from 0.37 to 1.37% of the Albertan population.

The interprovincial migration rate and its decreasing trend between 1971 and 2011 are depicted in Fig. 2. The decreasing strength of interprovincial migration in the last decades corresponds to the stylized facts observed by Molloy et al. (2011) for interstate migration in the USA over the last decades.

3.4 Other data

The model developed in Sect. 2 is a useful guide for selecting the controls. Basically, we need to capture three types of variables: (i) the variables affecting the probability of employment, (ii) the variables acting as proxies for the different wages across provinces and (iii) the variables related to time-varying amenities at destination.

We consider two variables affecting the probability of employment. One is the cyclical component of provincial output, i.e. the provincial output gap. The annual output gap of the 10 Canadian provinces is constructed using the Hodrick and Prescott filter on the logarithm of quarterly real GDP estimates. The output gap data were annualized in the second step and are available from 1981 to 2012. The other variable is the provincial unemployment rate. Unemployment rate data come from the CANSIM Table 2820055; the data are available from 1987 to 2012.

Labour productivity, the ratio between real GDP and employment (from the Labour Force Survey) is used as a proxy for wages. Terms-of-trade changes might also drive substantial migration across provinces. Endowments of natural resources vary substantially across provinces. Large and sustained increases in the price of oil, for example,

can encourage many Canadians to migrate to oil-rich provinces such as Alberta. We use a measure of the provincial terms of trade developed by Coulombe (2011) and used by Beine et al. (2015) for Canada. Terms-of-trade changes are derived under the standard assumption that they could be approximated by the difference between the changes in the GDP deflator and the consumer price index. In order to approximate provincial terms-of-trade changes, the provincial GDP deflators are derived from the growth of nominal and real GDP. We then subtract the growth in national CPI (computed from CANSIM Series V41693271) from the growth in provincial GDP deflator. Considered together, variations in labour productivity and terms-of-trade measures capture the differences in the change in national income across provinces.

The proxies for these variables are the relative shares of government expenditures and taxes. Provincial government expenditures and taxes are taken from Statistics Canada's provincial economic accounts in CANSIM (table number 3840004) see statistics Canada (2004). We use all provincial government expenditures and all autonomous revenues. We use nominal data divided by nominal GDP.

4 Econometric results

The results of our benchmark specification are presented in Tables 1 and 2 and Table 9 to 11 (Appendix B). The analysis illustrates the impact of the two international migration channels on the interprovincial net immigration flows. The effect varies substantially across age groups and, to a lesser extent, by gender. Table 2 summarizes the quantitative effects of TFWs on the interprovincial migration flows of various demographic groups. The results of alternative specifications and robustness analysis, including IV specifications, are presented in Tables 3, 4, 5 and 6, as well as in Tables 12 and 13 reported in the Appendix B.

4.1 General direction of results

Four main results emerge consistently from the estimation of the benchmark regressions involving different age profiles and genders. These main results are also confirmed in most of the alternative specifications and in the robustness analysis.

First, the effect of the TFW variable on the net interprovincial immigration is always negative, substantial and highly significant. The decrease in net immigration is driven by both a decrease in gross immigration and an increase in gross emigration. Nevertheless, the former effect tends to dominate the latter, from both a quantitative and a statistical point of view. While the decrease in gross immigration is always highly significant at the 1% level, the impact on gross emigration is less obvious and depends on the profiles of the interprovincial migrants.

Second, the direction of the effect of permanent immigrants on interprovincial flows is more uncertain than the one concerning the TFWs. In general, we find a negative impact of permanent immigrants on net immigration. This impact is not always significantly different from zero, and its statistical significance depends on the age profile of interprovincial immigrants. It is noteworthy that the magnitude of the impact of permanent immigrants, when negatively significant, is always much lower in

absolute terms than the one for TFWs. This important result is in line with the theoretical story of a lower degree of skill matching of permanent immigrants. We find very limited evidence of a positive and significant impact by permanent immigrants in the case of booming provinces. This suggests that positive externalities, while existing, are in general not large enough to counteract the negative impact in terms of job vacancies.

Third, the impact of TFWs and, to a lesser extent, of permanent immigrants on internal mobility displays some significant variability across the profiles of the interprovincial migrants. Unsurprisingly, the impact of international immigration, particularly by TFWs, is higher for young prospective internal migrants with slightly more male migrants than female affected.

Finally, the traditional controls in the regressions generally appear with the expected sign, with the exception of fiscal variables. Provincial unemployment rates and economic cycles that affect the expected probability of employment have the expected sign but display significance levels that vary with the age profiles. Direct proxies of provincial wages based on GDP do not perform as well. In contrast, proxies of provincial windfalls based on provincial terms of trade turn out to be powerful control variables and ensure that our results rely on well-specified frameworks.

4.2 Benchmark results

Tables 1 and 2 report the benchmark regression results based on specification (9) for the impact of international immigration flows on net interprovincial immigration flows for various demographic groups. Table 1 shows the results for all interprovincial migrants (both genders and all ages) and all interprovincial migrants in the working-age group (18 to 64 years old). We generally start with a more general specification and then use a parsimonious specification that can be estimated over a longer period; this is done because some covariates are unavailable.

Two points have to be taken into consideration regarding the interpretation of the estimated effects of the two international immigration channels. First, the model estimated for the benchmark regressions is a dynamic model. Therefore, strictly speaking, point estimates cannot be compared in a straightforward manner across the various specifications since the estimated coefficient of the lagged dependent variable turns out to vary.[11] In order to compare the effect of TFWs on interprovincial migration of various demographic groups, one can compute the estimated long-run effect. This long-run effect of TFW is given by $\beta_1^c / (1-\rho^c)$, and its implicit t ratio is the same as the one associated with the point estimate of TFWs β_1^c.

Second, the various interprovincial flows are measured as a ratio to the population of the receiving province of the specific demographic group. The two international immigration flows are measured as the ratio of these flows to the overall population. Consequently, if one wants to know the estimated effect on the interprovincial flows of an increase of one TFW, the point estimates reported for the TFW have to be adjusted by the relative size of the population

[11] Note, however, since estimates of ρ^c are fairly similar across regressions, the ranking of short-run effects and long-run effects across categories of natives is similar.

Table 1 Impact of international immigration on net internal migration: benchmark results

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	All migrants			18–64 years old		
Lagged migr.	0.618***	0.635***	0.710***	0.630***	0.645***	0.717***
	(9.4)	(11.8)	(13.5)	(9.8)	(12.3)	(13.6)
Public exp.	−3.223*	−3.923***		−3.453	−4.345***	
	(−1.7)	(−4.4)		(−1.6)	(−4.3)	
Taxes	−0.661			−0.304		
	(−0.2)			(−0.1)		
Log (wage)	0.132			0.201		
	(0.3)			(0.3)		
Unempl. rate	−0.034			−0.036		
	(−1.5)			(−1.4)		
Econ. cycle	1.795	2.505*		2.961*	3.648**	
	(1.2)	(1.9)		(1.8)	(2.4)	
TFWs	−0.828***	−0.650***	−0.531***	−0.909***	−0.724***	−0.590***
	(−4.1)	(−3.9)	(−3.4)	(−3.8)	(−3.6)	(−3.1)
Perm. immig.	−0.110	−0.099	−0.163*	−0.130	−0.118	−0.186*
	(−0.9)	(−1.1)	(−1.9)	(−1.0)	(−1.2)	(−1.9)
Terms of trade			0.025***			0.029***
			(3.5)			(3.4)
Observations	230	270	270	230	270	270
R-squared	0.840	0.808	0.816	0.851	0.819	0.825
Prov FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Sample period: 1981–2011. OLS estimation. Columns (1–3): all interprovincial migrants; columns (4–6): interprovincial migrants aged between 18 and 64. Robust *t* statistics in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$, for the impact of TFWs

Table 2 Quantitative effects of TFWs on interprovincial migration flows by age group

	Table/column	(1) Short run	(2) Short-run adjusted	(3) Long run	(4) Long-run adjusted
All migrants	1/3	−0.53	−0.53	−1.82	−1.82
18–64 both sexes	1/6	−0.59	−0.36	−2.00	−1.23
18–24 both sexes	9/3	−1.12	−0.13	−3.49	−0.40
25–44 both sexes	9/5	−0.70	−0.20	−2.33	−0.67
45–64 both sexes	9/7	−0.35	−0.07	−1.25	−0.26
18–24 males	10/4	−1.33	−0.08	−3.44	−0.19
18–24 females	11/4	−0.93	−0.05	−2.57	−0.14

The short-run impact (column 1) is the point estimate of TFWs reported in various columns (always with the terms-of-trade control) of Tables 1, 9, 10 and 11. The long-run effect (column 3) is computed directly from the short run, using the coefficient of the lagged dependent variable as explained in Sect. 4.2. All point estimates are significant at the one pc level.

subgroup to the total population. Long-run effects and adjusted effects are reported in Table 2 for the impact of TFW for the key specifications that include the terms-of-trade variable.

4.2.1 Effect(s) of TFWs

The main result that emerges from the estimation of the benchmark regression refers to the relative impact of TFWs on interprovincial migration across different demographic groups. As mentioned in Sect. 4.1, the various point estimates are always significant (at the 1% level) and display the expected negative sign.

However, the point estimates vary considerably across age groups and sexes. The key results from a quantitative point of view for the TFWs are summarized in Table 2. The point estimates of the TFWs are displayed in column (1) of Table 2 and represent the short-run effects. These are directly comparable to estimates of displacement effects in existing studies such as Hatton and Tani (2005).[12] A larger point estimate (as found for the 18 to 24 year olds) indicates that the short-run impact of an increase in TFWs is proportionally more important for this subgroup than for the other demographic groups. The short-run effect is the smallest for the all-migrant variable, indicating that the substitution effect of TFWs is less for the non-working population (children and seniors). The (unadjusted) long-run effects displayed in column (3) of Table 2 are larger since the impact of TFWs on interprovincial flows operates through a dynamic channel. The long-run effect of TFWs on interprovincial net migration flows is proportionally 40% larger and 103% larger for the 18 to 24 age group than for the 25 to 44 and 45 to 64 age groups respectively. In Sect. 4.5 below, we will see that the larger impact of TFWs on the on the 18 to 24 age groups is mainly driven by the arrival of lower skilled TFWs. The effect varies also by gender; the effect on young male interprovincial migrants is proportionally 29% larger than for young females.

The short-run adjusted effects of TFWs depicted in column (2) of Table 2 measure the effect of an increase of one TFW on the number of interprovincial immigrants of the subgroup. An increase in one TFW translates into a decrease of 0.53 interprovincial migrant of all ages in the short run. For the working-age population, the short-run reduction is 0.36 interprovincial migrants. These numbers are directly comparable to previous estimates of the literature. Hatton and Tani (2005) obtain an insignificant coefficient of 0.30 for the full sample and a significant effect of 0.444 for a restricted sample of Southern British regions. In general, our estimates of the displacement effect of TFWs are always more substantial and more significant. We ascribe that partly to the specific profile of Canadian TFWs.

The long-run adjusted effects are displayed in column (4). For the overall population, an increase of one TFW decreases interprovincial migrants of all ages by 1.82 persons in the long run. It might be surprising at first glance that the effect is larger than 1. However, one has to consider the fact that, contrary to TFWs, interprovincial migrants tend to move with spouses and children, especially for the long term. A worker can move to a province for a short while, and then, family might follow when the job is secure and the spouse can also find a work in the same province. Furthermore, an increase of one TFW translates into a decrease in interprovincial mobility of 1.23

[12] In particular, our estimates compare with the effects reported in their Table 7.

people in the working-age population. Children are now excluded, but one can speculate that the number exceeds 1 because of the spouse effect.

Those results suggest that the TFWs are close substitutes for prospective interprovincial migrants, and the effect is proportionally stronger for the young, especially the young male. This result is important because the TFW program was designed from the start to avoid such substitution effects. Firms willing to hire TFWs have to demonstrate that the new workers will not take the place of native workers. Our empirical evidence suggests that, while this might be the case in the local area, the implementation of the program exerts additional substitution effects on other native workers. These effects are demonstrated in a decrease of interprovincial mobility of potential workers, spouses and children.

4.2.2 Effect of permanent immigrants

Across Tables 1 and Table 9 to Table 11 in the Appendix, the impact of permanent immigrants on net interprovincial flows is always negative, sometimes significant at 5%, but the results are far from robust. When negative and significant, the impact of permanent immigrants on the interprovincial flows is always much smaller, in absolute values, than the impact of TFWs. This result is consistent with the theoretical framework allowing for a lower degree of skill matching of permanent immigrants ($|\alpha_T| < |\alpha_I|$). It is also consistent with a sufficient level of positive externalities that offset the direct positive effect on unemployment.

4.3 In-migration and out-migration

As explained in Sect. 2, the impact on interprovincial immigration that has been documented so far can be seen as the combined influence of two different channels. The first channel is the impact on the outflow of native workers; the second one is the effect on provincial immigration. While the theoretical framework sketched out in Sect. 2 does not allow for asymmetric effects of that kind, there are still good reasons to believe that the impact might not be purely symmetric in the real world. We therefore conduct separate analyses of the impact of TFWs and permanent immigrants on interprovincial emigration and immigration. Table 3 looks at the impact on gross emigration. This is the type of effect that has been mainly investigated in the existing literature. Table 4 looks at the impact on gross immigration, which has been given less attention in previous studies.

Basically, the results of Tables 3 and 4 lead us to two important conclusions. First, both channels of international immigration contribute to a decrease in net interprovincial immigration. In other terms, there is evidence that TFWs lead to moderate native outflows to other provinces and tend to deter the arrival of natives from other provinces. Second, there is strong evidence of a significant difference in the magnitude of both channels. While the impact on native outflows is moderate, especially for older migrants, there is a strong impact in terms of decreasing provincial immigration. In other terms, the effect in terms of net immigration is driven more by a decrease in immigration of natives from other Canadian provinces. This is an important finding, for at least two reasons. First, the traditional way of thinking about interprovincial mobility refers to native outflows, not inflows. Second, unlike the effect on outflows, the

Table 3 Impact of international immigration on gross interprovincial emigration

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	18–24 years old			18–64 years old		
Lagged migr.	0.706***	0.716***	0.712***	0.702***	0.711***	0.735***
	(15.8)	(16.1)	(15.6)	(15.6)	(15.7)	(16.1)
Public exp.	4.171***	3.582**	4.311***	1.720***	1.152	
	(2.813)	(2.026)	(2.885)	(2.932)	(1.609)	
Econ. cycle	−5.419**	−4.747**	−5.672**	−2.005**	−1.344	
	(−2.5)	(−2.1)	(−26)	(−2.0)	(−1.2)	
Unempl. rate	0.021	0.018		0.008	0.006	0.011
	(0.8)	(0.7)		(0.7)	(0.5)	(0.9)
Terms of trade		−0.010			−0.010*	−0.013***
		(−1.0)			(−1.9)	(−2.7)
TFWS	0.475*	0.451*	0.451*	0.285**	0.260**	0.225*
	(1.8)	(1.7)	(1.8)	(2.3)	(2.1)	(1.8)
Perm. immig.	−0.032	−0.017	−0.047	0.072	0.084	0.105
	(−0.2)	(−0.1)	(−0.3)	(0.8)	(1.0)	(1.2)
Observations	270	270	270	270	270	270
R-squared	0.970	0.970	0.970	0.963	0.964	0.963
Prov FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Sample period: 1981–2011. OLS estimation. Columns (1–3): interprovincial emigrants aged between 18 and 24; columns (4–6): interprovincial emigrants aged between 18 and 64. Robust *t* statistics in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

decrease in gross inflows is less directly observable and is best identified through econometric estimations.

Evidence of TFWs' asymmetric impact can be explained by a set of deviations from the assumptions used in the small theoretical framework of Sect. 2. For instance, the existence of outside options for prospective interprovincial emigrants in their native province might explain this asymmetry. For example, if young workers have access to family resources in case of unemployment, that might explain why the impact on emigration is less significant in terms of size. Uncertainty about the exact wage in alternative locations, combined with risk aversion of agents, can also rationalize the documented asymmetry.

The decrease in gross immigration of natives triggered by the arrival of TFWs is also consistent with new mechanisms of adjustment explored in the recent immigration literature (Peri and Sparber 2009; DAmuri and Peri 2014). If TFWs take vacant jobs for specific occupations in other provinces, an alternative strategy of native workers might be to change their occupation and stay in their province of origin. In other terms, if waiters from Ontario having considered initially moving to Alberta face more competition due to the arrival of TFWs, some of them might prefer to start their own restaurant in Ontario rather than to move to Alberta.

Table 4 Impact of international immigration on gross interprovincial immigration

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	18–24 years old			18–64 years old		
Lagged migr.	0.677***	0.673***	0.674***	0.647***	0.651***	0.705***
	(11.9)	(13.1)	(13.0)	(10.7)	(11.5)	(13.0)
Public exp.	−1.398	0.224		−2.223***	−1.519***	
	(−1.4)	(0.2)		(−3.9)	(−2.7)	
Econ. cycle	2.990*	0.986		1.336*	0.493	
	(1.9)	(0.6)		(1.7)	(0.6)	
Unempl. rate	−0.043*	−0.038	−0.039*	−0.014	−0.011	−0.012
	(−1.7)	(−1.6)	(−1.7)	(−1.1)	(−0.9)	(−1.0)
Terms of trade		0.029***	0.029***		0.012***	0.015***
		(3.4)	(3.8)		(2.9)	(3.6)
TFWS	−0.771***	−0.703***	−0.691***	−0.458***	−0.428***	−0.400***
	(−3.1)	(−3.1)	(−3.0)	(−3.5)	(−3.5)	(−3.2)
Perm. immig.	−0.253**	−0.290***	−0.284***	−0.068	−0.082	−0.099*
	(−2.5)	(−3.3)	(−3.1)	(−1.2)	(−1.6)	(−1.8)
Observations	270	270	270	270	270	270
R-squared	0.948	0.954	0.954	0.957	0.961	0.959
Prov FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Sample period: 1981–2011. OLS estimation. Columns (1–3): interprovincial immigrants aged between 18 and 24; columns (4–6): interprovincial immigrants aged between 18 and 64. Robust *t* statistics in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

4.4 Dealing with endogeneity concerns

The theoretical framework developed in Sect. 2 as well as the econometric investigation conducted so far have assumed that the provincial inflow of TFWs is either exogenous with respect to the interprovincial mobility of workers or at least uncorrelated with the error term in specification (9). This assumption might be questioned on several grounds, but deviation from that assumption can result in inconsistent fixed-effect estimates of the coefficients of Eq. (9). In particular, the endogenous nature of TFWs can lead to biased estimates of their impact on interprovincial migration. Endogeneity might occur as a result of reverse causality or omitted variables, requiring, in turn, some instrumentation strategy.

4.4.1 Reverse causality

Reverse causality from interprovincial migration to the inflows of TFWs could be expected, for instance, if provinces with insufficient inflows of interprovincial migrants (or excessive outflows of their residents) expand the TFW program to offset the negative impact on the labour supply. If this is the case, reverse causality implies a

negative correlation between the TFWs and the error term, which, in turn, implies that the estimated coefficients of Eq. (9) by FGLS would underestimate the true impact of TFWs on interprovincial immigration.

In the first place, it is important to point out that the differentiated results for the effect of TFWs across age groups (i.e. the effect decreases almost linearly with age, see Table 2) are in line with a causality that mainly runs from the TFWs to the net mobility of interprovincial migrants as in our theoretical model.

The empirical strategy to address is to lag the flows of international migrants in the estimation. We also estimate model (9) in first differences with the lagged changes in international migrants on the right-hand side. All in all, these additional estimations show that our estimates are robust to endogeneity issues that result from reverse causality between TFWs and internal migration. The results can be obtained upon request.

4.4.2 Instrumentation

The occurrence of reverse causality between TFWs and internal migration is not the only concern in estimating Eq. (10). Omitted factors of internal migration that are correlated with TFWs can also generate endogeneity issues. Suppose, for instance, that in a given province, there is a particular positive shock affecting the labour demand for specific skills. A good example is provided by the expansion of oil extraction from the tar sands in Alberta. Suppose that, since this activity is quite new, there is a great shortage of skills in Alberta for that particular occupation. In this case, the expansion of such an activity can create an increase in demand for these workers who can be found both in other Canadian provinces and in the rest of the world.

All in all, such a situation illustrates that omitted factors can result in a positive correlation between TFWs and the error term of Eq. (9). In that case, the estimation by FGLS might result in an underestimation of the absolute effect. Having said that, as reflected by the results of Table 1, the introduction of the terms of trade variable does a good job in capturing a substantial part of these shocks. The terms of trade variable is highly correlated with provincial specific shocks such as resource booms and cleans quite well the error term from the influence of these shocks. This results in a variation of the estimated effect of the impact of TFWs (see for instance comparisons between columns 2 and 3 on the one hand and 5 and 6 from Table 1 on the other hand).

If the error term still contains the impact of these unobserved shocks, this results in a situation in which there is some remaining degree of endogeneity. This source of endogeneity requires the use of external instruments, i.e. variables not correlated with the omitted factors but with the observed TFWs. Specification (9) makes clear that such an instrument needs to be defined at the provincial level and needs to vary over time.

To that end, we use an approach that has appeared extensively in the literature of international trade (see the original contribution of Frankel and Romer 1999) but also in some recent papers dealing with international migration. Recent illustrations are provided by Spilimbergo (2009) and by Beine et al. (2013) among others. We generate an instrument, taking advantage of the disaggregation of TFWs coming into each province by country of origin. The computation of that instrument is done into two steps. First, we estimate a gravity model that explains the magnitude of the flow of TFWs from

each origin country of the world to each province for each year. The covariates of that gravity model include exogenous variables and fixed effects.

The fixed effects are country of origin, province and time. These fixed effects are useful in capturing the role of time-invariant factors specific to the origin (e.g. geographic factors, such as its being an island), specific to the destination (e.g. geographic factors, such as airports and climate) and time-specific (e.g. the general Canadian immigration policy). These are supposed to be uncorrelated to the unobserved provincial shocks of Eq. (9).

The exogenous time-invariant bilateral variables are the bilateral distance between each province and each country of origin as well as dummy variables capturing whether the destination and the origin share the same language (English or French). We create two dummies, one for English and one for French (to deal with the cases of Quebec and New Brunswick). Based on the estimated gravity model, we recover the predicted flows for each country–province–year triplet.

Finally, we also capture some kind of network effect in the migration of TFWs. Employers, having hired TFWs from a specific origin country, get some useful information about those workers' productivity and commitment to the job. If satisfied, Canadian employers subsequently tend to hire the same TFWs or TFWs of the same origin. Much anecdotal evidence suggests that it is an important factor in explaining the magnitude of bilateral flows of TFWs. We capture that by using the cumulated flows over the five previous years. These cumulated flows are supposed to be exogenous to the contemporaneous provincial shocks if these shocks are not too persistent over time. Appendix A gives the details and results of the first step of our instrumentation strategy.

Based on the estimation of the gravity model, we sum up the predicted flows across origin countries to get a total predicted flow of TFWs by year and province. This total predicted value can therefore be used as an instrument of the observed TFWs in specification (9).

Table 5 provides the final IV estimation results using the aggregate predicted flows of TFWs as an instrument of the observed TFWs. Table 5 replicates the estimations of Table 1 with the IV procedure instead of the FGLS estimation. Two main comments are in order. First, the negative impact of TFWs on net mobility that is obtained with FGLS survives the IV correction. The coefficients of TFWs are negative and significant for all specifications. Importantly, the decrease in the significance level is associated with an increase in the standard error of the coefficient, a well-known consequence of instrumentation, and is not due to a decrease in the point estimates. On the contrary, all the IV estimations tend to yield more negative effects with respect to FGLS estimates. Focusing on our preferred specification (see columns (3) and (6) of Table 5), the size of this adjustment amounts to 25 and 62% for the all-migrants case and the 18–64 age case respectively. The direction of this adjustment is fully consistent with a situation in which unobservable shocks to internal immigration are positively correlated with the flows of TFWs. In other terms, it is fully in line with a story like the oil sands in Alberta. All in all, while the amplitude of the IV estimates should be taken with caution given that the instruments are generated, all the procedures dealing with possible concerns of endogeneity issues in the estimation of Eq. (9) confirm that the TFWs exert a negative impact on net mobility of natives.

Table 5 Impact of international immigration on net internal migration: IV regressions with external instrument

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	All migrants			18–64 years of age		
Lagged mig.	0.619***	0.721***	0.709***	0.643***	0.728***	0.717***
	(9.282)	(14.919)	(19.770)	(10.489)	(15.359)	(14.840)
Public exp.	−3.421	−4.834***		−4.136	−5.830***	
	(−1.106)	(−2.725)		(−1.163)	(−2.817)	
Log (wage)	0.625			0.652		
	(1.518)			(1.370)		
Unempl. rate	−0.053**			−0.059**		
	(−2.093)			(−2.227)		
Econ. cycle	2.483*	3.610***		3.826**	5.159***	
	(1.813)	(2.788)		(2.353)	(3.370)	
TFWs	−1.836**	−1.231*	−0.666*	−2.267***	−1.694**	−0.957*
	(−2.405)	(−1.854)	(−1.685)	(−2.827)	(−2.291)	(−1.790)
Perm. immig.	−0.146	−0.115	−0.162*	−0.162	−0.123	−0.183*
	(−1.048)	(−0.935)	(−1.880)	(−1.033)	(−0.849)	(−1.927)
Terms of trade			0.025***			0.029***
			(7.124)			(3.728)
F stat first stage	17.65	24.05	40.66	22.24	26.66	36.63
Observations	230	250	270	230	250	270
R-squared	0.816	0.799	0.815	0.822	0.806	0.822
Prov FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Sample period: 1981–2011. IV estimation, robust standard errors. Columns (1–3): all interprovincial migrants; columns (4–6): interprovincial migrants aged between 18 and 64. Robust *t* statistics in parentheses; TFWs are instrumented using total predicted inflows of TFWs by province computed from the sum (across countries of origin) of bilateral flows predicted by gravity model (column 5 of Table 8)

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

4.4.3 A diff-in-diff analysis using the limited expedited LMO policy

As a complement to the IV strategy, we also carry out a diff-in-diff analysis aiming at showing the robustness of our main results to endogeneity issues. In particular, we take benefit of what has been coined as a natural experiment regarding the admissions of TFWs in two Western provinces between 2007 and 2010. We follow the same approach as the one developed by Gross (2014) using the so-called Expedited Labour Market Opinion (E-LMO) pilot project conducted in British Columbia and Alberta between September 2007 and April 2010. The E-LMO policy implemented by the immigration authorities were intended to facilitate the admission of TFWs for a set of professional occupations for registered employers in these two provinces and to lower the costs and the delays in processing the traditional LMO application. Basically, rather than to handle individual LMO applications, the authorities established first the employers'

eligibility, and if accepted, all the LMO applications were processed within 5 days instead of period up to 5 months. Basically, the project led to a drastic reduction in the obstacles to hire TFWs and corresponds more or less to a temporary abolition of the labour market tests for a period of 2 years and a half, for some occupations and specific to two regions.

As explained by Gross (2014), given its design, the E-LMO project can be considered as a natural experiment of a policy-induced exogenous increase in the number of admitted TFWs in a treated group (the two provinces). The implementation of the project resulted in a sharp increase in the number of positions confirmed through LMOs in BC and Alberta from 2007.[13] It also resulted in a drastic increase of the number of TFWs and the intensity rate of TFWs in the provinces, compared to the rest of Canada.

We build on model (9) and extend the specification to include the terms relevant to a diff-in-diff analysis. The estimated equation takes the following form:

$$m^c_{j,t} = \gamma^c_j + t^c_t + \rho^c m^c_{j,t-1} + \beta^c_1 T_{j,t} + \beta^c_2 T^w_{1j,t} + \beta^c_3 \mathrm{ELMO}_{j,t} + \beta^c_4 I_{j,t} + \beta^c_5 I^w_{1j,t} + \beta^c_6 x_{j,t} + \varepsilon^c_{j,t} \quad (10)$$

in which we collapse all province-time specific variables in the variable $x_{j,t}$. We include three additional specific terms corresponding to the diff-in-diff approach. $T^{\mathrm{w}}_{1j,t}$ captures the flows of the TFWs in the two provinces over the full period of time. The idea is to account for possible differences of TFWs over the full period of time between the treated and the non-treated provinces. If this is not taken into account, the effect(s) of the studied policy could be confounded with the ones due to differences in unobserved characteristics between the treated and non-treated provinces. The $I^w_{1j,t}$ does exactly the same job, but for the impact of permanent immigrants. The $\mathrm{ELMO}_{j,t}$ term is our key variable and is defined as the inflows of TFWs in Alberta and BC during the E-LMO policy. We allow for two definitions of the E-LMO period since in 2007, the policy was limited to a subset of professional occupations (12 occupations versus 33 occupations in 2008). Also, the project was launched in September 2007, and therefore, its effects in 2007 are questionable. In Table 6, we define the E-LMO period over 2008–2010. It should be stressed that parameter β^c_4, namely the impact of the expedited LMO program is identified with only six observations, which leads to a very low power of the test. Still, we find compelling evidence that the rise in the TFW inflows in Alberta and BC due to the implementation of the E-LMO program leads to a further decrease of the net internal immigration into these provinces.

The results of the diff-in-diff analysis are all in line with the results obtained above. The impact of the E-LMO program is in general negative and significant, suggesting that the exogenous rise of TFW inflows led to a further reduction in the net immigration of natives to the two treated provinces. Also, the coefficient of the $T^w_{1j,t}$ variable turns out to be insignificant for all categories, suggesting that the impact of TFWs on the internal mobility outside the E-LMO period is not structurally different between the treated and the non-treated provinces. This is important

[13] See Table 1 of Gross (2014) for more details.

Table 6 Diff-in-diff analysis: impact of the E-LMO policy (2008–2010) on interprovincial migration flows

Age category	(1)	(2)	(3)	(4)	(5)
variables	All	18–64	18–24	25–44	45–64
Lagged mig.	0.719***	0.728***	0.727***	0.734***	0.725***
	(18.283)	(13.935)	(13.939)	(14.836)	(12.521)
Terms of trade	0.023***	0.026***	0.045***	0.030***	0.010***
	(5.951)	(2.959)	(2.831)	(3.073)	(2.655)
Economic cycle	1.308	2.333	6.703*	2.128	0.715
	(1.154)	(1.304)	(1.951)	(1.038)	(0.943)
TFWs	−0.596*	−0.691*	−0.953	−0.968**	−0.375**
	(−1.671)	(−1.733)	(−1.002)	(−2.082)	(−2.179)
TFWs BC-AL	0.501	0.670	1.163	1.002*	0.294
	(1.217)	(1.394)	(1.135)	(1.706)	(1.370)
Expedited-LMO	−0.352**	−0.490**	−1.106***	−0.568**	−0.208**
	(−1.985)	(−2.295)	(−2.679)	(−2.187)	(−1.976)
Perm. immig.	−0.115	−0.133	−0.225	−0.124	−0.076*
	(−1.090)	(−1.357)	(−0.981)	(−1.009)	(−1.741)
Perm. immig. BC-AL	-0.369	−0.398	−0.407	−0.434	−0.204
	(−1.384)	(−1.175)	(−0.632)	(−1.105)	(−1.345)
Constant	0.737***	0.851***	1.771***	0.857***	0.346***
	(4.526)	(4.033)	(4.040)	(3.559)	(3.819)
Observations	270	270	270	270	270
R-squared	0.821	0.832	0.909	0.778	0.865
Prov FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Sample period: 1981–2011. Robust *t* statistics in parentheses. The expedited-LMO variable is defined as the inflow of TFWs in the provinces benefitting from the expedited LMO policy in place during the 2008–2010 period

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

for the interpretation of the impact of the E-LMO policy as a natural experiment, as in Gross (2014).

4.5 The skill dimension

As explained before, the data used in our analysis provide at least three important advantages over those usually used in the existing literature. First, by using annual data on interprovincial movements and on international immigrants, we are able to capture the quick response native workers provided in terms of internal mobility. Second, we use direct measures of flows instead of imputed flows from differences in population stocks to capture internal mobility, minimizing measurement errors and noise in the data. Third, the data include important information in terms of age and gender. In contrast, our data provide less information in terms of skills, either for the interprovincial migrants or for the temporary foreign workers.

The traditional approach of the literature devoted to the labour market effects of international migration has put a lot of emphasis on the various skill levels of immigrants and native workers. One of the few clear-cut conclusions of that literature is that, if any, the impact should be larger for unskilled domestic workers (see Card and Peri 2016 for a summary of the recent debate). This might therefore be desirable to attempt to account for the skill dimension in our analysis. This literature shows also the importance of work experience in capturing these effects, which is here accounted for by our analysis in terms of age groups.

The data on interprovincial migrants inferred from the annual tax reports do not include the education level of the taxpayers, neither their professional occupation. It is therefore impossible to break down the interprovincial migration flows by skill level. For the TFWs, CIC provides for each province and for each year a classification of the immigrants for two main skill levels.[14] This information is nevertheless available only from 2000 onwards. In defining the skill levels, we strictly follow the National Occupational Classification (NOC) used by CIC. The higher skilled TFWs include managerial workers, professional workers and skilled and technical workers. The lower skilled TFWs refer to intermediate and clerical workers as well as elemental workers and labourers.

As an extension of our benchmark analysis, we extend the benchmark econometric specification (9) by breaking down the $T_{j,t}$ variable, i.e. the annual inflow of TFWs in province j at time t into the corresponding inflows for higher skilled TFWs and lower skilled TFWs. The equation is estimated over the 2000–2011 period and includes the covariates of our preferred specification, i.e. the lagged interprovincial net flow, the terms of trade variable as well the usual set of provincial and time fixed effects.

Before looking at the results, some words of caution should be provided. First, given the time period for which skill levels of TFWs are available, our sample size is much reduced (we lose more than half of our observations), which raises concerns about the power of the statistical inference. Variability is also much reduced because the period of investigation basically corresponds to the resource boom, especially in western provinces and Newfoundland. Second, in contrast of the traditional literature evoked above, we do not match skill levels for native and immigrants. More precisely, we look at the impact of higher skilled (and lower skilled) TFWs on the mobility of both types of native workers. Therefore, unlike most studies, our estimates capture an average effect in terms of substitution and complementarity between TFWs and natives.[15] Finally, the two flows of TFWs are highly correlated, preventing their joint inclusion in the specification.[16] The results for the point estimates and the standard errors for the two variables of interests (lower skilled and higher skilled TFWs) are presented in the synthetic Table 7. We only report the impact of the two TFW flows on interprovincial migration for a variety of age groups. Two main points come out of the analysis reported in Table 7.

[14] Source: Immigration Refugees and Citizenship Canada, Facts and figures—immigration overview: temporary residents overview, March 2016 released.

[15] For instance, if one expects to have substitution effects for similar levels of skills between natives and TFWs, and complementarity effects for different levels of skills, this means that our estimates will capture a mixed effect between complementarity and substitution. If this is the case, our estimates can be seen as a lower bound of the substitution effects between similar levels of skills.

[16] The correlation between the immigration rates (resp. flows) for unskilled and skilled TFWs is 0.84 (resp. 0.93), which leads to a very high degree of multicollinearity. This illustrates that provinces tended to attract both types of TFWs at the same time and that, in light with our theoretical background, the global tightness of the provincial labour market played a prominent role in attracting these TFWs.

Table 7 Effects of TFWs by skill level on various interprovincial migration flows per age group, 2000–2011

	(1) Lower skilled TFWs	(2) Higher skilled TFWs
All migrants	−1.08*** (−2.87)	−1.19** (−1.99)
18–64 both sexes	−1.25*** (−2.75)	−1.21* (−1.67)
18–24 both sexes	−2.28** (−2.34)	−1.48 (−0.95)
25–44 both sexes	−1.36*** (−2.64)	−1.33 (−1.56)
45–64 both sexes	−0.70*** (−2.71)	−0.76* (−1.88)

The table provides estimates of the impact of TFWs by skill level using specification (9). Flow rates by skill level are introduced separately due to collinearity. The covariates included lagged net interprovincial flow rates and the terms of trade variable. Sample period: 2000–2011. Number of observations: 120. Robust *t* statistics in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

First, for all age groups, the impacts of both types of TFWs on interprovincial migration are negative and comparable in magnitude. However, whereas the impact of the lower skilled TFWs is always significant at least at the 5% level, the point estimate of the higher skilled TFWs is not always significant at a reasonable degree of confidence across all age groups. Nevertheless, the impact of the higher skilled TFWs is significant at the 5% level for the overall population and at the 10% level for the population in the 18–64 age group.

Second, the impact of lower skilled TFWs on the population of the 18–24 age group is higher and much more significant than for the higher skilled TFWs. Our earlier results suggested that the substitution effect between the TFWs and interprovincial migrants was quantitatively more important for the population in the 18–24 age group. This result appears to be driven by the arrival of lower skilled TFWs. Two additional mechanisms can explain that result. First, the interprovincial migrants of the 18–24 age groups are likely to be much more unskilled compared to the other age groups and the overall Canadian population, since they include school drop-outs and do not include a large proportion of graduates from universities. Therefore, the impact of lower skilled TFWs is likely to be driven much more by the substitution effect between low-skilled TFWs and natives. Second, this age group includes a much larger number of Canadian workers with no or little work experience. By their very nature, the lower skilled TFWs coming in Canada have also little work experience, at least on the Canadian labour market. Furthermore, they receive no or little training due to the very short-term nature of their labour contract. This also means that from a work experience point of view, the native workers in the 18–24 age groups are likely to be more substitutes to the incoming TFWs.

5 Conclusion

This paper revisits the impact of international migration on the internal mobility of domestic workers. For that purpose, we rely on Canadian data that allow us to examine the effect of two very different immigrants' channels: the TFWs on the one hand and the permanent immigrants selected through the immigration point system on the other hand. The Canadian immigration policy provides an interesting natural experiment in

the sense that it combines simultaneously in the same country an immigrant-driven system (the point system) and an employer-driven system (the one governing the admission of TFWs). Our main contribution is to show that the profile of these immigrants is key when identifying their impact on the propensity of Canadian residents to move to another province. TFWs tend to decrease the net interprovincial migration rate of the province in which they settle. In contrast, permanent immigrants do not affect the mobility of natives in a systematic way. Our interpretation of this contrast lies in the way both channels affect the job vacancy rate/unemployment rate ratio. TFWs come into Canada to fill vacancies, whereas the effect of permanent immigrants on the vacancy/unemployment ratio is unclear, given the way they are selected. This vacancy/unemployment ratio is likely to affect the perceived probability of employment of prospective internal migrants and, hence, the expected gains from moving. In general, our results show how important immigration policies are in shaping the labour market impact of international immigration.

Our findings show that, in the short run (within the year), 10 additional TFWs arriving in one given province tend to displace about six native workers, a number that is higher than the ones found in previous similar studies. The results also indicate that, in the long run, one additional TFW tends to decrease net interprovincial migration of the province the TFW lands in by about two internal working-age migrants. These general results vary significantly across the characteristics of the internal migrants. It is higher for young workers and for males. The impact of TFWs on young workers appears to be driven by the arrival of lower skilled workers. Also, the impact of TFWs on net immigration is driven by the effect on gross emigration and immigration. We show that, while both effects exist, the decrease in gross immigration is more significant than the increase in resident outflows. The respective contribution is roughly 60 and 40% of the total impact. To the best of our knowledge, this result has not been documented before in the existing literature and is noteworthy because the dominant impact on immigration is more obvious.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix A: Two-step instrumentation strategy: procedure and detailed results

In this appendix, we detail the procedure and results of the instrumentation strategy used in Sect. 4.4.2 to cope with the potential occurrence of unobservable province-specific shocks. If these unobservable shocks are correlated with the inflows of the TFWs, then the FGLS estimates of the structural model to be estimated (see Eq. (9)) can be biased.

The IV procedure basically requires us to use an instrument that is correlated with the observed inflows of TFWs but uncorrelated with the error term and hence with the unobservable shocks. We need to emphasize that these shocks and the instrument are time- and province-specific. Our IV procedure builds on the previous strategies implemented in the literature of growth, trade, and migration. See Frankel and Romer (1999) for an application to the impact of trade on growth. It has also been used in the literature on international migration (see Spilimbergo (2009) and Beine et al. (2013), among others). The present strategy extends the previous contributions in the sense that we use a panel dimension while the previous papers dealt only with cross-sectional data.

The procedure involves two main separate steps. For the sake of clarity, the first step can be broken down further into separate substeps.

A.1 First step: gravity model and aggregate predicted inflows of TFWs by provinces

In this first step, we use a gravity model applied to the bilateral flows of TFWs between each country of origin of the world and each province in each year. The model is used to generate predicted bilateral flows for each triplet (origin country-destination province-time) that are afterwards aggregated across countries of origin to generate our instrument. This instrument is the time-varying, province-specific aggregate predicted inflows of TFWs. The prediction is supposed to be generated by exogenous factors, i.e., covariates of the gravity model that are uncorrelated with the unobservable shocks (and the error term) of Eq. (9).

We first estimate the following benchmark gravity model:

$$ln\left(1+m_{ij,t}\right)=\alpha_i+\alpha_j+\alpha_t+\beta_1\ ln\left(d_{ij}\right)+\beta_2\ l_{ij}+\beta_3\ M_{ij,t\text{-}1}+\gamma'f\left(y_{it}\right)+\varepsilon_{ij,t} \quad (11)$$

The gravity model involves a log-log specification explaining the log of the number of TFWs $m_{ij,t}$ each year t between country of origin i and province j. This specification can be more or less justified on the basis of microfoundations with optimizing agents (see Beine et al. (2016) for a survey).

Since there are many pairs with zero bilateral flows or even missing bilateral flows, the use of $\ln(m_{ij,t})$ would generate estimations that are subject to a significant selection bias. We can indeed expect that countries that do not send any TFWs to a given province do not share the same observed and unobserved features as those of the countries sending TFWs. The same line of reasoning can apply to missing data about the flows. To avoid that, we use the usual "trick" of taking $\ln(1 + m_{ij,t})$ (the so-called scaled estimation procedure) to include the zeroes in the estimation. Further to that, we also have to deal with the missing data. Looking at the database (kindly provided by Citizenship and Immigration Canada (CIC)), we notice that most of the missing data was found for triplets for which zero flows were observed during other years. If this is correct, we can transform the missing data into zeroes, which would involve even more observations. We follow both procedures and check that the results are qualitatively and quantitatively similar.

Model (11) involves either covariates or fixed effects. With respect to fixed effects, we include country of origin fixed effects α_i that capture the time-invariant characteristics of origin countries such as geographical location. We also include the destination province fixed effects α_j that capture the time-invariant characteristics of receiving provinces such

as geographical location or language. Finally, we include time fixed effects that capture the general factors affecting the migration of TFWs. These include important factors such as the Canada-wide immigration policy regarding these TFWs.

We use two time-invariant factors affecting the relative attraction between each country of origin and each province. First, we use geographic distance d_{ij} between each origin country and each province, using the respective capitals as references. Second, we use linguistic proximity measures denoted by l_{ij}. Note that Canada is mainly an English-speaking country with the exceptions of Quebec, which is French-speaking, and New Brunswick in which both languages are spoken. l_{ij} is broken down further into two variables, one for French, one for English. The two variables are dummy ones taking 1 if the origin and the destination share the same language, 0 otherwise. The l_{ij} and d_{ij} variables are exogenous with respect to unobserved shocks.

We also capture in model (11) some network effect regarding the TFWs. The migration of workers has been shown to depend a lot on migrants' networks at the macroeconomic level (see Beine et al. (2014)). These networks are related to the stock of previous migrants in the destination province who came from the same origin. For TFWs, however, this concept is not directly applicable since these are temporary migrants who have to return to their country at the end of the year. Still, some network effect definitely exists in the process of hiring TFWs. In hiring TFWs from a specific origin, Canadian employers obtain some information about productivity, efficiency, and so on of that origin's workers from previously hired TFWs from the origin. But these important revelations can be asymmetric. Furthermore, if employers are satisfied with the previous TFWs, employers can hire the same workers provided they return to their origin and reapply to the program. Anecdotal evidence of farmers in Quebec repeatedly hiring agricultural workers from Honduras as TFWs is a good illustration of that phenomenon. We capture this particular network effect by summing up the flows of previous TFWs over the last 5 years. This variable is denoted by $M_{ij,t-1}$. If unobserved shocks to the province are not too persistent over time, this variable is also exogenous with respect to unobserved shocks.

Finally, we include origin-specific income shocks y_{it}. We use GDP per head data from the Penn World Tables (version 8.0)[17] in several functional forms. In a first one, we simply use the log of GDP per head, i.e., $\gamma' f(y_{it}) = \beta_4 \ln(y_{it})$. This could capture the role of the wage differential between the origin and Canada, and we should expect a negative coefficient if this mechanism is prevailing. Nevertheless, the literature on migration shows that income at origin can have a non-linear effect. See Mayda (2010) and Beine et al. (2016) on that. Low-income levels can be associated with little emigration because liquidity constraints are operating. As income increases, this releases these constraints and leads to more

[17] Actually, the database of bilateral flows to each province transmitted by CIC includes up to 251 origins (the maximum number is for Ontario). While most of these origins are countries, a subset includes regions of some countries (the remaining origins are aggregates of countries like East Africa and are omitted). A good example is provided by the four overseas departments of France (Guyana, Guadeloupe, Martinique, and La Réunion) for which the flows are distinct from the ones coming from Metropolitan France. Aggregating the flows with those coming from Metropolitan France would include some bias since these departments differ significantly from the Metropole, especially in terms of distance to Canada but also in terms of income levels. It is still interesting to include these regions since they send many migrants to Canada and especially to French-speaking Quebec. For these entities, we calculated our own GDP per head data since they are not available in the Penn World Tables (version 8.0). We use the data of the Institut National de la Statistique et des Études Économiques (Insee) for 2009, 2010, and 2011. For the rest of the sample period, we applied the ratio department/metropole to the French data to get GDP per head estimates of these origins.

migration. After some threshold, when constraints are no longer operating, further increases lead to a reduction in the wage differential and therefore deter emigration. In that case, one should expect a concave relationship. In this functional form, we have $\gamma' f(y_{it}) = \beta_4 y_{it} + \beta_5 y_{it}^2$. Income shocks at origin y_{it} are obviously uncorrelated with province-specific shocks and can be therefore considered as exogenous factors.

Table 8 presents the results of the estimation of Eq. (11) with different variants.

The results of the gravity regressions are more or less in line with the expectations. Flows of TFWs to a given province from a given origin increase with linguistic similarity, decrease with distance, increase with the size of the previous flows of the TFWs. The role of origin-specific GDP shocks receives less support from the data. While the signs of the coefficients are consistent with the expectations, they are mostly insignificant. This might due to the fact that what matters for migration decisions is the wage at origin. GDP per head might be a poor proxy for the wages in a lot of cases. This issue has already been identified in the existing literature on gravity models applied to international migration (see Beine et al. (2016), among others).

The different specifications (1) to (6) give fairly similar results. The R2 vary between 0.83 and 0.90, which suggests that the prediction should be quite good, at least at the bilateral level. The fact that missing data are transformed into zero values leads to a

Table 8 First-stage regressions: explaining flows of TFWs

	Dependent variable: ln(1+Temporary Foreign Workers)					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1.444*** (10.373)	1.588*** (8.988)	1.510*** (10.762)	1.162*** (9.342)	1.358*** (8.793)	1.228*** (9.736)
Log (distance)	-0.567*** (-9.779)	-0.562*** (-9.750)	-0.562*** (-9.737)	-0.402*** (-7.653)	-0.399*** (-7.578)	-0.399*** (-7.577)
Common English	0.222*** (7.970)	0.245*** (8.708)	0.245*** (8.688)	0.234*** (8.206)	0.245*** (8.468)	0.245*** (8.466)
Common French	0.381*** (15.736)	0.398*** (16.272)	0.398*** (16.251)	0.162*** (7.470)	0.165*** (7.547)	0.165*** (7.545)
Past TFWS last 5 years	0.529*** (97.011)	0.520*** (93.047)	0.520*** (93.138)	0.561*** (130.512)	0.557*** (127.069)	0.557*** (127.145)
GDP per head			-0.000* (-1.815)			-0.000 (-1.053)
GDP per head squared			0.000			0.000
			(1.385)			(0.914)
Log (GDP per head)		-0.011 (-0.818)			-0.017 (-1.553)	
Observations	35,088	33,310	33,310	50,712	48,502	48,502
R-squared	0.898	0.898	0.898	0.833	0.832	0.832
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Prov FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust t-statistics in parentheses. Specifications (1) to (3): missing data not included for the TFWs. Specifications (4) to (6): missing data transformed in zeroes for the TFW

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

slightly less-good fit; this is understandable since, in some cases, this might be too strong an assumption. One should be aware that each model will give rise to a different instrument, so a choice has to be made for the subsequent instrumentation procedure. In Sect. 4.4.2, we use the instrument generated by model (6). Nevertheless, the results of the final IV estimation do not depend in general on that choice since the results are qualitatively and quantitatively similar across the six possible instruments.[18]

A.2 Prediction of bilateral flows of TFWs

Once model (11) has been estimated, one can recover the estimates of the fixed effects and the coefficients to predict each bilateral flow of TFWs between each origin and each province of destination at each point of time. Let us denote α' as the vector of the estimated fixed effects and denote θ' as the vector containing the estimated slope coefficients

$$\left(\widehat{\beta}_1, \widehat{\beta}_2, \widehat{\beta}_3, \widehat{\beta}_4, \widehat{\beta}_5\right)$$

from model (11). Finally, let us collapse in vector X'_{jt} the covariates used in each regression. Then, we have

$$\left(1 + \widehat{m}_{1\,j,t}\right) = exp\left(\alpha' + \theta' X'_{ijt}\right). \tag{12}$$

A.3 Prediction of inflows of TFWs by province and by year

We then can use the predicted $\widehat{m}_{1\,j,t}$ at the dyadic level to produce a predicted aggregate value for each province at each point of time. This is obtained simply by summing up across origins for each province in each year:

$$\widehat{m}_{j,t} = \sum_{i=1}^{N} m_{ij,t}. \tag{13}$$

The predicted $\widehat{m}_{j,t}$ can be used subsequently as an instrument for the observed values of TFWs by province and time period.

The validity of these instruments has to fulfil the usual two conditions. First, the instruments must be strong predictors of the observed TFWs. The estimates of Table 8, in particular the values of the R^2, suggest that this is the case at the bilateral level. Furthermore, at the aggregate level, i.e., after summing up across origins, this can be evaluated by the F-stat of the first stage of the final IV procedure. The values of the F-stats reported in Table 5 in the core of the text are far beyond the usual threshold of 10.

The second condition is that the instrument must be uncorrelated with the error term of the final regression. In this case, the error term contains the influence of unobserved provincial shocks on the net interprovincial immigration flows of native workers. The covariates used for the prediction of $\widehat{m}_{j,t}$ and $\widehat{m}_{j,t}$ are obviously uncorrelated with the contemporaneous shocks. The exclusion restriction can be questioned only for our measure of the network effect $M_{ij,t-1}$ if these shocks are highly persistent over time. Nevertheless, instruments generated without the inclusion of $M_{ij,t-1}$ give qualitatively similar results.[19]

[18] All the results are available upon request from Michel Beine.

[19] Once again, these results are available upon request from Michel Beine.

Appendix B: Supplementary results

Table 9 Impact of international immigration on net internal migration by age profile: benchmark results

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	18–24 years old			25–44 years old		45–64 years old	
Lagged migr.	0.647***	0.668***	0.679***	0.629***	0.704***	0.640***	0.719***
	(10.3)	(12.4)	(13.3)	(10.2)	(13.6)	(9.6)	(11.9)
Public exp.	-2.617			-4.410		-2.145**	
	(-0.6)			(-1.6)		(-2.4)	
Taxes	4.035			-1.488		-0.298	
	(0.6)			(-0.4)		(-0.2)	
Log(wage)	1.328			-0.002		-0.074	
	(1.1)			(-0.0)		(-0.3)	
Unempl. rate	-0.090*	-0.093**	-0.070*	-0.039	-0.018	-0.005	0.001
	(-1.8)	(-2.2)	(-1.7)	(-1.2)	(-0.7)	(-0.4)	(0.1)
Econ. cycle	7.668**	9.946***	6.215*	3.217	1.847	1.008	0.705
	(2.305)	(3.168)	(1.839)	(1.621)	(0.890)	(1.422)	(0.929)
TFWs	-1.548***	-1.219***	-1.125***	-0.962***	-0.696***	-0.480***	-0.350***
	(-3.3)	(-3.0)	(-2.8)	(-3.5)	(-3.1)	(-3.1)	(-3.0)
Perm_ immig.	-0.235	-0.332	(-1.5)	-0.162	-0.230*	-0.048	-0.104**
	(-0.7)	(-1.4)		(-1.1)	(-1.8)	(-0.8)	(-2.3)
Terms of trade			0.043***		0.029***		0.010***
			(2.8)		(3.1)		(2.7)
Observations	230	270	270	230	270	230	270
R-squared	0.915	0.898	0.907	0.797	0.773	0.881	0.861
Prov FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sample period: 1981–2010. OLS estimation. Columns (1–3): interprovincial migrants aged between 18 and 24; columns (4–5): interprovincial migrants aged between 25 and 44; interprovincial migrants aged between 45 and 64. Robust t-statistics in parentheses. For the impact of TFWs, the second figure within the bracket reports the long-run impact

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table 10 Impact of international immigration on net internal migration by age profile, males: benchmark results

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	18–64		18–24		25–44		45–64	
Lagged migr.	0.611*** (10.1)	0.675*** (12.0)	0.639*** (10.4)	0.663*** (12.0)	0.614*** (10.0)	0.688*** (12.3)	0.611*** (9.8)	0.712*** (12.0)
Public exp.	-3.213 (-1.3)		-1.574 (-0.3)		4.256 (-1.4)		-2.169** (-2.1)	
Log(wage)	0.314 (0.5)		1.208 (0.9)		0.137 (0.2)		0.007 (0.0)	
Unempl. rate	-0.030 (-1.1)	-0.026 (-1.1)	-0.085 (-1.4)	-0.072 (-1.4)	-0.027 (-0.8)	-0.020 (-0.7)	-0.001 (-0.1)	-0.002 (-0.2)
Econ. cycle	3.815** (2.0)	2.534 (1.2)	9397** (2.6)	7A89* (1.9)	4.193* (1.0)	2.320 (1.0)	1.198 (1.5)	0.643 (0.7)
TFWs	-0.909*** (-0.4)	-0.740*** (-3.2)	-1.701*** (-3.4)	-1.328*** (-2.9)	-0.880*** (-2.9)	-0.728*** (-2.7)	-0.497*** (-3.5)	-0.400*** (-3.3)
Perm. immig.	-0.130 (-1.3)	-0.233** (-2.1)	-0.216 (-0.8)	-0.343 (-1.3)	-0.129 (-1.3)	-0.233 (-1.6)	-0.086 (-1.4)	-0.139** (-2.4)
Terms of trade		0.030*** (3.1)		0.052*** (2.9)		0.034*** (3.0)		0.012*** (3.0)
Observations	240	270	240	270	240	270	240	270
R-squared	0.827	0.811	0.901	0.896	0.768	0.752	0.855	0.839
Prov FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sample period: 1981–2010. OLS estimation. Columns (1–2): interprovincial male migrants aged between 18 and 64; columns (3–4): interprovincial male migrants aged between 18 and 24; columns (5–6): interprovincial male migrants aged between 25 and 44; columns (7–8): interprovincial male migrants aged between 45 and 64. Robust t-statistics in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table 11 Impact of international immigration on net internal migration by age profile, females: benchmark results

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	18–64		18–24		25–44		45–64	
Lagged migr.	0.619*** (102)	0.692*** (12.6)	0.598*** (10.4)	0.638*** (12.3)	0.604*** (10.1)	0.697*** (13.4)	0.601*** (9.0)	0.690*** (10.7)
Public exp.	4.253** (-2.5)		4.125 (-1.1)		-5.464** (-2.5)		-2.482*** (-3.0)	
Log(wage)	-0.049 (-0.1)		0.617 (0.7)		-0.150 (-0.3)		-0.188 (-1.0)	
Unempl. rate	-0.031 (-1.4)	-0.022 (-1.1)	-0.112** (-2.4)	-0.088** (-2.2)	-0.031 (-1.1)	-0.020 (-0.8)	-0.004 (-0.4)	0.002 (0.2)
Econ. cycle	2.088 (1.5)	1.767 (1.1)	5.650* (1.8)	5.096 (1.6)	2.128 (1.2)	1.426 (0.7)	0.835 (1.3)	0.794 (1.1)
TFWs	-0.757*** (4.1)	-0.589*** (-3.5)	-1.252*** (-3.5)	-0.935** (-2.5)	-0.831*** (4.0)	-0.664*** (-3.5)	M.425*** (-3.1)	-0.319*** (-2.8)
Penn. immig.	-0.120 (-1.4)	-0.195* (-1.9)	-0.251 (-1.2)	-0.341 (-1.5)	-0.161 (-1.4)	-0.237* (-1.8)	-0.356 (-0.9)	-0.722 (-1.6)
Terms of trade		0.021*** (2.9)		0.034** (2.4)		0.025*** (3.2)		0.007** (2.3)
Observations	240	270	240	270	240	270	240	270
R-squared	0.859	0.831	0.903	0.891	0.800	0.771	0.880	0.859
Prov FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sample period: 1981–2010. OLS estimation. Columns (1–2): interprovincial female migrants aged between 18 and 64; columns (3–4): interprovincial female migrants aged between 18 and 24; columns (5–6): interprovincial female migrants aged between 25 and 44; columns (7–8): interprovincial female migrants aged between 45 and 64. Robust t-statistics in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table 12 The impact of international immigration on net internal migration (including permanent economic and non-economic immigrants)

Variables	(1)	(2)	(3)	(4)
	18–64		18–24	
Lagged immig.	0.690***	0.716***	0.678***	0.684***
	(12.6)	(13.4)	(13.2)	(12.9)
Econo. cycle	2.157		6.260*	
	(1.2)		(1.8)	
Unempl. rate	-0.022		-0.069*	-0.083**
	(-1.1)		(-1.7)	(-2.0)
Terms of trade	0.026***	0.028***	0.043***	0.050***
	(3.0)	(3.4)	(2.8)	(3.3)
TFWS	-0.671***	(-3.1)	-1.135***	-1.046**
	(-3.4)		(-2.8)	(-2.6)
Perm. econ. migrants	-0.176*	-0.151	-0.272	-0.266
	(-1.0)	(-1.5)	(-1.2)	(-1.1)
Perm non-econ.migr.	-35.487	-35.393	-57.063	-54.480
	(-1.5)	(-1.5)	(-1.1)	(-1.1)
Observations	270	270	270	270
R-squared	0.829	0.826	0.907	0.905
Prov FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Sample period: 1981–2010. OLS estimation. Columns (1–2): migrants aged between 18 and 64; columns (3–4): migrants aged between 18 and 24. Robust t-statistics in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table 13 Diff-in-diff analysis: impact of the E-LMO policy (2007–2010)

Age category	(1)	(2)	(3)	(4)	(5)
Variables	all	18–64	18–24	25–44	45–64
Lagged mig.	0.713***	0.719***	0.716***	0.726***	0.717***
	(18.178)	(13.768)	(13.954)	(14.603)	(12.189)
Terms of trade	0.024***	0.027***	0.046***	0.030***	0.010***
	(6.019)	(3.016)	(2.879)	(3.134)	(2.708)
Economic Cycle	1.202	2.179	6.335*	1.940	0.659
	(1.055)	(1.203)	(1.826)	(0.934)	(0.855)
TFWs	-0.597*	-0.692*	-0.967	-0.970**	-0.377**
	(-1.671)	(-1.747)	(-1.021)	(-2.101)	(-2.207)
TFWs BC-AL	0.525	0.730	1.461	1.078	0.278
	(1.193)	(1.295)	(1.264)	(1.549)	(1.086)
Expedited-LMO	-0.316*	-0.459*	-1.151**	-0.535*	-0.164
	(-1.694)	(-1.769)	(-2.387)	(-1.666)	(-1.312)
Penn. immig.	-0.128	-0.152	-0.267	-0.147	-0.083*
	(-1.216)	(-1.549)	(-1.158)	(-1.211)	(-1.849)
Perm. immig.BC-AL	-0.330	-0.343	-0.277	-0.370	-0.185
	(-1.242)	(-0.986)	(-0.422)	(-0.910)	(-1.180)
Constant	0.719***	0.817***	1.655***	0.814***	0.344***
	(4.190)	(3.618)	(3.598)	(3.133)	(3.472)
Observations	270	270	270	270	270
R-squared	0.820	0.831	0.908	0.777	0.864
Prov FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Sample period: 1981–2012. Robust t-statistics in parentheses. The Expedited-LMO variable is defined as the inflow of TFWs in the provinces benefitting from the expedited LMO policy in place during the 2007–2010 period

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

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