Estimating fertility differentials by occupation using the Korean census (2010 and 2015)

Eunkoo Lee

Paper prepared for the 16th Conference of IAOS
OECD Headquarters, Paris, France, 19-21 September 2018

Session 3.A., Day 2, 20/09, 10:30: New technologies for compiling statistics

Eunkoo Lee
Exl155@naver.com
Statistics Korea

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DRAFT VERSION 30/08/2018
PLEASE DO NOT CITE

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Note *:*
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ABSTRACT

Demographers and National Statistics Organizations use period total fertility rate (TFR) to measure and compare fertility levels of different groups. However, it is difficult to estimate TFRs by various socio-economic variables since data required to compute the TFR are often scattered in multiple sources of data, if available. I used the ‘own-children’ method to estimate the period TFR by occupation. The census contains all necessary information required to calculate the own-children TFR estimates by occupation in a single data set. I use two censuses (2010 and 2015) to compare and validate the TFR estimates obtained from the own-children method. The TFR estimates from the two censuses are very close to each other at the aggregate level (for all women). When TFR estimates are disaggregated by occupation, I observe fluctuations in some occupational categories but on the whole the TFR estimates by occupation from the two censuses are similar in levels and trends. I find that traditionally high levels of TFR estimates of "Skilled agricultural, forestry and fishery workers" are diminishing rapidly and converging to other occupational categories in recent years. "Managers" seem to have stable levels of fertility throughout the period of analysis and seem to be immune to external impacts (for example, economic crises) in their fertility behaviour.

Keywords: total fertility rate, own-children method, census,

1. INTRODUCTION

National Statistics Organizations (NSOs) use the period total fertility rate (TFR) to measure the level of fertility. It is the most widely used fertility measure due to its simplicity and convenience. It is easy to interpret and understand its underlying concepts. Furthermore, since it is an age-standardized measure, it is convenient to compare TFRs calculated from different age structures. Despite its usefulness, it is limited in providing multidimensional aspects of fertility such as fertility differentials by various socioeconomic variables (education, occupation status etc.). Estimating fertility differentials by socioeconomic variables is challenging because the NSOs rely on vital statistics to compile TFR and often times vital statistics do not contain enough socioeconomic variables necessary for this fertility differential estimation. In the past, researchers have linked multiple sources of data which contain socio-economic variables of interest and have applied a proportional method to estimate the numerator (number of births by women's age) and denominator (number of women by age) of the TFR. In doing so, they linked multiple sources of data since this information is not readily estimable in a single data source. However, pooling heterogeneous sources of data could lead to errors and the accuracy and the validity of applying the proportional method has not been confirmed to date.

While it is often necessary to link multiple sources data to estimate a TFR by a specific socio-economic variable of interest, a census is a complete set of data that contains all information required to estimate a TFR by a specific socio-economic variable in the census. As an illustration, I use 2010 and 2015 censuses and apply the own-children method (OWCH) to estimate fertility differentials by occupation. The OWCH was developed at the East-West Center by Cho, Retherford, and Choe (1986) to estimate a period TFR from a census or a large scale survey.

There have been a few studies that explore the relationship between occupation and its impact on fertility (Barakat and Durham 2013; Begall and Mills 2012; Dribe and Stanfors 2010; Cooney and Uhlenberg 1989). Most of these studies have used survey, census and administrative data sources to build statistical models to investigate the causal relationship of occupation and fertility. However, the purpose of this paper is to empirically calculate the period TFR by occupation from the 2010 (10%) and 2015 (20%) census samples. Female dominated occupations or working conditions favorable to childbearing such as flexible working hours are known to cause fertility differentials across occupation categories (Begall and Mills 2012). Dribe and Stanfors (2010) found that "power couples (or dual career households)" working in the public sector have higher probability to continue childbearing because of their family-friendly work conditions. However, Begall and Mills (2012) could not find a significant evidence on the transition to higher order of birth in occupations located in the (semi) public sector in the case of the Netherlands which suggests different country contexts do matter. Barakat and Durham (2013) also argue that "greater autonomy" and "earning potential" are linked to variations in fertility levels by occupation. In the Korean context, Choi and Park (2009) used the 2005 census sample (10%) to estimate the fertility level of Korean women by occupation. They calculate the average number of children ever born as their fertility measure. They do not observe, with the exception for women in the agricultural and fishery occupational category, any significant fertility differences across occupational categories when age is controlled from 40 to 49, which is a completed fertility. In addition, they report that the fertility level of women in the agricultural and fishery job category at younger age groups show a steep declining trend (for example, 3.44 for 55-59 age group to 2.33 for 40~44 age group).

The purpose of this paper is to indirectly calculate period TFRs by occupational categories enumerated in the census. The OWCH fertility estimates from two different census periods (2010 and 2015) are compared for each occupational categories. I attempt to validate the consistency of the OWCH estimates and provide possible explanations on the patterns and differences between the OWCH estimates obtained from 2010 and 2015 censuses.

2. DATA

I use a 10% and 20% sample of Korea's 2010 and 2015 censuses respectively. They contain all necessary variables that I need to estimate the TFRs by occupational categories. For this study, the 2010 census (10%) and 2015 census (20%) provides 5,457,530 and 9,538,188 individual records respectively. As far as I am aware, this is the first study that empirically calculates the period TFR by occupation from the census with such a large magnitude.

In order to apply the OWCH for each occupational category contained in the census, I use the Korean Standard Classification of Occupation (KSCO-2017) which is in agreement with the International Standard Classification of Occupations (ISCO-2008)[1]. I aggregate occupational categories into 6 groups for the purpose of this paper's analysis (see Table 1 below). This aggregation scheme is also similar to the one used by Barakat and Durham (2013). The only difference is that "Professionals" and "Technicians and Associate Professionlas" are grouped together in this paper due to a structure difference between KSCO-2017 and ISCO-2008.

Table 1: Occupational categories

Code	Categories
1	Managers
2	Professionals, technicians and associate professionals
3	Clerks, service and sales workers,
4	Crafts and related trade workers
5	Plant and machine operators and assemblers[2]
6	Skilled agricultural, forestry and fishery workers

Using the occupational categories in Table 1, I create 6 data sets for each occupational category. To simplify the complexity of this exercise, I only focus on the occupation of the women (aged 15-49) who responded that they are currently employed at the time of census taking. As a part of the OWCH requirement, all children under 15 (aged 0-14) are included in each data set mentioned so that they are ready to be matched to their respective mothers by OWCH. The details of the matching process and the OWCH itself are further explained in the method section.

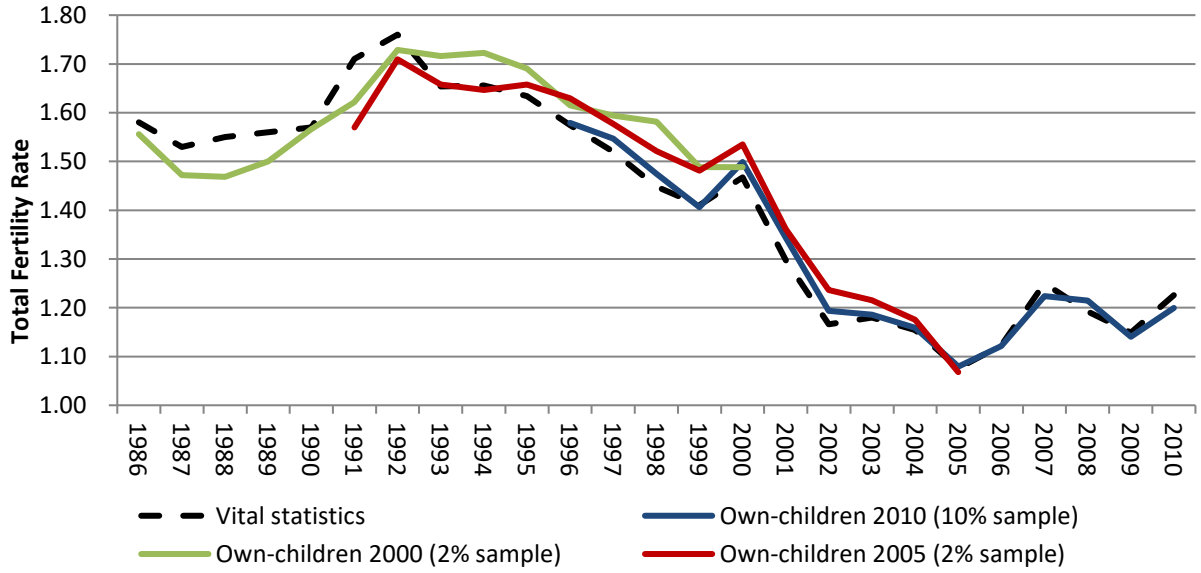
[1] The KSCO-2017 and ISCO-2008 are in agreement at the major level (first digit level). The only exception is that KSCO-2017 groups ISCO-2008's "2. Professionals" and "3. Technicians and Associate Professionals" in the same major group ("2. Professionals and Associate Professionals).
[2] This occupational category also includes elementary workers.

3. METHOD

I use the OWCH to indirectly estimate the period TFR by occupation by using the census. OWCH reconstructs the fertility history of women in a census or a survey in consideration by matching the eligible mothers to potential children based on the information on the household identifier (or any code that uniquely identifies a household unit), age, sex, and relation to the head of the household. For example, a women aged 40 who has two children aged 10 and 5 in the 2015 census translates to giving birth in 2010 and 2005 at age of 35 and 30 respectively. Repeating this matching process for each household in the census, we are able to reconstruct the birth history of all women in the census. The birth history provides the number of births by women's age and number of women by age. Then we are ready to calculate the usual TFR from this reconstructed birth history. Since it tracks and carries out its matching process by household unit, potential mothers and children should reside in the same household unit to increase the matching rate. OWCH makes an assumption that children aged 14 or younger are most likely to live with their parents in the same household. Consequently, the OWCH provides TFR estimates for each of the 15 years prior to the census. Fortunately, the East-West Center (1992) provides computer software that matches the potential children to their mothers. The software also has the option to account for mortality information from the life table to account for the children or mothers who have died during the period of analysis. This study does not use this mortality adjustment option since separate mortality information (or life table) for different job categories are not available. Although the mortality level between occupation categories could be significant, it is safe to assume that this will not seriously impact our results since the mortality level is very low for children aged 0-14 and women aged 15-49 in Korea.

To validate the appropriateness and accuracy of applying the OWCH, Lee (2018) compared the OWCH estimates by using the 2% sample of Korea's 2000 (2%) and 2005 (2%) censuses with the OWCH estimates from the 2010 census (10%), as well as their TFRs from vital statistics (see Figure 1 below).

Figure 1: TFR by the Own-Children Method and vital statistics



Source: Lee (2018)

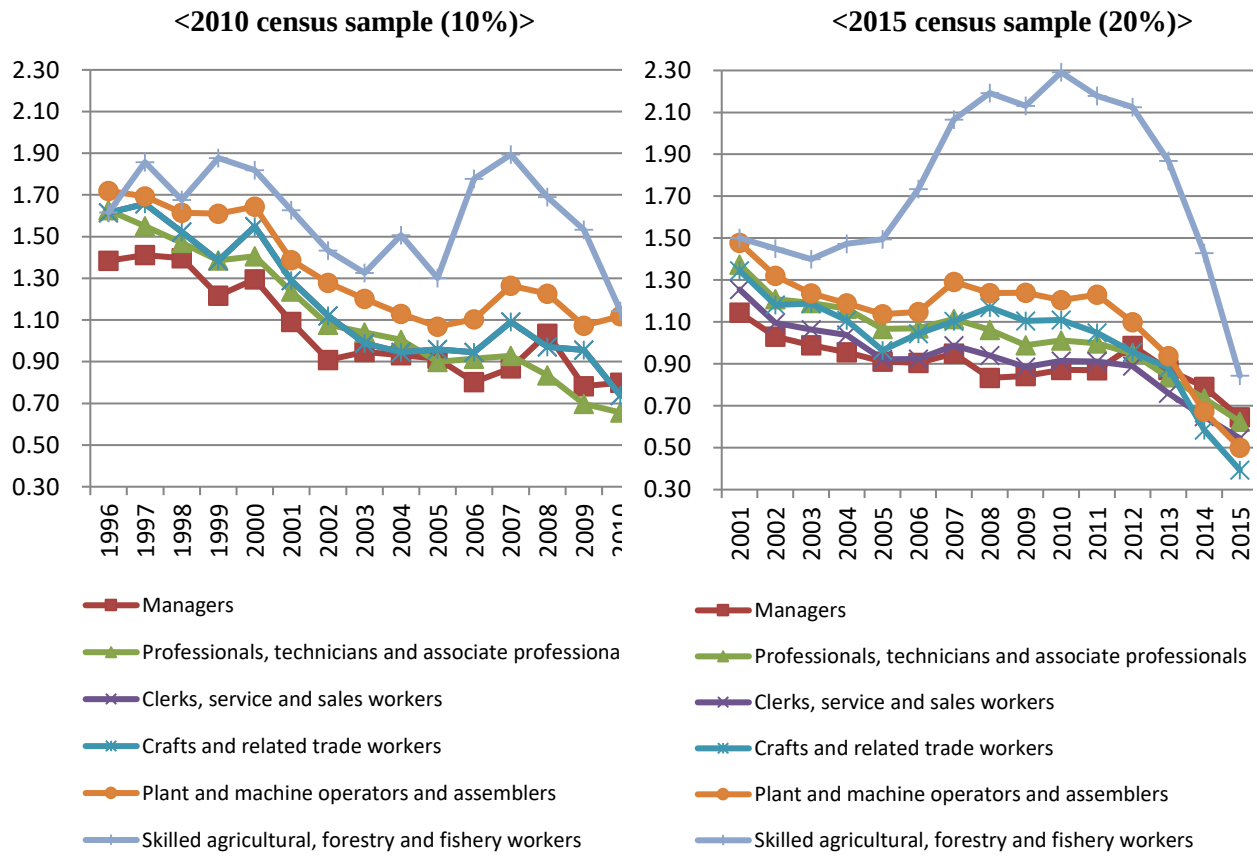
Figure 1 shows that the TFR estimates calculated by OWCH are very similar to TFR calculated from vital statistics. This confirms the validity of applying the OWCH and suggests a high quality of census and vital statistics in Korea. The accuracy of the OWCH estimates ultimately depend on the variables it used in the census and Figure 1, in particular, reflects a high quality of "age" and "relationship to head" information in the census.

As a caveat, it is also important to note that this paper drew information on occupation at the time when the census is conducted. Hence, it does not take into considerations past occupations. Despite the fact people change jobs over the course of their lifetime, the TFR estimates by occupational categories from 2010 and 2015 censuses are compared to observe the magnitudes and patterns of such differences. In other words, if a particular occupational category has stable employment conditions (meaning the retention rate in that job category is high) and the quality of census data is high, then we would expect similar levels and trends of TFR estimates from 2010 and 2015 censuses.

4. RESULTS

Figure 2 shows the occupational-specific period TFR estimates obtained by applying the OWCH to 2010 and 2015 census samples. With the exception of TFR estimates of "Skilled agricultural, forestry

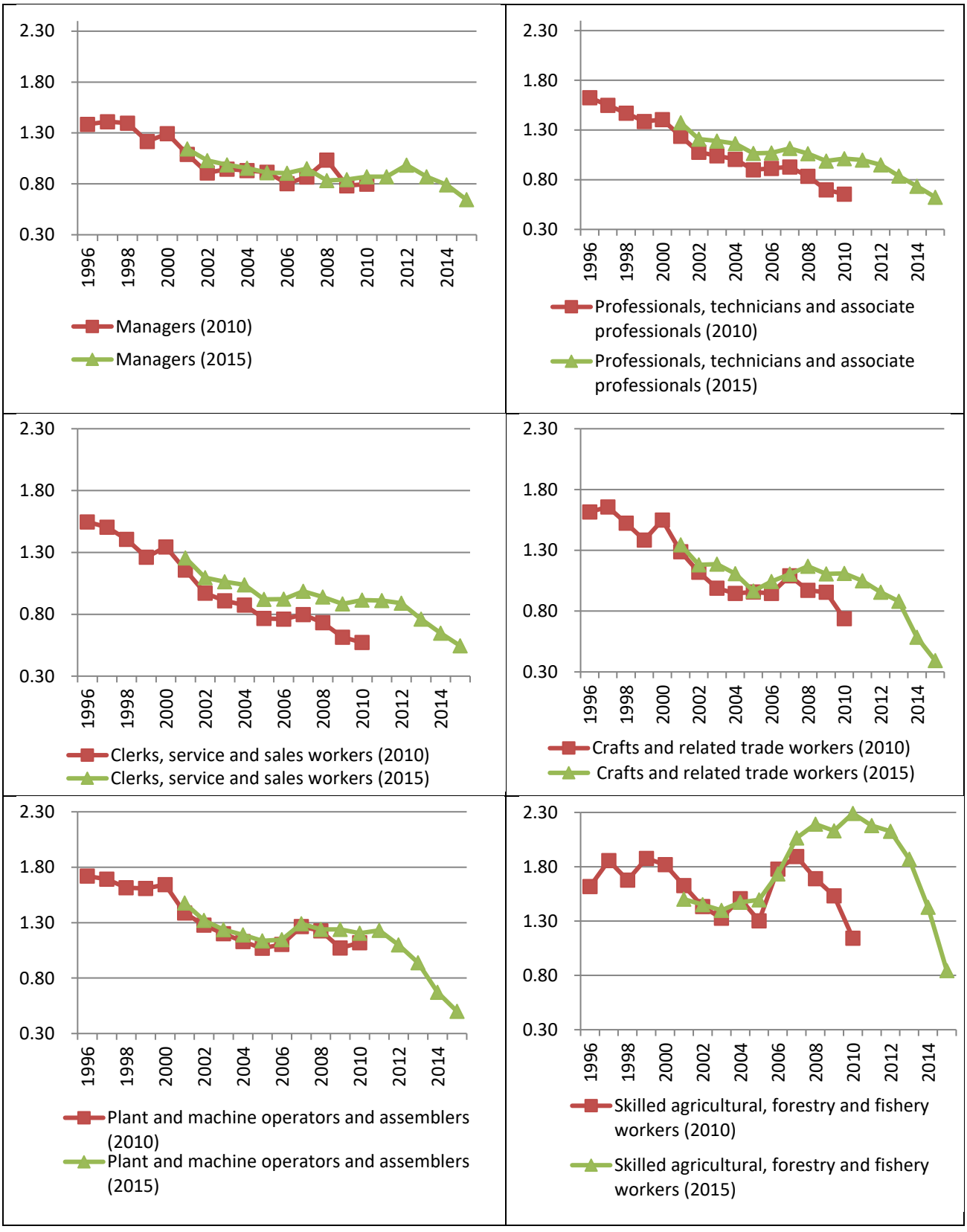
Figure 2: TFR estimates by the Own-Children Method



and fishery workers, the occupational-specific period TFR estimates from the 2010 and 2015 censuses seem to show similar levels and trends. The TFR estimates of "Skilled agricultural, forestry and fishery workers" seem to fluctuate but the general trend is very similar in both censuses. This fluctuation in level could be attributable to the temporal and unstable nature of occupations in this category. In other words, women working in the agricultural and fishery industry have a higher probability to work on a part-time basis, and to switch to other jobs or quit, which is reflected in TFR estimates in Figure 1. It is also interesting to note that the TFR estimates of "Skilled agricultural, forestry and fishery workers" are rapidly declining and almost converging to other occupational groups. They used to be a major contributor to the increasing the level of the TFR but this contribution seems to be disappearing in recent years. In the 2010 census, there is a visible pattern that "Skilled agricultural, forestry and fishery workers" had the highest TFR, then " Plant and machine operators and assemblers" came in second. However, in the 2015 census, I observe that fertility levels of all occupational categories considered in this study are converging and showing rapidly declining trends in recent years. "Managers" have the lowest fertility level but they seem to show a stable level of fertility throughout the period which might suggest that they are able to buffer external shocks (for example, an economic crisis) in their fertility behaviour.

Figure 3 makes comparisons of OWCH TFR estimates for occupation in the same category from the 2010 and 2015 censuses. Figure 3 enables close examination of the trend and level of the TFR estimates from the 2010 and 2015 censuses for each job category. Inspecting plots in Figure 3, despite the general concordance in the level and trend of TFR estimates obtained between 2010 and 2015 census samples, I observe that the level of conformity obtained in Figure 1 is not present in Figure 3. There are several explanations for such an outcome. One possible explanation is that Figure 1 is aggregated data, estimating the TFR of all women. Figure 3 is disaggregated by occupational status which is more prone to fluctuation. The other explanations could be that certain occupational categories have relatively unstable work conditions or temporal traits that make people switch or quit their jobs more than other occupational categories. The final explanation could be errors in census taking which lead to under or over estimation. However, given the evidence in Figure 1 and Figure 3, the overlapping years are very close in their estimated values except for the TFR estimates of "Skilled agricultural, forestry and fishery workers". This high level of conformity confirms the high quality of the census and validates the use of OWCH to estimate TFRs by occupation.

Figure 2: Comparison of TFR estimates from 2010 and 2015 censuses by each occupational category


2.30
1.80
1.30
0.80
0.30
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Managers (2010)
Managers (2015)
Professionals, technicians and associate professionals (2010)
Professionals, technicians and associate professionals (2015)
Clerks, service and sales workers (2010)
Clerks, service and sales workers (2015)
Crafts and related trade workers (2010)
Crafts and related trade workers (2015)
Plant and machine operators and assemblers (2010)
Plant and machine operators and assemblers (2015)
Skilled agricultural, forestry and fishery workers (2010)
Skilled agricultural, forestry and fishery workers (2015)

5. CONCLUSION

This paper demonstrated how to utilize information rich census data (2010 and 2015 census samples) to estimate the occupation-specific period TFR by applying the OWCH. The OWCH is most useful in estimating TFR from surveys or censuses for countries which do not have a complete set of civil registration and vital statistics. However, I have shown that it is also useful for researchers who are interested in estimating TFR by various socioeconomic variables. By repeating the OWCH analysis on multiple censuses, one can gauge the quality of the census by examining the level and trend of the selected socio-economic specific fertility of overlapping years. I found that high level of TFR estimates of "Skilled agricultural, forestry and fishery workers" is diminishing rapidly and converging to other occupational categories in recent years. "Managers" seem to have a stable level of fertility throughout the period of analysis and seem to be impervious to external impacts (for example, economic crises) in their fertility behaviour.

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