Projecting Labour Market Needs in Canada: The COPS National Model after 30 Years

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Abstract

The Canadian Occupational Projection System (COPS) has been producing analytical outputs and Labour Market Information for nearly 30 years. The outputs of COPS are widely available to policy and labour market analysts. More importantly, COPS disseminates labour market information to the public through publications or online. This role has the potential to directly influence the choices participants make in the labour market. While existing literature adequately describes the outlines of the system which existed in the 1990s, significant improvements have been made in the last 15 years. Nevertheless, significant conceptual and technical challenges to the provision of occupational projections remain. This paper will focus on the purpose and aims of the COPS National Model. Central to the discussion will be how the system arrives at an assessment of broad skill and occupational imbalances. Finally, technical and logistical challenges as well as innovations to the system will be highlighted.

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The Canadian Occupational Projection System (COPS) was established in 1982 and built on the framework of the, then existing, Canadian Occupational Forecasting System (COFOR). The COPS suite of models is designed to anticipate *ex-ante* occupational imbalances and provide forward-looking analysis of occupational trends for policy analysts and labour market information users.

The system has a long history and the outputs produced are widely available to policy analysts and the general public. While numerous technical working papers exist as to the workings of COPS model components, there are few places to obtain a concise and accessible summary of the scope, purposes and functioning of the system. This paper seeks to fulfil that role. Moreover, innovative features of the system and the limitations of the COPS projections are highlighted.

Section one provides a brief history of COPS, the changing goals and technical tools used to achieve these. Section two lays out the structure of the modelling system and describes the methods used in the model components. Section three provides an overall description of the datasets used in the construction of the necessary data. Section four provides some overall results and assessments of the model outputs. Section five highlights some of the innovative features of the system and some of the challenges in producing occupational projections. Section six concludes and describes future work.

1. Thirty Years of Occupational Projections

In 2012 the COPS system will have been providing occupational assessments for thirty years. While the system was launched with much fanfare and great expectations, over time it has found a niche as a specialist provider of quantitative occupational information. The modelling system has a unique structure for the provision of occupational projections (Forecasting and Analysis Unit, 2004). The model itself has evolved over a long period and continues to produce a steady stream of information used by job seekers and policy analysts.

The information generated by COPS is funded and provided for through the public sector. Neugart and Schömann (2002) claim that the provision of Labour Market Information (LMI) meets the criteria for being considered a public good and that the public sector is best positioned to provide the information to job seekers. The COPS national model is housed within the public sector for historical reasons and remains a relevant contributor to Canada's LMI system. A good description of COPS and the LMI system in Canada can be found in Smith (2002). While it is difficult to avoid overlap with that work, the remainder of this document will stress historical and new developments not covered there.

Aside from a set of once-off studies (Meltz and Penz, 1968 and Ahmad, 1969), the first regularly published demand-side occupational projections for Canada and the provinces were performed in the early to mid 1970s using the Canadian Occupational Forecasting Program (COFOR) model (Manpower and Immigration, 1975). These projections

excluded occupations generally requiring post secondary education but afforded the first regularly produced medium-term manpower projections for the country and its constituent provinces. In 1981 with the release of the Report of the Task Force on Labour Market Development, the groundwork was laid to replace the COFOR model with a more expansive projection system (Dodge, 1981). The COPS system was created as a result of this report.

The earlier models are well documented and have been improved substantially over time. The demand methodology and approaches to addressing the supply side of the market were developed in 1983 (Strategic Policy and Planning, 1983a and 1983b). While the demand methodology remained wedded to the COFOR approach, the developments on the supply side, in particular the student flows model, was an entirely new approach. The models were quite ambitious providing detailed occupational results by province, including the supply-side of the labour market.

The models proved rather rigid and the elevated expectations of end users led quickly to dissatisfaction with the accuracy of projections (Employment and Immigration, 1991). The fixed coefficients approach of the CDM was updated to allow for variable coefficients within the demand side of the model (Henson, 1991). This new approach allowed some flexibility and analyst judgement to more formally enter the projections.

A subsequent revision expanded both the demand and supply sides of the model (Boothby, Roth and Roy 1995). In this revision the school leaver model is first distinguished from the previously existing student flow model. Better accounting was made for various labour market flows and expansion and replacement demand components were fully described as separate models (previous documents simply described “occupational demand” and “attrition” components on the demand side). The concept of imbalances was developed in this document for the first time – that is, anticipated imbalances between supply and demand were incorporated into the framework as a series of qualitative indicators. Other documents described these improvements in detail. These include the two reports of Boothby (1995 a and b) and Boydell, Gautier and Hughes (1995).

For several years (the late 1990s and early 2000s), the COPS model was not the object of significant development effort. Most of the work being done by the national COPS team was focussed on the production of the labour market information product *Job Futures*[1] and to responding to various ad-hoc requests. Starting in 2005 model development again became a priority and much of the developments focussed on expanding the supply side in order to enrich the analysis of labour market imbalances produced by the system. Further work, extending the stock-flow accounting and introducing net mobility flows followed.

Over the 2004-2008 period the “Looking Ahead” documents were developed as a flagship analytical product. These documents offered a comprehensive analytical

[1] This product has been discontinued and has largely been replaced by the Working in Canada portal (www.workingincanada.gc.ca).

structure and narrative. Furthermore, they offered a descriptive outline of all methodologies used to produce the models. Many of the developments presented in the last Looking Ahead (2008) are still used in the current projections but model development and enhancement continues.

Constant model development work is necessary to ensure that the various demands placed on the CNM can be addressed with suitable forecasting models that can capture, in an appropriate way, structural changes in the economy as well as data revisions. While it is important to appreciate the timelines on the evolution of the COPS models, the previous incarnations of the models will not be discussed further. Instead, the most recent vintage of the COPS models will be presented.

2. Evaluating Occupational Imbalances

The occupational projection methods used by COPS are within the family of manpower planning models pioneered in the mid twentieth century. The earliest cited reference to the practical application of these models is that of Parnes (1962). The basic conceptual framework seeks to identify the anticipated (or target) industrial structure within an area. The manpower requirements for this industrial structure are then computed and educational targets are set to meet these needs. Most occupational projection systems today forgo the educational targets as these generally have proven to be inaccurate in the past.

The COPS model follows this traditional structure but stops short of proposing targets of any sort. Furthermore, the model revisions of the mid-1990s documented by Boothby, Roth and Roy (1995) proposed a disequilibrium concept to represent occupational imbalances, namely that the market clearing wage rates be held constant for the projection period. This approach allowed for a separation of the modelling of supply and demand and allowed for some grey areas in the model output to emerge. Namely, that the imbalances presented could point to the anticipated areas where pressures would emerge and the direction of those pressures while not generating point estimates of the expected state of occupational labour market equilibrium in the projection period. This result, while giving useful LMI, merely pointed to the anticipated outcomes in a vague and parsimonious fashion.

To begin the projection some form of target economic state has to be defined. The industrial structure over the projection period is identified by using macroeconomic and employment forecasts to anticipate the expected path of industrial employment in the 33 COPS industries. This target path is constrained to follow an economic consensus forecast at the macro level, essentially becoming an anticipated employment path, rather than an employment target. The macroeconomic forecast is then broken down into output, productivity and employment at the industrial level. The expected path of the change in industrial employment is then split into the anticipated path of occupations within the individual industries. These are then summed across industry to obtain occupational employment. The change in occupational employment is called the expansion demand (ED). Supplementary measures of departing workers are made to

arrive at the total number of new positions being generated or existing positions being vacated. These are called the replacement demand. Together, these relationships are referred to as new job openings (NJO). Hence, for each of 140 3-digit occupational groupings *o* at time *t*:

$$NJO_t^o = ED_t^o + RD_t^o \quad (1)$$

Equation 2 generates the total number of new job opening or the total new demand which needs to be filled in order to meet the production goals within the 33 industries.

$$NJO_t = \sum_{o=1}^{140} NJO_t^o \quad (2)$$

However, the sources of the job seekers (JS) must also be considered. This side of the labour market is represented by entrants into particular occupations. The largest source of job seekers comes from those who enter the labour market for the first time from the school system. These individuals are called school leavers (SL). Another source of new labour supply comes from immigrants who participate in the labour market (IMM). Further sources of job seekers come from net re-entrants (NRE): the number of other labour market entrants, net of those who choose to leave the labour market and are captured by replacement demand. One additional important source of new occupational supply is occupational mobility (OM). However, this component does not add to the stock of new workers, but simply changes the composition of existing employment. Hence, the total number of new job seekers for each of 140 3-digit occupations *o* at time *t* can be represented as

$$JS_t^o = SL_t^o + IMM_t^o + NRE_t^o + OM_t^o \quad (3)$$

$$JS_t = \sum_{o=1}^{140} JS_t^o \quad (4)$$

Occupational Imbalances are computed by comparing the number of new job openings to the number of job seekers over the projection period. If the number of job openings exceeds the number of job seekers, excess demand is anticipated and if the number of job seekers exceeds job openings then excess supply is expected.

2.1 Expansion Demand

The cornerstone of the COPS model is the expansion demand model. The basic configuration of this model predates the COPS system by a decade. While many technical improvements have been made to the model specification and the quality of the projections the underlying model remains true to the original manpower planning concept from which it was developed. Abstracting from the stock of capital, industrial output can be said to depend on the occupational composition of the production process and the labour-augmenting technology within that industry. Hence, total output (*Y*) in an industry *i* is produced through total employment (*N*) by occupational class *o* and by labour productivity (A) in that industry.

$$Y_t^i = A_t^i f_i(N_t^{i,1}, N_t^{i,2}, ..., N_t^{i,o}) \quad (5)$$

In theory, inverting the production function would show that occupational labour demand in industry *i* is some function of output and productivity as well as the choice of other labour inputs. Summing across industries then produces the total occupational labour demand. The expansion demand is obtained from this by taking the period change in employment.

In practice, the COPS model estimates occupational by industry shares using time series regression. By using single equation regression methods the COPS model can more easily decompose anticipated occupational employment changes through shift-share analysis. Expansion demand is broken down into an industrial effect (reflecting the change in employment due to the performance of the industry) and an occupational effect (the changes due to the trend path of the occupational share in the industry) for analytical convenience.

Operationally, preliminary employment share projections are estimated using OLS in and are largely driven by time trends and an output gap measure, with the former more likely to be statistically significant in the majority of cases.[2] The results are evaluated and adjusted through a vetting process and then normalized to the industrial total. At a higher level of disaggregation occupational clusters are projected together to allow for within-group variability for 3-digit occupational projections.

2.2 Replacement Demand

Replacement demand is a broad term that tends to capture any unfilled job openings that are generated by departures from employment. These, within the boundaries of the COPS system, are broken out into retirements, in-service mortality, emigration and other separations. Of those, the first 3 are modelled as part of the demand side, with other separations measured as "negative supply" under the net re-entrants measure on the supply side (when there are more leavers than entrants).

The projections of replacement demand are dominated by the retirement model as over 80% of replacement needs stem from this source. Retirements in the COPS model are defined as a final withdrawal from the labour force for those aged 50 and over. The measures are constructed specifically to capture both voluntary and involuntary retirements. The concepts behind the model can be found in Dunn (2005), although the fixed-effects model specification presented there is no longer in use.

The retirement model is composed of three sub-models. The first, a benchmarking model, decomposes retirements into a trend voluntary retirement component by using the self-reported retirement series found in the Labour Force Survey (LFS) and an involuntary

[2] While using OLS may not be optimal due to the fact that estimates below zero and above one are possible, it should be understood that the statistical technique is merely a mechanical tool to assist the analyst in assessing the projection and is vetted thoroughly.

retirement series proxied by a constant and cyclical unemployment component. The model is used to benchmark the retirement rate series out to the last known data point of the LFS. This is necessary as the retirement rate data is constructed using a survival analysis of tax filer data – which creates a lag of several years prior to the start of the projection period.

The second model is an internal consensus of three projections of single age- and gender-specific retirement rates. The first of these projections is a naïve forecast of no change, the second is an autoregressive forecast of order 1 and the third propagates retirement rates mathematically by birth cohort. These projections are analyzed, weighted and combined to generate final age and gender-specific retirement rates. Combining these with population and employment rate projections yields the aggregate retirement benchmark.

The final component of the retirement model is an Age Distribution Model (ADM). Occupational employment by single age is turned into an occupational age distribution and the median age of retirement. A normalized potential retirement pool of workers is then obtained by computing the share of the distribution within a benchmark number of years of the median retirement age. This benchmark age increases with the number of projection years. The ADM produces the unconstrained retirement series which are then constrained to the total derived from the retirement aggregates produced by the aggregate retirement model.

The in-service mortality model is an estimate of how mortality will affect the number of currently occupied positions. To compute this age-specific death rates, constructed from the ratio of deaths (DEA) and population (POP), are applied to occupational employment (EMP) by single age, *a*, for a projected age distribution by occupation, *o*. The results are then summed across ages to arrive at an estimate of in-service mortality (ISM) by occupation.

$$ISM_t^o = \sum_{a=15}^{99} \left(POP_{t,a} \times \frac{DEA_{t,a}}{POP_{t,a}} \times \frac{EMP_{t,a}^o}{POP_{t,a}} \right) \tag{6}$$

The emigration models are almost entirely demographically driven. The number of projected emigrants is multiplied by a labour force participation rate projection and filtered by an average occupational share vector.

These 3 components, Retirements (RET), in-service mortality (ISM) and emigration (EMM) combine to form the replacement demand in the COPS framework for each of 140 occupations *o* at time *t*. This can be written:

$$RD_t^o = RET_t^o + ISM_t^o + EMM_t^o \tag{8}$$

One of the distinguishing characteristics of the COPS model is its focus on the supply side of occupational labour markets. The supply side of the model is primarily composed

of school leavers and immigrants. Numerous other components have been added to the supply-side out of analytical convenience and these are also described below.

2.3 School Leavers

The school leavers model captures the new inflows into the labour market from the education system. Conceptually, the model assumes that students invest in education and attempt to find work in an area related to their field of study choices. This process is modelled in 3 separate stages. In the first, aggregate flows of graduates and discontinuants (DEP) are projected over the forecast horizon. Next, for those with post-secondary education, a fixed share vector of field of study choices (FOS) is assigned to each level of post-secondary studies, *los*. For those without post-secondary education no fields of study are allocated. Discontinuants are assigned the immediately preceding level of education for the field of study transition vector. Finally, a fixed participation rate (LFPR) and a set of fixed field of study by occupation transition matrices by level of study are applied for those who are not continuing on in the education system (NRTS). Two field of study to occupation transition matrices (FOM) are used to create two alternative supply scenarios (*scen*).

$$^{scen}SCHLV_t^o = DEP_t^{los} \times FOS_t^{los} \times LFPR_t^{los} \times NRTS^{los} \times {}^{scen}FOM^{o,los} \qquad (9)$$

The scenarios are inelegantly called the *ex-ante* (before labour market resolution) and *ex-post* (after labour market resolution) scenarios. In the *ex-ante* scenario an analyst constrained set of matrices is applied which only permits employment in a related occupation. The constraints are quite lenient and workers are allowed to move to any occupation within the same skill level (as defined by the level of study usually required) as well as numerous related occupations in other skill levels. The goal of the constraining process is to limit the number of post-secondary graduates who move into low-skilled occupations. This version of the model assumes that if an investment in education was undertaken then the intention of the worker was to work in a related or higher-skilled occupation. The second approach, the ex-post scenario, models actual outcomes that post-secondary graduates face in the labour market upon graduation.

Comparing the two scenarios can then facilitate an analysis of education-occupation mismatch. This is because the *ex-ante* scenario attempts to model the outcomes that an investment in education would bring while *the ex-post* scenario models the outcomes that labour market resolution brings. That is, many of those who “intend” to work in specific occupations in the *ex-ante* scenario are confined to other occupations in the *ex-post* scenario. This provides a good starting point to the analysis of occupational mismatch for young workers.

2.4 Immigration

The immigration model in the COPS system is quite simple and lacks many of the interesting dynamics of other more developed models. This model assumes a fixed proportion (IS) of the current population (POP) will enter the country each year. Of these

new entrants a fixed share will choose to participate in the labour market (LFPR) and their occupational choices are modelled using a fixed share vector of occupational outcomes (OV) for new immigrants.

$$IMM_t^o = POP_t \times IS \times LFPR_t \times OV^o \quad (10)$$

There are other models which, for historical reasons, are assessed on the supply-side that more properly fit in the stock-flow reconciliation. These are net occupational mobility, other net re-entrants and an add-factor used to capture the anticipated demographically-driven declines in unemployment rates.

2.5 Stock-flow reconciliation and imbalances assessment

The stock-flow reconciliation process captures additional occupational flows not accounted for in the more developed models described above. The stock-flow reconciliation is performed using a labour-market entry cohort model by single age, education and labour force status. That is, all the reconciliation models simply use net measures obtained from an already existing stock model. All model flows are accounted for in the system and any outstanding countable flows are assigned to net occupational mobility, net re-entrants or the unemployment add-factor.

Net occupational mobility is the component of the model which generates labour supply for occupations which normally require experience as a pre-requisite. This flow sums to zero and is the largest source of new management occupations. Because of the requirement that mobility produces no new in or outflows, there are an equivalent number of negative job seekers. These negative supply flows should be counted as positive job openings on the demand side but have incorporated into the supply side as this is where most of the development effort has been directed in recent years.

Net re-entrants and the unemployment add factor capture the net inflows into the economy stemming from the anticipated rise in age- and gender-specific participation rates and falling unemployment rates generated by demographic change. These components are residuals of the stock flow accounting and, like net mobility, are accounted for on the supply-side due to COPS-specific historical reasons.

The stock-flow accounting itself is a reconciliation process for historical and projected data. Model estimates from the COPS flow models are accounted for in the system and compared to realized historical changes. This is then used as a benchmark against which to compare the stock-flow reconciliation of the projection estimates. While it is not essential that the future flows closely mirror the historical data it provides a reasonable benchmark as to the expected flows and their magnitude.

Once the projections are completed, a qualitative assessment of future labour market conditions (FLMC) can be obtained by comparing the demand and supply components. To do this, a quantitative assessment is first computed. Excess demand and supply conditions are evaluated based on the difference between anticipated job openings and

the number of job seekers available to fill them. The evaluation is done for the combined projection period. In the COPS model excess demand (XD) is defined as the difference between the demand and supply components described above.

$$XD^o = \sum_{t=1}^{10} NJO_t^o - \sum_{t=1}^{10} JS_t^o \tag{11}$$

Quantitatively, the model will always produce some measure of excess demand, excess supply will simply occur when the excess demand measure is negative. To evaluate this, a concept called the normalized future labour market situation (NFLMS) indicator is used. NFLMS is simply the expected excess occupational demand divided by base year employment – the last year of historical data available – and divided by the number of years in the projection added to the aggregate normalized NFLMS growth. The qualitative assessment of imbalances uses a two standard deviation bound to demark occupations in excess supply from those in excess demand. All occupations falling within the two standard deviation interval of the aggregate NFLMS said to be balanced.

$$NFLMS^o = 100 \times \frac{XD^o}{EMP_0^o} \tag{12}$$

Once all the above information is combined and assessed a simple algorithm is used to produce the FLMC. This quantitatively-driven indicator framework suffers from a critical shortcoming in that it relies only on balanced growth in producing assessments of future conditions. This implicitly assumes that the occupation must be balanced in the base year. Operationally, this is rather implausible in the case of a number of occupations. Hence, a current labour market conditions (CLMC) assessment is also used to revise any occupations which cannot be considered balanced in the base year. The CLMC is a slightly altered version of methods used by the U.S. Bureau of Labor Statistics in assessing current labour market conditions.

3. Data Requirements

To produce an assessment of occupational imbalances a large amount of data, largely from secondary sources, is needed. At the national level approximately 15,000 time series inputs are used to execute the projections. There are also numerous data used in intermediate calculations and various matrices which convert the projection results to final occupational results. The key data sources and model components which use them are described below.

The basis of the model, demographics and macro-industrial growth, use information from Statistics Canada's demographic estimates and from the system of national accounts. These are supplemented by consensus estimates as well as input from partner organizations and other levels of government. The occupational components of the model use a more diverse set of data.

On the demand side, the expansion demand model uses mainly data from the Labour Force Survey (LFS). The LFS is a monthly cross sectional survey of 54,000 households using a rotating panel design. The LFS has the best timely occupational labour market data available in Canada. For this reason, the occupational information used in the replacement demand model is also highly dependent on LFS information. However, the aggregate estimates of retirements also rely on tax filer data obtained through the Longitudinal Administrative Databank (LAD). This dataset was chosen because of its longitudinal nature and the large sample size (20% of all tax filers). The longitudinal aspect of the file allowed for an assessment of final withdrawal from the labour force, while that large representative sample allowed for detailed analysis by age and gender.

On the supply side, the school leavers model (SLM) has the broadest array of data inputs among the COPS models. The aggregate flow projections gather data form the Elementary-Secondary Education Survey, the Trade and Vocational Survey and Post-Secondary Education Information System. The first two of these are surveys while the third is a census of the post-secondary student populations. Other computations rely on a number of secondary data sources as well as data from the Labour Force Survey, the National Graduates Survey and the Census of Population. The immigration model has smaller data requirements, using only the LFS and Census. All other ancillary models use only data obtained from the LFS.

4. An Overview of Model Outputs

The outputs of the COPS models are released to the public every two years and are now posted on the COPS website.[3] The publicly released information contains the projected data series by component and a short written assessment of current and future labour market conditions. In this section, a more detailed exposition of COPS model outputs for the 2011 reference scenario will be presented to provide an example of the typical outputs of the system.

The macroeconomic forecast predicts a rebound from the somewhat depressed production levels seen in the aftermath of the 2008 recession. Employment growth in primary production and manufacturing is expected to pick up in the forecast period while construction and public administration is expected to slow from historical growth rates recorded over the previous decade. Demographic and Labour Force growth is expected to continue moderating as the population ages.

The disaggregated industrial results (not shown) are used as the basis for the occupational employment projection while the labour force is partitioned out into education, age and gender-specific components to be used in the stock-flow reconciliation process. The projected occupational employment is then converted to expansion demand.

[3] The website address at the date of this publication is www23.hrsdc.gc.ca.

Table 1:
Key Macroeconomic and Demographic Figures

			Historical: 2001-2010		Projection: 2011-2020	
	2010	2020	10-year change	AAGR*	10-year change	AAGR*
GDP (millions)	1325085	1711267	224570	2.0	386183	2.9
Source Population t (000s)	27659	30461	3569	1.5	2803	1.0
Labour Force t (000s)	18525	20113	2676	1.7	1588	0.9
Employment (000s)	17045	18984	2279	1.5	1939	1.1
Agriculture	301	263	-71	-1.9	-38	-1.3
Other Primary	330	450	57	2.1	120	3.7
Manufacturing	1744	1977	-499	-2.2	232	1.3
Construction	1218	1408	411	5.1	190	1.6
Utilities	148	175	32	2.8	26	1.8
Services	12347	13695	2168	2.1	1349	1.1
Public Administration	957	1016	182	2.3	60	0.6
Unemployment Rate (per cent)	8.0	5.6	1.2		-2.4	
Participation Rate (per cent)	67.0	66.0	1.2		-0.9	

* Annualized Average Growth Rate

Source: COPS 2011 Reference Scenario.

Expansion demand growth is expected to be highest in high skilled occupations and in natural and applied sciences and health occupations. Conversely, employment in occupations unique to processing, manufacturing and utilities are expected to show below average expansion demand growth. The employment projections used to construct expansion demand are also linked to replacement demand, in providing the baseline from which retirees emerge.

Retirements will grow fastest among managers, business, finance and administration occupations and in occupations unique to processing, manufacturing and utilities because workers in these occupations are older than average. While slightly higher for occupations in management, in-service mortality and emigration are not expected to vary widely by broad skill category. In total, the expected number of new job openings is expected to grow fastest in management and in health occupations.

Job seekers entering the labour market for the first time from the education system tend to do so in the lower skill levels. The strongest growth for school leavers will occur in Skill Level D, jobs requiring only on-the-job training. For these new entrants, the weakest growth will be management occupations. The fastest growing skill types will be for occupations in natural and applied sciences and in art, culture, recreation and sport. Similarly, new job seekers stemming from immigration into Canada will expand more quickly among occupations usually requiring only on the job training and in natural and applied sciences occupations. However, growth for immigrant job seekers will also be more pronounced in occupations unique to processing, manufacturing and utilities.

Table 2:
COPS Occupational Projections by 2-Digit NOC, by Skill Level and Skill Type: 2011 reference Scenario

2011-2020 (unless otherwise indicated)		2010 Employ.	Expansion Demand	Retire.	In-Svc. Mort.	Emig.	Expected Demand	School Leavers	Immig.	Mobility	Other	Expected Supply	Excess Demand (annual)	NFLMS	CLMC	FLMC
All Occupations		15,732	1,987.4	3,696.3	495.8	354.0	**6,534**	4,736.7	1,065.3	0.00	461.50	**6,263**	27.0	0.2		Fair
Management		1,490	177.7	441.8	55.0	33.4	**708**	251.1	85.0	268.93	117.70	**723**	-1.5	-0.1		Fair
Skill Level A		3,021	524.8	698.8	99.4	69.5	**1,393**	979.1	197.1	-7.44	179.90	**1,349**	4.4	0.1		Fair
Skill Level B		5,331	684.4	1,275.1	164.4	120.0	**2,244**	1,550.0	246.3	-27.40	233.32	**2,002**	24.2	0.5		Fair
Skill Level C		4,365	421.3	978.3	128.9	96.8	**1,625**	1,352.6	355.4	28.99	-18.32	**1,719**	-9.3	-0.2		Fair
Skill Level D		1,525	179.1	302.2	48.1	34.3	**564**	603.9	181.4	-263.09	-51.10	**471**	9.3	0.6		Fair
Business, Finance & Adm		3,194	310.6	901.5	103.1	70.9	**1,386**	847.5	178.2	63.56	93.32	**1,183**	20.4	0.6		Fair
Natural and Applied Sc.		1,282	240.8	244.9	33.7	29.6	**549**	445.4	135.3	-12.81	69.49	**637**	-8.8	-0.7		Fair
Health		1,137	247.2	296.3	36.9	26.8	**607**	331.8	52.4	112.80	42.39	**539**	6.8	0.6		Fair
Social Sc,. Education & Gov.		1,504	211.7	342.0	45.1	34.1	**633**	504.3	64.5	-48.15	82.23	**603**	3.0	0.2		Fair
Art, Culture, Recreation & Sport		499	76.9	110.3	17.4	11.3	**216**	196.3	26.3	-38.07	26.38	**211**	0.5	0.1		Fair
Sales and Services		4,091	502.8	850.6	134.3	92.2	**1,580**	1,382.6	314.5	-307.61	52.97	**1,442**	13.7	0.3		Fair
Trades & Transport		2,657	308.1	596.1	77.9	59.3	**1,041**	720.0	137.4	130.98	77.54	**1,066**	-2.4	-0.1		Fair
Primary		514	47.6	114.0	22.7	11.4	**196**	134.5	22.2	-8.51	11.27	**160**	3.6	0.7		Fair
Processing, Manufacturing & Utilities		853	41.8	240.4	24.7	18.5	**325**	174.3	134.4	107.80	5.91	**422**	-9.7	-1.1		Fair
00-09	Management Occupations	1,490	177.7	441.8	55.0	33.4	**708**	251.1	85.0	268.93	117.70	**723**	-1.5	-0.1	Fair	Fair
11	Professional Occ's in Business & Finance	549	104.9	148.6	20.6	12.8	**287**	155.7	27.6	17.76	32.61	**234**	5.3	1.0	Good	Fair
12	Skilled Administrative & Business Occ's	976	82.9	317.4	33.5	21.5	**455**	211.5	35.7	16.60	41.95	**306**	15.0	1.5	Fair	Good
14	Clerical Occupations	1,359	91.6	331.7	38.2	29.7	**491**	424.8	95.0	-26.65	-5.64	**487**	0.4	0.0	Fair	Fair
21	Professional Occ's in Natural / Applied Science	692	144.0	111.5	18.7	16.1	**290**	244.2	88.6	-6.41	41.33	**368**	-7.7	-1.1	Good	Fair
22	Technical Occ's Related to Natural / Applied Sc	512	80.2	115.0	12.8	11.7	**220**	186.5	41.0	-17.64	22.44	**232**	-1.3	-0.2	Fair	Fair
31	Professional Occupations in Health	473	113.7	119.9	17.5	11.2	**262**	137.1	23.2	33.48	27.69	**222**	4.1	0.9	Good	Fair
32	Technical / Skilled Occupations in Health	242	44.2	56.7	6.5	5.6	**113**	84.8	11.2	1.13	10.25	**107**	0.5	0.2	Fair	Fair
34	Assisting Occ's in Support of Health Services	316	73.9	74.6	9.0	7.6	**165**	98.6	15.9	44.83	-1.27	**158**	0.7	0.2	Fair	Fair
41	Professionals in Social Science / Education / G	1,072	131.6	255.2	32.9	24.1	**444**	363.7	45.2	-44.20	64.14	**429**	1.5	0.1	Fair	Fair
42	Paraprofessional Occ's in Law / Social Services	399	77.6	73.4	10.9	9.3	**171**	137.2	19.1	-18.58	17.14	**155**	1.6	0.4	Fair	Fair
51	Professional Occupations in Art & Culture	235	30.6	63.7	9.7	5.3	**109**	78.2	12.5	-8.07	14.13	**97**	1.3	0.5	Fair	Fair
52	Technical / Skilled Occ's in Art / Culture / Recre	250	45.0	41.8	7.1	5.7	**100**	113.8	13.0	-35.46	10.95	**102**	-0.3	-0.1	Fair	Fair
62	Skilled Sales & Service Occupations	1,025	148.3	214.5	31.9	23.4	**418**	326.7	50.2	-44.94	44.57	**376**	4.2	0.4	Fair	Fair
64	Intermediate Sales & Service Occupations	1,278	150.4	231.6	38.3	28.7	**449**	503.4	98.8	-145.34	-5.30	**452**	-0.3	0.0	Limited	Fair
66	Elemental Sales & Service Occupations	1,170	141.7	240.9	39.8	26.4	**449**	440.8	120.8	-179.11	-38.23	**344**	10.5	0.9	Limited	Fair
72-73	Trades & Skilled Transport & Equipment Opera	1,464	164.2	328.3	39.4	32.6	**565**	427.1	66.0	13.54	65.90	**573**	-0.8	-0.1	Fair	Fair
74	Intermediate Occ's in Transport / Equipment Of	820	91.5	186.2	27.6	18.3	**324**	181.3	52.9	90.54	-3.52	**321**	0.2	0.0	Fair	Fair
76	Trades Helpers, Construction Labourers & Rela	136	16.3	18.3	2.8	3.0	**40**	73.5	11.4	-32.95	-5.01	**47**	-0.7	-0.5	Limited	Fair
82	Skilled Occ's in Primary Industry	326	29.8	83.3	17.7	7.2	**138**	43.3	5.7	27.16	14.12	**90**	4.8	1.5	Fair	Good
84	Intermediate Occ's in Primary Industry	95	4.2	16.0	2.7	2.0	**25**	41.3	9.5	-12.85	-0.44	**37**	-1.3	-1.3	Limited	Limited
86	Primary Industry Labourers	83	10.2	12.2	1.9	1.9	**26**	48.8	6.7	-27.51	-3.18	**25**	0.1	0.2	Limited	Fair
92	Processing / Manufacturing / Utilities Supervisio	137	12.3	44.8	4.6	3.0	**65**	19.1	4.4	30.80	6.00	**60**	0.4	0.3	Fair	Fair
94-95	Processing & Manufacturing Machine Operators	497	9.7	138.2	13.2	10.5	**172**	103.2	83.3	78.46	-2.15	**263**	-9.1	-1.8	Limited	Limited
96	Labourers in Processing, Manufacturing & Utilit	135	10.8	30.9	3.6	3.0	**48**	40.9	42.5	-23.52	-4.68	**55**	-0.7	-0.5	Limited	Fair

Notes: NFLMS is the normalized future labour market situation, the ratio of excess demand to base year employment. CLMC is the qualitative assessment of current labour market conditions and FLMC is the qualitative assessment of future labour market conditions.

Conversely, job seekers from other sources, such as net labour market re-entrants and occupational migrants, will offset the number of job seekers in lower skill levels, and generate a greater number of job seekers at higher skill levels, particularly in management as more seasoned workers advance their careers. Other factors, such as occupational mobility and net re-entrants will raise the number of job seekers in management and remove job seekers from lower skill level positions.

When comparing the number of anticipated job openings to the number of job seekers, there are no anticipated imbalances at the broad skill level or skill type. However, at the 2-digit National Occupational Classification level, skilled administrative and business occupations and skilled occupations in primary industry show signs of excess demand going forward. Conversely, intermediate occupations in primary industry and processing and manufacturing machine operators and assemblers face a situation of excess supply over the ten year projection period.

5. Innovations and Challenges

Because of the increased policy focus of the model, a number of innovations to encourage policy relevance have been made. The retirement model, based on detailed tax filer data adds increased reliability to the estimates of gross replacement demand from this source. The production of supply-side information, particularly alternative outcomes of the school-to-work transition, allows for an analysis of education-to-occupation mismatch among youth. Finally, the process of comparing expected supply and demand flows allows for a richer picture of the anticipated composition of the labour market than a snapshot of labour market equilibrium would afford.

Numerous conceptual challenges exist in obtaining an ex-ante assessment of the labour market. While this has been the identified goal of the COPS National Model for the past 15 years, the data and models are not capable of producing a pure estimate of what a full-employment economy extrapolated forward ten years with a fixed wage structure would demand in terms of labour. This is due to the fact that a credible macro scenario is constructed with as to the anticipated path of the actual economy rather than a full employment economy. Effectively, the COPS model projects *ex-post* equilibrium occupational demand and evaluates whether there are sufficient sources of *ex-ante* supply to meet this demand. While this is a conceptual concern, the method of determining imbalances described above is robust to a level shift in demand as long as the degree of demand growth is dispersed fairly evenly across occupations (and in most cases, the occupational structure is rather stable). This is because the imbalance assessment is done as a relative, not an absolute, measure.

Conceptually, the analysis of intended and actual outcomes for labour market entrants coming from the school system allows for evaluations of educational-occupational mismatch. However, there is no clear way to validate whether the analyst-imposed restrictions on the outcomes of graduates (through a matching of field of study and occupational skills requirements) are valid. More importantly, are the model results even appropriate for policy analysis purposes? While no better way has been proposed, it is

uncertain whether presenting quantitative predictions to end users generates a false sense of certainty in occupational outcomes.

On a more technical level, challenges remain with building a consistent and functional stock-flow reconciliation process. Research is ongoing on being able to produce consistent and reliable estimates of occupational mobility flows and how to incorporate these into an ex-ante assessment of labour market conditions. Furthermore, many data series are constructed internally, from partial data and assumptions – these are difficult to validate. Finally, evaluating the accuracy of a system that does not produce an equilibrium assessment of the labour market is tricky and costly to perform given the sheer size of the model.

6. **Summary and Future Work**

The COPS model produces *ex-ante* assessments of occupational imbalances at the detailed occupational and broad skill levels. The model has large data requirements due to the detailed nature of the work. It is capable of producing coherent and stock-flow consistent assessments of the demand for and supply of new and existing labour market entrants for use in policy analysis and labour market information provision.

The projection output is consistent with recent historical experience. The most recent projections from the system anticipate strong growth in both the demand and supply of high-skilled workers and managers while showing weaker labour market conditions for lower skilled occupations. While the model produces reliable and credible outputs at the occupational level, numerous challenges remain.

Innovative use of both supply and demand components in the COPS system has led to model outputs that can be used for policy purposes. Of particular note is the structure of the retirement model, which uses tax filer data to estimate gross retirement flows. Another key innovation is the multiple scenario school leaver models, which allows for assessments of education to occupation mismatch. The ability to compare *ex-ante* demand and supply are the key methodological innovation that the COPS model permits.

While numerous technical and conceptual challenges to the effective production of occupational projections for analytical and labour market information remain, work is ongoing to improve the quality of the model outputs. With the conclusion of the 2011 production cycle, model improvement will continue over the coming year and a half. Expansion and reconciliation of the stock-flow accounting system, a revision of the aggregate labour force participation model and an improved occupational mobility model are priorities. A more general assessment of the overall methodology is also underway, which may produce a significant revision of the overall system in coming years.

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