School holidays in Morocco:
Evaluation of an atypical calendar effect with seasonal adjustment approach

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Abstract

The school rhythms represent an undeniably important part in the social life of the Moroccan population, as in many other countries. However, the research in calendar effects seems not to give importance to these events. In fact, it is generally considered "a priori" that these holidays are regarded simply as explanatory elements of seasonality and / or traditional calendar. Consequently, seasonal adjustment, according to good practice is usually able to eliminate their effects. This is true in developed countries, generally governed by the Gregorian calendar, but did not in Morocco because these holidays are programmed in a very different way.

Beginning first by measuring the interdependencies between the school holidays in Morocco with seasonality and the religious calendar, this work aims to evaluate the impacts of these holidays on some economic indicators. To do this, we build some specific regressors, which will be incorporated in REG-ARIMA models.

Keywords: School holidays, calendar effects, seasonal adjustment

1. Characteristics of the school holidays in Morocco

The first point to underline about the school holidays in Morocco is that they are relatively large compared to other countries, such as in France. The second fact is that their timing is relatively unstable, and their lengths are relatively changed from one year to another. The main reason is that they depend on both Gregorian calendar and Lunar calendar. Briefly, we can say that a school holiday in Morocco seems to be atypical.

Indeed, the pattern of change of these holidays, over the period 2000-2013, shows that the number of vacation days is highly variable from year to year; both for the month and for the quarters (cf. Figure 1). This means that the statistical variability of that number is not only seasonal. The important result is that the simple seasonal adjustment will not correct all their effects.

Although this seasonal adjustment takes into account the effects of conventional calendar, it will not be able to correct all the effects of these school holidays.

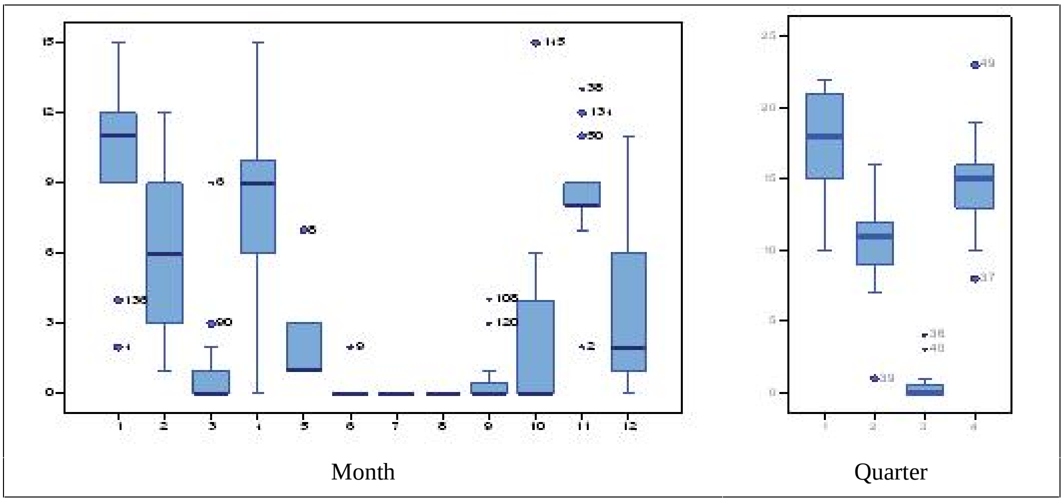


Figure 1: Monthly and quarterly distribution of the number of days of school holidays in Morocco

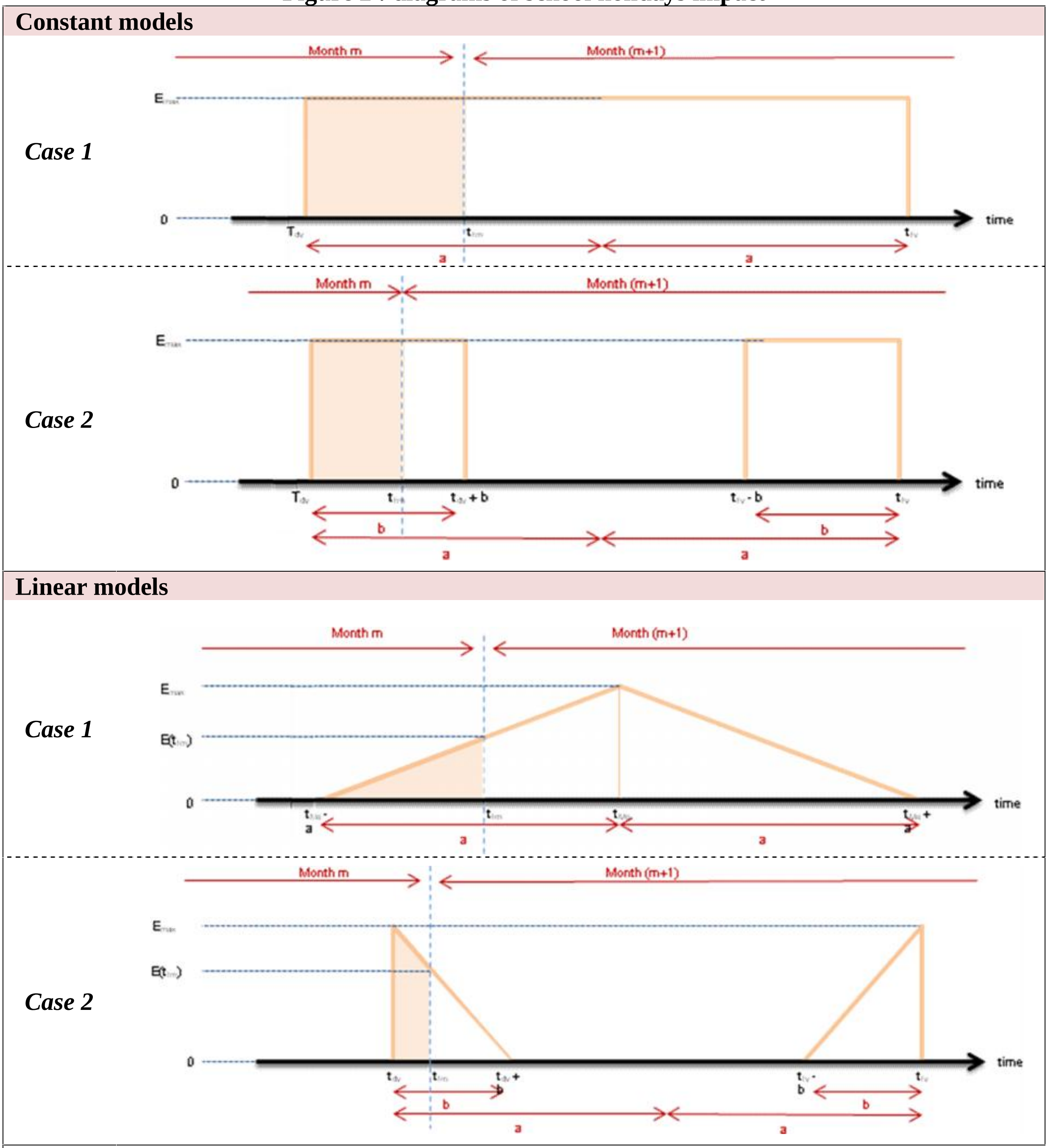
2. Construction of *ad hoc* regressors

In order to measure and remove the impacts of these school holidays, we have built a variety of specific regressors, derived from many assumptions and options.

First of all, we have distinguished between the case where every day of a holiday has an impact (case 1) and the case where only some days that have one (case 2). In this second case, we assume that only the beginning and the ending days of the holidays that should be considered.

In the same time, we have retained the two schemes commonly identified in the literature calendar effects, namely the constant model, where the impact is the same for each day of holiday, and the linear model where the impact is variable depending on the position of the day in the holiday (cf. Figure 2).

Figure 2 : diagrams of school holidays impact



Legend : t_{dv} : day of the beginning of the holidays; t_{fv} : day of the end of the holidays ; t_{fm} : day of the end of the month m; *2a* : number of days of school holiday; *b* : width of the end of the holidays (where the impact is made)

Thus, the impact due to school holiday ***v***, which will be felt (partially or totally) during the month ***m*** (colored areas in Figure 2) is calculated, for each case and type of model, with the formulas of Table 1. These formulas come from a important normalization rule: the school holidays are distinguished according to their importance or level. We had selected the length of the holiday as the proxy indicator of this level (in other words, the total impact of school holiday ***v*** is set (normalized) to be equal to *2*a*; i.e. $\mathrm{E}_{\mathrm{v}}^{\bullet} = 2a$ for all cases and models).

Table 1 : Formulas of regressors (before definitive treatment)

	Constant models	**Linear models**
Case 1	$\mathrm{E}_{\mathrm{v}}^{1\mathrm{C}}(m) = \begin{cases} 0 & if \;\; t_{fm} < t_{dv} \\ (t_{fm} - t_{dv}) & si \;\; t_{fm} < t_{fv} \\ 2a & \text{otherwise} \end{cases}$	$\mathrm{E}_{\mathrm{v}}^{2\mathrm{C}}(m) = \begin{cases} 0 & if \;\; t_{fm} < t_{dv} \\ (t_{fm} - t_{dv})\dfrac{a}{b} & if \;\; t_{fm} < t_{dv} + b \\ a & if \;\; t_{fm} < t_{fv} - b \\ 2a - (t_{fv} - t_{fm})\dfrac{a}{b} & if \;\; t_{fm} < t_{fv} \\ 2a & \text{otherwise} \end{cases}$
Case 2	$\mathrm{E}_{\mathrm{v}}^{1\mathrm{L}}(m) = \begin{cases} 0 & if \;\; t_{fm} \le t_{dv} \\ \left(\dfrac{[t_{mf} - t_{dv}]^2}{a}\right) & if \;\; t_{fm} \le t_{Me} \\ \left(2a - \dfrac{[t_{fv} - t_{mf}]^2}{a}\right) & if \;\; t_{fm} < t_{fv} \\ 2a & \text{otherwise} \end{cases}$	$\mathrm{E}_{\mathrm{v}}^{2\mathrm{L}}(m) = \begin{cases} 0 & if \;\; t_{fm} < t_{dv} \\ a\left(1 - \dfrac{[(t_{dv} + b) - t_{mf}]^2}{b^2}\right) & if \;\; t_{fm} \le t_{dv} + b \\ a & if \;\; t_{fm} < t_{fv} - b \\ a\left(1 + \dfrac{[t_{mf} - (t_{dv} - b)]^2}{b^2}\right) & if \;\; t_{fm} \le t_{fv} \\ 2a & \text{otherwise} \end{cases}$

The two cases of impact window and the two models specification (according the nature of this impact) is an important asset, because they give us a large choice. However, we must point out that these situations can, sometimes, be the same between them. For example, if one month contains all window impact holiday, then the constant model will be identical to linear model (obviously for this month only), regardless of the case (due to the normalization rule). In this context, the question of the distinction between these several situations will be asked when holidays overlap two months. When we examine the Moroccan school holidays, over the period of the study (124 holidays in all), we found that nearly 45% of them coincide with two adjacent months. Focused in case 2 (more special because the equivalence of the two models is only true if one extremity overlaps two months), we note that 11% of these holidays overlap two months.

Moreover, all these formulas are elaborated for one school holiday (denoted ***v***). To construct the regressor of school holidays, that we can use directly to estimate there impact, we aggregate, for each period (month ***m***), all the effects observed in this period (to obtain time series):

$$\mathrm{Reg}(m) = \sum_{v} \mathrm{E}_{v}(m)$$

Then, all these regressors have been seasonally adjusted by substracting the period averages (as indicated in good practices in seasonal adjustment, see Fendley (2009) and EuroStat (2009)):

$$\text{Reg}_c(m) = \text{Reg}(m) - \frac{1}{A}\sum_a \text{Reg}(m,a)$$

Where *a* is the year and A is the number of year

The used model to estimate all effects is given (type REG-ARIMA):

$$\phi_p(B)\Phi_P(B^s)(1-B)^d(1-B^s)^D\left[Y_t - \beta' X_t - \text{Reg}_c(t)\right] = \theta_q(B)\Theta_Q(B^s)a_t$$

With Y_t the target variable to correct, X_t the variables of conventional calendar effects. The matrix X_t can contain day of the week, trading day, religious holidays (such “Aid al Adha”, month of Ramadan, etc. (see Elguellab & al. (2012)).

To reduce the potential correlation between these regressors and other conventional (traditional) calendar regressors (in order to have robust estimations), we adopted “a priori” censorship rule that retain only the school holidays which length are strictly more than two days.

In addition to these considerations, the elaboration of regressors depends on the width of the different impact retained windows (parameters ***a*** and ***b***). We also consider the option which takes into account the effects of the night before a holiday (eve effect) and “late returns”.

Taking into account all of these options give us 12 regressors for Moroccan school holidays. Each regressor is identified by a quadruple code (4 positions). It is composed primarily by the model type (*C* or *L*), secondly by the case (1 or 2), thirdly by “eve effect” and late returns effects (1 if yes and 0 otherwise) and, lastly, by the width *b* (which is not relevant in the case 1). Ultimately, 12 regressors were made: *RegC11, RegC10, RegL11, RegL10, RegC201, RegC211, RegC202, RegC212, RegL201, RegL211, RegL202,* and *RegL212*. For illustration, the regressor *RegC202* is a regressor school holidays with a constant effect model in case 2, without taking into account “eve effect” and late returns effects, which it consider two days impact in the end and in the beginning.

3. Applications

We use these regressors to estimate school holidays effects on three economic sectors: ***i)*** on rail transport, measured by number of passengers; ***ii)*** on local tourism, measured by the number of tourist overnights stays of residents; and ***iii)*** on monetary activity (in term of flow).

For each of these examples, our approach to select the best specification of the model REG-ARIMA is entirely empirical. It’s based on two tools, moreover not fully independent. Firstly, we will be careful into the quality of adjustment (we use in this way the information criteria (AICC); significance of parameters (T-Student); quality of residual component (must have usual properties)). Secondly, we will consider the quality of the components from seasonal adjustment (quality of smoothing; the weight of the irregular; non-deterministic evolution; quality statistics; stability criteria).

The choice was systematically between three specifications: the first, called SA, is a so-called "naive" seasonal adjustment, which supports only the regular seasonality; the second, denoted SA-TD is a seasonally adjusted treatment, taking into account the conventional calendar effects (days and religious holidays); and the last, denoted SA-TD-SH is equivalent to the second but taking also into account the effects of school holidays.

Initial estimates were made on the monthly series of Moroccan rail transport. The estimation of the three above-mentioned specifications shows that the inclusion of school holidays in the treatment seems very significant. The AICC criteria indicates that the ***model 3.2*** (Recall that the regressor *RegC10* mean, on one hand, a constant effect every day and, on the other hand, the absence of effects of early departures and late returns) that explains better the range of behavior (gains according to this criterion are significant, see U. S. Census (2013), pp 44-47). The parameter specific to school holiday regressor is very significant (risk less than 0.2%) and comes with the expected positive sign (cf. Table 2).

In addition, the value of this impact is important. The value of this parameter suggests that one additional day of school a holiday in Morocco generates a supplement of traffic growth equivalent to 0.6% (annual comparison). For example, the fortnight's holiday, observed during the month of April 2012, were the source of an additional annual traffic growth of 8.6%, in comparison with the same month of 2011. To a lesser extent, in February 2011, which coincided with the three days holiday have seen a further growth of 1.7%. We must draw attention here that these impacts are outside working day effects, since they were jointly estimated.

Table 2: Estimation results

		Indicator 1: rail transport (number of passengers)					Indicator 2: Tourist nights (spent by residents)			
		AICC	Conventional calendar effects			School holidays	AICC	Conventional calendar effects		School holidays
			Aid Adha	Ramadan month	Trading day			Ramadan	Trading day	
1. SA specification		1300,76	-	-	-	-	1811,56	-	-	-
2. SA-TD specification		1266,46	0,0482 (0,0121)**	-0,0126 (0,0012)*	-0,0039 (0,0013)*	-	1628,99	-0,0305 (0,0014)***	-0,0037 (0,0014)***	-
3. SA-TD-SH specification	***(regressor)***									
3.1	*RegC11*	1257,98	0,0381 (0,002)***	-0,0122 (0,0000)	-0,0028 (0,0313)**	0,0067 (0,002)***	1626,96	-0,0318 (0,0014)***	-0,0026 (0,0014)**	0,0097 (0,0024)***
3.2	*RegC10*	1257,00	0,0372 (0,0028)***	-0,0124 (0,0000)***	-0,0027 (0,0357)**	0,0057 (0,0015)***	1631,10	-0,0318 (0,0015)***	-0,0026 (0,0014)**	0,0072 (0,002)***
3.3	*RegL11*	1258,15	0,0394 (0,0013)***	-0,0121 (0,0000)***	-0,0029 (0,0283)**	0,0062 (0,0318)**	1624,07	-0,0318 (0,0014)***	-0,0026 (0,0014)**	0,0099 (0,0022)***
3.4	*RegL10*	1258,46	0,0389 (0,0016)***	-0,0123 (0,0000)***	-0,0028 (0,0318)**	0,0051 (0,0018)***	1628,10	-0,0318 (0,0015)***	-0,0026 (0,0014)**	0,0074 (0,0019)***
3.5	*RegC201*	1260,88	0,04 (0,0013)***	-0,0123 (0,0000)***	-0,0028 (0,0321)**	0,007 (0,0189)**	1640,13	-0,0314 (0,0015)***	-0,0031 (0,0015)**	0,0057 (0,0029)**
3.6	*RegC211*	1258,90	0,037 (0,0031)***	-0,0125 (0,0000)***	-0,0028 (0,0335)**	0,0064 (0,0023)***	1629,90	-0,0308 (0,0014)***	-0,0033 (0,0014)**	-
3.7	*RegC202*	1259,27	0,0398 (0,0012)***	-0,0123 (0,0000)***	-0,0029 (0,0289)**	0,0075 (0,0028)***	1638,15	-0,0315 (0,0015)***	-0,0031 (0,0015)**	0,0068 (0,0029)**
3.8	*RegC212*	1271,06	0,0373 0,0049)***	-0,0125 (0,0000)***	-0,0021 (0,1173)**	0,0058 (0,0069)***	1629,50	-0,0308 (0,0014)***	-0,0033 (0,0014)**	-
3.9	*RegL201*	1260,88	0,04 (0,0013)***	-0,0123 (0,0000)***	-0,0028 (0,0321)**	0,007 (0,0189)**	1640,13	-0,0314 (0,0015)***	-0,0031 (0,0015)**	0,0057 (0,0029)**
3.10	*RegL211*	1258,90	0,037 (0,0031)***	-0,0125 (0,0000)***	-0,0028 (0,0335)**	0,0064 (0,0023)***	1629,90	-0,0308 (0,0014)***	-0,0033 (0,0014)**	-
3.11	*RegL202*	1261,48	0,0413 (0,0009)***	-0,0122 (0,0000)***	-0,003 (0,0243)**	0,0064 (0,0088)***	1639,72	-0,0314 (0,0015)***	-0,0032 (0,0015)**	0,0058 (0,0028)**
3.12	*RegL212*	1260,50	0,0407 (0,001)***	-0,0123 (0,0000)***	-0,0028 (0,0313)**	0,0071 (0,0052)***	1640,04	-0,0314 (0,0015)***	-0,0032 (0,0015)**	0,0057 (0,0029)**

Numbers between brackets represent the p-values of Student test.
Significance of parameter at the 1% (***), 5% (**) and 10% (*)

In a second case, the effects of school holidays were tested on the monthly series of tourist overnights stays of residents. The estimates show that these effects are also important in this sector. The nature of this impact, however, is different to that seen in rail transport: the best specification now follows a linear pattern (***model 3.3***). This means that the effect is even greater than the day is in the middle of the holiday. Another feature of this effect on domestic tourism is that early departures (eve effects) and late returns also appear to have an impact, as evidenced by the results of the estimates.
This impact is significant (risk less than 0.2% like for first example) and important. In this sense, an extra day of school holidays generates a positive additional 1% in the annual evolution of this indicator. To more illustrate, the strong annual growth (+17.8%) recorded by residents tourist nights in the second month of 2010, excluding the effects of the season and the effects of the weekend, was due in large part (10.8 points of this growth) to the impact of school holidays.

We also tried to focus on the monetary sector with the aim to detect any impact of these school holidays. The results were not conclusive for the series of the money that we expected (M1 and M2 aggregates). Estimates made on these two aggregates, taking into account the various options for regressors' school holidays, to conclude that the school holidays don't make a significant impact on the flow of the money in Morocco.

Conclusion

At the end of this work, it seems that the school holidays are not a trivial phenomenon in Morocco. Calculations show that their effects can be substantial: an additional day of school holiday can generate from 0.6% to 1% additional growth depending on whether one is in rail transport or local tourism. Obviously, sometime these impacts may not be significant, as showed in the case of the monetary activity (M1 and M2 aggregates).

A second lesson from this work is that the inclusion of these holidays in a seasonal adjustment procedure is very relevant. The results in this last pattern turn out, in fact, more robust and, consequently, the calculated components are less volatile (seasonal adjusted series, trend-cycle). In this way, the economic message from these treatments is easier to read and more important regarding the underlying economic developments.

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