**Improving Monthly Estimates of Job Vacancies Survey With Statistical Model**

**Abstract**

*This paper suggests a statistical solution for a common problem in panel sample with a small sample and high variation of the estimators.*

*In order to reduce the response burden and due to budget constraint, monthly business surveys sample a quarterly survey that are divided randomly between the quarter's month.*

*We reveal a high correlation between the monthly estimators of month ( t) to the monthly estimators of month (t-3) and apply a statistical model that based on Tiller (1992).*

*The implication of the Tiller model dramatically reduced the variance and allows us to avoid false information increasing the survey's estimator's reliability without increasing the response burden*

The monthly Job Vacancies Survey in Israel began in 2009 by the Central Bureau Of Statistics.

The survey goals are:

To serve as a leading indicator for the cyclicality in the labour market (during recession firms will begin by reducing their job openings and only later proceed with dismissing employees).

To aid in assessing the demand for labour and identifying work opportunities by industry and composition of employed persons.

To supply a broad view of the labour market by comparing estimates of job vacancies and the profile of workers requested by employers (labour demand) against the estimates of job seekers and their profiles as derived from labor force survey data (labour supply).

The survey was established in 2009 as a monthly survey that is conducted by the Israel CBS and replaced a quarterly survey that was conducted by the Economic ministry without representative sample.

In order to reduce the response burden, it was determined that the firms that belong to the take some strata (small and medium firms) will be divided randomly during the quarter.

While the large firms from the take all strata will report monthly.

The strata are determined by the number of employees in the firm while the survey's target is the number of vacancies in each firm.

Sometimes those variables (employees, vacancies) do not have high correlation (there is a large variation of the vacancies between firms in the same strata)

This sample design led to a high variation of the monthly estimates that reflected by false signs of positive/negative change in the demand for workers in the labor market.

Those false signs motivate us to examine the survey's estimates carefully and we found that this variation has the form of three month error type.

In contrast to other business surveys take some strata in the vacancies survey are responsible for large share of the demand for workers (also in countries that estimates it without panel data).

The combination between these unique characters and the sample design led to a great variation that is derived due to small and medium firms in the sample and led to false conclusions, especially in the branch level.

**Figure 1- vacancies level in the construction branch**

**Figure 2- monthly change (percentage in compare with the month before) of vacancies in the trade branch**

When we examined the monthly change of the estimators we can see that great variation and the positive correlation between the monthly change each three month.

At this point of time we had 3 optional solutions to this problem:

1. to publish estimators that are calculated by 3 month moving average

2. to expand the sample and to collect the firms’ reports each month

3. to apply a statistical model that will handle the variation that is caused from the sample design

The Central Bank of Israel monitors the demand in the labor market closely and asks us to publish monthly estimates and avoid three month moving average which track and detect the business cycle later then monthly estimates.

The number of business surveys increased since Israel’s entrance to the OECD. In order to avoid greater response burden, we eliminate the option of collecting monthly reports from all samples.

We follow the Tiller (1992) methodology that is based on isolating the sampling error and reducing the variance in small samples.

Every survey is effected by sampling error and in our survey the sample design led to high correlation between the sampling error of month t and month t-3.

In order to estimate the sampling error we describe the time series as a state space model that is decomposed into the form:

$$y\_{t}=L\_{t}+S\_{t}+I\_{t}+e\_{t}$$

The terms in the right-hand side denote the trend, seasonality ,irregularity and sampling error.

We estimate the different components by using smoothing filter based on Kalman filter.

**Figure 3- comparison between the estimators of number of vacancies in construction branch**

In figure 3 we can see the difference in the estimators for the number of vacancies in the construction branch.

We can see that the model estimator smooths the variance and prevent wrong conclusions about major change in the labor market demand.

**Figure 4- monthly change (percentage in compare with the month before) of vacancies in the trade branch – model vs original estimators**

The difference between the estimators are more remarkable when we examined the monthly change.

In figure 4 it is easy to notice that the cycle behavior of the original estimators (blue line) is diminished.

**Conclusions:**

Due to a budget constraint, many business surveys use panel sample where the sampled units are divided randomly between the quarter month and report quarterly while the estimations are monthly.

 The job vacancies survey in Israel use this method. Examination of the estimators for this survey revealed a common problem that was caused by this sample design leading us to doubt the monthly estimators particularly in the branch level.

Our decision to apply a model that was based on Tiller paper solved the problem and reduced the variance of the estimators without major increase in the survey budget and in the response burden.

Tiller, Richard B. "Time series modeling of sample survey data from the US Current Population Survey." *Journal of Official Statistics* 8.2 (1992): 149.‏