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RESEARCH NOTES IN ECONOMICS

Estimating the Bridging Day Effect on Turkish Industrial Production*

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Özet: İktisadi faaliyete ilişkin verilerin ana eğilimlerini daha iyi anlamak için ilgili zaman serisi verilerinin mevsim ve takvim etkilerinden arındırılması büyük önem arz etmektedir. Ancak köprü günü gibi düzensiz etmenler, analiz yapanların en doğru mevsimsellikten arındırmayı yapmalarına engel teşkil edebilmekte ve yanlış arındırılmış sonuçlar elde etmelerine yol açabilmektedir. Bu çalışmada köprü günlerinin Sanayi Üretim Endeksi (SÜE) üzerine etkilerinin, köprü günlerinin hangi mevsime denk geldiği de dikkate alınarak hesaplanması amaçlanmaktadır. Sonuçlar milli bayramlara denk gelen köprü günlerinin SÜE'yi etkilemediğini, ancak dini bayramlara denk gelen köprü günlerinin etkilediğini ortaya koymaktadır. Ancak bu etkinin büyüklüğünün köprü gününün denk düştüğü sezona göre değiştiği tespit edilmiştir. Üretim kaybı yaz turizmi sezonuna (Haziran – Ekim) denk gelen köprü günlerinde normal bir çalışma gününe göre yüzde 40 azalırken, bu azalış yılın kalan dönemlerinde bu değerin yarısına inmektedir.

Abstract: Adjusting the economic data for seasonal and calendar effects is of crucial importance for understanding the underlying information for the time series under consideration. However, irregular factors such as bridging days may impede the analysts perform the most accurate seasonal adjustment and lead to wrong adjusted values. In this study we aim to identify the impact of bridging days on Industrial Production Index (IPI) in Turkey by also taking into account the time of the year the bridging days fall. The results show that while national holiday bridging days do not affect IPI, religious holiday bridging days do. However, the magnitude of impact changes according to the season of the year. The production loss impact during a religious holiday in the high season (June-October) is around 40 percent, it is reduced by half during the low season.

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1. Introduction

Most of the raw economic data/statistics need filtering before making a firm interpretation for policy analysis, modelling or forecasting. Issues like seasonal fluctuations and calendar effects have to be factored out in order to reveal the true underlying movements of the time series under consideration. Usual seasonal fluctuations are the movements recurring with similar intensity in the same season each year and which, on the basis of the past movements of the time series in question and under normal circumstances, can be expected to recur (Eurostat, 2015). On the other hand, calendar effects arise from annual differences in the number of working or trading days in a month or a quarter, as well as dates or duration of public holidays. However, seasonal and calendar adjustment methods may not always be capable of removing all seasonal and working day effects. Regarding the former, extreme weather conditions may not be fully eliminated and the extent beyond the average weather conditions may still be contained within seasonally adjusted series. Likewise, issues like bridging days or school holidays make identification of calendar component harder. Moreover, failing to control for such effects distorts conventional seasonal adjustment procedures (Boldin and Wright, 2015).

In this study we aim to identify the impact of bridging days on Industrial Production Index (IPI) in Turkey. Bridging days are defined as the days between two statutory holidays or a statutory holiday and a weekend (Deutsche Bundesbank, 2012a). As an example, if Tuesday is a national holiday, then Monday is considered as a bridge day. In such a case, employees may prefer to take Monday off to have a long weekend or employers may prefer to give that day off to all employees. Standard working day/calendar regressors consider such days as normal working days in regular seasonal adjustment process, which may lead to wrong or at least more volatile adjusted series. The problem is that precise identification of such an effect is a very hard task. It would be necessary to conduct surveys to what extent firms or employees choose to take the days between holidays off. Accordingly, to our best knowledge, none of the countries adjust official time series for such bridging day effects. The reasons are several: First, the impact of a bridge day on IPI depends on the current level of demand for industrial goods. During boom times, it is less likely to take bridging days off since each worker may not be allowed to have extra vacation. Second, the type of the bridging day or to which month of the year it corresponds to may determine its impact. Third, decision to take bridge days off at a particular time comes at the expense of not taking days off in the other months of the year. Thus from a theoretical point of view, such catching-up effects should also be taken into account. However, the estimation of this countermovement is often not possible in practice (Eurostat, 2015). Finally, if there may be a chance for taking more than one bridge day off at a particular month, it is more probable to benefit from only one of them, not both. Nevertheless, the possibility of bridge days is a phenomenon to be taken into account by policy makers while interpreting the real economic activity. For instance, in Germany, industrial output during a bridge day is estimated to be one-third lower than a normal working day (Deutsche Bundesbank, 2012a). Therefore, although not officially incorporated into seasonal adjustment processes, using qualitative expressions in official press releases regarding the role of bridging days on increasing volatility of economic activity measures during such periods may be beneficial for policy making and communication to give a better insight on the issue.[1]

Identification of the bridging day impact on economic activity is important for Turkey because there are 6 national and 2 religious holidays during a year.[2] Therefore, the opportunity of taking bridging days off is high in Turkey. Particularly, religious moving holidays Ramadan and Sacrifice Holidays, which are 3.5 and 4.5 days long including the Eve day respectively, provide incentives to take bridging days off for employees or to give employees compulsory vacation time for firms. Due to its moving structure, in recent years religious holidays have begun to take place in high season time for tourism, when people would be more willing to take working days off to extend their holidays. The volatility of the monthly growth rate of the officially seasonally adjusted IPI series during months corresponding to religious holidays has captured attention recently. To this end, estimating such bridging day effects on economic activity is important for Turkey.

Bozok and Kanlı (2013) is the first attempt to estimate the bridging day impact on IPI in Turkey.[3] With the official IPI (2010=100) series starting from 2005, they find that IPI falls by 40 percent in a bridge day compared to a regular working day. Moreover, people tend to use bridging days opportunity during religious holidays rather than national holidays. Our study has some improvements over Bozok and Kanlı (2013). Our approach in estimating the bridging day effect on IPI is not based only on the type of the holiday but also on the time of the year. A priori, people are more likely to take bridging days off in high season. Although Turkey's climate allows for both winter and summer holiday options, households prefer to travel more and stay longer days during the summer time.[4] This necessitates distinguishing the impact of bridging days according to both the nature (religious or national) and the timing of the holiday (high or low season). To this end, we categorize high season as from June to

[1] As an example, Deutsche Bundesbank (2012b) in Monthly Report, July 2012, p.5 uses such an expression regarding the impact of bridge day on production: "It should be noted that production in April was depressed by a bridge day at the end of the month"

[2] The national holidays are January 1, April 23, May 1, May 19, August 30, and October 29. The religious holidays are Ramadan and Sacrifice Holidays which are moving holidays.

[3] In fact, they also investigate whether to count Eve days as working or non-working days. Since Turkish Statistical Institute (TURKSTAT) no longer counts Eve days as working days in its newly designed working day regressors, this part can be taken as granted.

[4] See Household Domestic Travel Statistics in TURKSTAT website www.tuik.gov.tr .

October, and low season as from November to May. To perform such an analysis, we need a longer IPI series than officially published IPI (2010=100) time-series, which starts from January 2005, so that we can have enough observations for each bridging day definition. Accordingly, unlike Bozok and Kanlı (2013) we extend our sample back to 1987.

2. Methodology and Data

In a seasonal adjustment procedure, calendar adjustment is needed to get seasonally adjusted series whose values are independent of the length and the composition in days (number of Mondays, Tuesdays, etc. or number of working days and weekend days) of the month (Eurostat, 2015). Some part of this composition is seasonal and is captured by the seasonal component in the decomposition of the time series. However, the non-seasonal calendar effect, i.e. the working day effect, has to be introduced as a separate regressor to the seasonal adjustment procedure. This non-seasonal calendar effect can be estimated as the difference of the number of working days from its long run averages. Atabek et al. (2009) is the first attempt to construct such a working day regressor for Turkey. However, recently TURKSTAT switched to a new approach for calculating the long run average of working days in each month and recalculated the working day regressors with 10 different definitions for IPI.[5] In our study, we benefit from this latest working day regressor. The bridging day regressors are also prepared in accordance with this working day regressor definition. It is a common practice to count only 1 day between the holidays as a bridge day. However, we also counted 2 and 3 days between official holidays and weekends as bridging days, based on the dynamics and characteristics of the country. Since religious holidays are long, by taking 2 or 3 days off one could make a full week vacation. Some firms are also known to consider such periods as an opportunity for maintenance and repair works at the factories and turn such days into compulsory vacation for their employees.

We perform our analysis with Turkish IPI data from January 1987 to December 2014. It is a long and at the same time short sample size in some aspects. It is short because due to the moving structure of the religious holidays, the number of observations for each bridge day regressor may not be the best to get the most accurate estimation. On the other hand, it is a bit long because according to ESS Guidelines on Seasonal Adjustment 2015 (Eurostat, 2015), any time-series longer than 20 years is harder to adjust seasonally and might need to be divided into several periods. However, dividing our sample into smaller pieces or just using the current IPI (2010=100) series would make it harder to identify the bridging day effect accurately as we lose bridging day observations.[6]

[5] See metadata on this issue at http://www.tuik.gov.tr/indir/m_t_metaveri/sue_mv.pdf
[6] See the number of observations for bridging days in Appendix Table A1.

Our analysis strategy for determining the impact of bridging days on Turkish IPI is as follows. We start with a regular seasonal adjustment of IPI series with the working day regressor, which excludes Sundays, Religious and National holidays.[7] This is our benchmark model (Model 1) to evaluate the usefulness of different bridging day regressor specifications. In the second model, we add a single total bridging day regressor which covers all possible bridging days. As the third model, we separate bridging days resulting from national and religious holidays to test if the type of the bridging days changes the results. This also allows making comparison with the empirical results of Bozok and Kanlı (2013). Finally, we perform seasonal adjustment by categorizing bridging days as high season and low season (Model 4) and interact both with national and religious holidays (Model 5). As measures of goodness of our seasonal adjustment procedures, we present some diagnostic test results. We most importantly check the statistical significance of the parameters of bridging day regressors. Smaller seasonal innovation variance, information criteria values and higher log-likelihood makes a model more preferable (Grudkowska, 2011).

3. Empirical Analysis

Table 1 shows the estimation results of our progressive approach in analyzing the impact of bridge day effect on IPI in Turkey. Our benchmark model estimation shows that on average 1 day extra working increases the industrial production by 2.42 percent and this coefficient is statistically significant. Model 2 shows that introducing bridge holidays as a single regressor does not make statistically significant contribution to the seasonal adjustment of IPI. This does not necessarily mean that there is no bridging day effect on IPI in Turkey. Aggregation of bridging days might have hindered their role on IPI. As mentioned earlier, not all bridging day opportunities can be exploited or even if all bridging days are taken off, there may be catching-up effects in some of them, which makes overall estimation insignificant. Accordingly, disaggregating the bridging day regressor seems to be a wiser option to identify the real effect.

Our first disaggregation method is to categorize bridging day regressors as national and religious holiday bridging day regressors as done by Bozok and Kanlı (2013). National holidays are 1 day long and thus the probability of turning it into a long holiday is lower. Moreover, bridging days following the national holidays are usually 1 day long, so even if these days are taken off, it is easier to compensate for the production loss at the following or preceding days of the month, which may lead to statistically insignificant results for the estimated parameter. On the other hand, religious holidays Ramadan and Sacrifice are 3.5 and 4.5 days including the Eve days, respectively. Thus, the probability of taking bridging

[7] In fact, we tested all 10 definitions for working day regressor but this is found to be the one that suits best for IPI between 1987 and 2014.

days off during already relatively longer holiday to turn it into a full-week holiday is higher and catching-up the production loss at the same month is less likely. Therefore, one would expect bridging days corresponding to religious holidays should be more prominent. In fact, our results back this argument. While national holiday bridge days are statistically insignificant, religious holiday bridge days are statistically significant (Model 3). The production loss in each bridge day off during religious holidays is on average around 28 percent (0.0063/0.0222) compared to a regular working day. This finding is qualitatively in parallel with that of Bozok and Kanlı (2013), although their finding is around 40 percent. The difference is probably emanating from longer sample we use.

One of the hardest parts of estimating the impact of bridging days on economic activity is that it is not exogenous to the time of the year. The motivation is that what matters for employees or employers may not be the type of the bridging day but its season. To this end, we run two more seasonal adjustment models, which are peculiar to this study. We divide the year into two as high season and low season for tourism purposes. Both bridging day regressors corresponding to seasons are found statistically insignificant (Model 4). However, interacting the season and the type of the bridge day gives different results. Model 5 shows that the impact of religious holiday bridge day is statistically significant in both parts of the year. However, when it is during the high season, the impact doubles the impact in the low season. Therefore, there is more motivation to take bridging days off during the high season than the low season. The production loss ratio rises up to 41 percent (0.0091/0.0221) in the high season, while falls to 21 percent (0.0047/0.0221) during the low season. Regarding the national bridge days, the results are unexpected. Although statistically significant it does not have the proper sign for the high season, while it is statistically insignificant for the low season. In fact, the number of national holidays corresponding to the high season is 2: August 30 and October 29. To crosscheck this result, we run estimation where bridge days for these two national holidays are introduced to the seasonal adjustment procedure separately. Interestingly, we could not find statistically significant impact for both of them. Seasonal adjustment procedure might have attributed another kind of irregularity in the data to the aggregated bridge day regressor.[8]

[8] Another possible explanation for the positive sign of the high season may be that it reflects the catching up effects of taking bridging days off in high season during religious holidays. As mentioned earlier, employees/firms are not expected to benefit from all bridging day opportunities. It seems like people prefer using this opportunity during religious holidays and vacation demands are either rejected or is not demanded during high season national holiday bridge days. In such days production may be increased to catch up production loss in the high season religious holiday bridge days.

Table 1. Diagnostic Test and Estimation Results for Seasonal Adjustment Model Specifications of IPI with Different Bridging Day Regressors*

	Model 1	Model 2	Model 3	Model 4	Model 5
Parameter Estimates					
Working Day Regressor	0.0242 (0.000)	0.0235 (0,000)	0.0222 (0.000)	0.0235 (0.000)	0.0221 (0.000)
Total Bridge Days	-	-0,0024 (0.1808)	-	-	-
National Holiday Bridge days	-	-	0.0026 (0.3380)	-	-
Religious Holidays Bridge Days	-	-	-0,0063 (0.0085)	-	-
High-Season Bridge Days	-	-	-	-0.0039 (0.1428)	-
Low-Season Bridge Days	-	-	-	-0.0014 (0,5215)	-
High-Season National Holiday Bridge Days	-	-	-	-	0.0142 (0,0164)
Low-Season National Holiday Bridge Days	-	-	-	-	0.0059 (0,1747)
High-Season Religious Holiday Bridge Days	-	-	-	-	-0.0091 (0,0064)
Low-Season Religious Holiday Bridge Days	-	-	-	-	-0.0047 (0,0973)
Decomposition					
Seasonal Innovation Variance	0.0125	0.0121	0.0111	0.0119	0.0112
Irregular Innovation Variance	0.314	0.311	0.309	0.3105	0.3065
Model Adequacy					
Log-Likelihood	639.59	640.49	643.46	640.78	644.37
AIC	1471.49	1471.67	1467.74	1473.08	1469.90
AICC	1472.1	1472.38	1468.59	1473.93	1471.09
BIC	1505.49	1509.45	1509.29	1514.64	1519.02
BIC (Tramo Definition)	-6.69	-6.6812	-6.68	-6.66	-6.65
Hannan-Quinn	1485.06	1486.7522	1484.33	1489.67	1489.51
Number of Effective Observations	323	323	323	323	323
Number of Estimated Parameters	9	10	11	11	13

*See Table A2 in Appendix for model specifications.
The numbers in parentheses are probability of rejecting the null of zero. AIC: Akaike Information Criteria, AICC: Corrected Akaike Information Criteria, BIC: Schwarz-Bayes Information Criteria.

4. Conclusion

Adjusting the economic data for seasonal and calendar effects is of crucial importance for understanding the underlying information for the time series under consideration. However, irregular factors such as bridge days may impede the analysts perform the most accurate adjustment and lead to wrong estimates. Lately, bridging day effect became an intriguing concept in Turkey as religious holidays started to coincide with the high season for tourism.

In this study we aimed to quantify the impact of such bridge days on economic activity through industrial production index. To this end, we constructed several seasonal adjustment models with different definitions of bridging days. Our results show that categorizing the bridging days according to both the nature (religious or national) and the timing of the holiday (high or low season) is useful than using a single bridging day regressor. The results show us that particularly during religious holidays there is more incentive to use bridging days off. More importantly, if they correspond to high tourism season, there is a production loss of almost 40 percent compared to a regular working day, otherwise, the loss falls to approximately 20 percent. Therefore, we show that when qualitative judgments on the bridging day effects are made, the timing of the holidays has to be taken into more consideration as well. On the other hand, bridging days for national holidays are not found to affect the industrial production significantly or with an expected negative sign. Further research may investigate the issue in more detail by disaggregating the industrial production into sectors and check if there is any significant difference on the impact of bridge day usage in different sectors.

Reference:

Atabek, A., Atuk, O., Coşar, E. E. and Sarıkaya, Ç. (2009) Mevsimsel Modellerde Çalışma Günü Değişkeni (in Turkish), CBT Research Notes in Economics, No: 2009-3, Central Bank of Turkey.

Boldin, M. and Wright, J. H. (2015) Weather-Adjusting Employment Data, Working Papers, No: 15-05, Research Department Federal Reserve Bank of Philadelphia.

Bozok, İ. and Kanlı, İ. B. (2013) Impact of de facto Bridge Holidays, CBT Research Notes in Economics, No: 2013-08, Central Bank of Turkey.

Deutsche Bundesbank (2012a) Calendar Effects on Economic Activity, Monthly Report, December 2012.

Deutsche Bundesbank (2012b) Monthly Report, July 2012, p.5.

Eurostat (2015) ESS Guidelines on Seasonal Adjustment 2015 Edition, Eurostat Manuals and Guidelines, ISSN 2315-0815.

Grudkowska, S. (2011) Demetra+ User Manual, Central Bank of Poland.

Appendix:

Table A1. Number of Monthly Observations for Bridge Days under Different Periods

	Jan 1987 - Dec 2014	Jan 2005 - Dec 2014
Total Number of Observation	336	120
Total Bridge Days	108	41
National Holiday Bridge days	63	23
Religious Holidays Bridge Days	55	23
High Season Bridge Days	43	19
Low Season Bridge Days	65	22
High Season National Holiday Bridge Days	24	8
Low Season National Holiday Bridge Days	39	15
High Season Religious Holiday Bridge Days	23	15
Low Season Religious Holiday Bridge Days	32	8

The summation of components may not give the totals due to the collision of religious and national holidays or bridge days longer than 1 could have taken values in multiple months if bridge days fell at the end and the beginning of consecutive months.

Table A2. ARIMA Model Specifications for Each Seasonal Adjustment Model*

	Model 1	Model 2	Model 3	Model 4	Model 5
Log Transformation	Yes	Yes	Yes	Yes	Yes
Constant Term	No	No	No	No	No
ARIMA Model (p,d,q) (P, D, Q)	(0,1,1) (0,1,1)	(0,1,1) (0,1,1)	(0,1,1) (0,1,1)	(0,1,1) (0,1,1)	(0,1,1) (0,1,1)
Calendar Effect	Yes	Yes	Yes	Yes	Yes
Total Bridge Days	-	Yes	-	-	-
National Holiday Bridge Days	-	-	Yes	-	-
Religious Holidays Bridge Days	-	-	Yes	-	-
High-Season Bridge Days	-	-	-	Yes	-
Low-Season Bridge Days	-	-	-	Yes	-
High-Season National Holiday Bridge Days	-	-	-	-	Yes
Low-Season National Holiday Bridge Days	-	-	-	-	Yes
High-Season Religious Holiday Bridge Days	-	-	-	-	Yes
Low-Season Religious Holiday Bridge Days	-	-	-	-	Yes
Outliers	AO[1991-1]; LS[2005-1]; AO[1987-7]; LS[1994-2]; LS[2008-12]	AO[1991-1]; LS[2005-1]; AO[1987-7]; LS[1994-2]; LS[2008-12]	AO[1991-1]; LS[2005-1]; AO[1987-7]; LS[1994-2]; LS[2008-12]	AO[1991-1]; LS[2005-1]; AO[1987-7]; LS[1994-2]; LS[2008-12]	AO[1991-1]; LS[2005-1]; AO[1987-7]; LS[1994-2]; LS[2008-12]

* All seasonal adjustment is made by applying TRAMO/SEATS method at Demetra+ program.
p: non-seasonal auto-regressive component, d: non-seasonal difference, q: non-seasonal MA term; P: Seasonal auto-regressive component, D: Seasonal difference, Q: Seasonal MA term; AO: Additive Outlier, LS: Level Shift.

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