Real time estimates of GDP growth

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Abstract

This paper describes the components of the EICIE, the Econometric Institute Current Indicator of the Economy. This measure concerns quarterly and annual growth of Dutch real Gross Domestic Product. The key component of our real-time forecasting model for Dutch quarterly GDP is weekly staffing services obtained from Randstad company, which is single explanatory variable. We show that these two variables are cointegrated, and that the staffing variable helps to give quarterly GDP figures with just a two-week delay.

Keywords: Current indicator, staffing, GDP

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1 Introduction

In this paper we outline the development of a Current Indicator of the Dutch Economy, where we assume that real Gross Domestic Product (GDP) adequately summarizes the state of the economy. As the authors are affiliated with the Econometric Institute of the Erasmus University Rotterdam, we will call this the EICIE indicator, at least for the moment.

The main motivation to develop our indicator is that official, and preliminary, data on real GDP are released with a time lag of at least one quarter. We aim to publish the EICIE indicator with a time lag of less than two weeks[1]. This short time lag is caused by our belief that we have an explanatory variable for real GDP with strong explanatory power, with the additional feature that this variable can be observed weekly, with a delay of just a few days. Hence, once a quarter is over, it takes just a week or two to obtain the relevant data on this explanatory variable. Moreover, the data on this variable are adequately measured, that is, measurement errors are not to be expected. Finally, in contrast to other predictive variables like stock market prices and interest rates, which are sometimes found to be relevant to forecast real GDP, values of our variable can partly be set by the company involved.

Our explanatory variable concerns temporary employment, and the data are provided by Randstad Staffing Services. In Section 2, we outline why we believe that fluctuations in temporary employment correlate with fluctuations in GDP[2]. Next, in Section 3, we discuss the data that we use for constructing a model linking real GDP with staffing data. In Section 4, we examine the univariate time series properties of each of the series, and we construct two models, one for the annual growth rates of real GDP and one for the quarterly growth rates. We show that the variables real GDP and staffing (after

[1]This publication will appear in the Dutch language two-weekly journal *Economische Statistische Berichten* (ESB). In the present paper we outline the methodology. In the ESB one can read about the calculated values for growth for recent quarters.

[2]A search on the internet reveals that various practitioners share the notion that temporary employment can have predictive value for the state of the economy. Interestingly, to our knowledge there are no academic studies on this topic.

taking natural logs) are cointegrated, and also that they are strongly correlated, both contemporaneously as well as dynamically. We do not take the cointegration relation as an important variable that requires an interpretation, but merely we interpret our finding only as that the two variables share a common stochastic trend. Section 5 describes the way we intend to release the EICIE values. Section 6 concludes with a summary of further research topics, that might lead to future improvements to our indicator.

2 Why using staffing data?

The following quote is from the American Staffing Association, that is, "Many economists view temporary employment as a leading economic indicator because businesses can immediately adjust to changes in demand by scaling up or down their use of temporary help. Historically, demand for temporary employees has shifted quickly as businesses adjust to changes in the economy.", and the quote is from Professor Lawrence Katz, Harvard University. Professor Katz consistently advises to keep an eye on the temporary labor market. This is because temporary employment was used reliably in the past two recessions as a leading indicator of real employment and sustained economic recovery.

These quotes suggest that there are reasons to consider temporary employment as a possible measure concurrent with fluctuations of the economy. During times that demand for personnel is lower than the supply, the mobility of personnel, that is, switching activity towards other employers, is reduced. Most of the time HRM managers think that the latter has to do with good HRM policies, however we believe it is simply due to market conditions. During the time that such a situation is present, customers' orders have a short duration, where the customer means the firm which hires temporary personnel. A firm rather cancels the labor relation with the temporary staffing personnel and renews the relationship within a short period than to continue the relationship. Economically, the customer gains a couple of days or weeks of salary cost without running a risk that new temporary staffing personnel is no longer available. In a tight labor market, a customer would never do this since the risk of non-availability of temporary staffing personnel becomes too high. The reverse of this temporary labor market description, when demand

for personnel is higher than supply, also holds.

The above described situations alternate in time. The shifts from a tight labor market towards a labor market with an abundance of temporary staffing supply follow the same patterns of growth and shrinkage as real GDP. Intuitively this reasoning is very appealing also because of its simplicity, that is, a growth in staffing employees at work corresponds with a growth of GDP. Furthermore, this two-variable relationship reflects real and factual behavior.

Randstad Staffing Services in the Netherlands (hereafter: Randstad) data are available on a weekly basis. Hence, insights into the direction of real GDP can be improved in a relatively short period. This gives certain advantages for policy makers of the company and also for others when the information becomes publicly available for other policymakers.

Ever since the founding of Randstad in the year 1960, each year branches were opened to accommodate the growing market demand. From 1960 until 2004 the staffing services market grew from its inception as a percentage of the Dutch labor force from 0% to 5%. As of the first year a recording was done on a weekly basis of all staffing employees employed through Randstad.

3 The variables

In this paper we will show that the natural log of quarterly real GDP ($\log GDP_t$) and the natural log of Randstad staffing services ($\log S_t$) are strongly correlated. This correlation concerns the long run, the short run, as well as contemporaneous correlation. Now, we shall look at the data in more detail. The data used to obtain the estimation results below are displayed in the graphs in Figure 1. The data themselves are given in Tables 1 and 2. Electronic versions of these data can be obtained upon request. All computations in this paper have been done using Eviews, version 5.

Staffing data

Randstad data encompasses weekly data on the number of staffing employees employed through Randstad the Netherlands for the years 1967 to 2004. In univariate analysis

we will use the full sample. For multivariate analysis we consider the sample starting from 1977, as from then onwards also reliable GDP data are available, published by the Netherlands Central Bureau of Statistics (CBS). In our analysis we use quarterly staffing data, where we have constructed the quarterly data by averaging over the first 13 weeks, until the last 13 weeks, where we add the remaining days within a year to the last week, and we add the first few days to the first week.

The data of Randstad the Netherlands are reliable as the data are obtained directly from the administrative source of the company. The data are an integral part of the weekly business process. Every single data detail is linked to an invoice to the customer (firm) and to the salary slip of the staffing employee. Moreover, these data are part of the monthly, quarterly and annual business appraisal of the branches (the outlets) of the company, its regional management and its policy making board. Randstad data are also representative for the Dutch staffing sector as they cover about 40% of the staffing market in the Netherlands, from its inception until today.

When do GDP data get released?

To give an impression of the release process of real GDP data by the CBS, consider the contents of Table 3. About one-and-a-half month after the end of a quarter, the CBS releases a so-called Flash value of real GDP. We will denote this value as GDP_{Flash}. Again, one-and-a-half month later, the Regular Quarterly Forecast (RQF) is published, which we will denote as GDP_{RQF}. The RQFs for an entire year are adjusted in July of the subsequent year, to be labelled as GDP_{ARQF}. One year later, the preliminary definitive values, that is, GDP_{PD}, are published and yet again one year later, the final definitive value is published, which is GDP_D.

Given this special scheme of data releases, it seems unwise to seasonally adjust the data, as the seasonal and other components are allowed to change reasonably often[3].

[3]As mentioned, it takes about three years for the final definitive values of real GDP are known. This means that the part of GDP that is attributed to seasonality not only needs revisions due to changing seasonal factors, but also since the very value of GDP is unknown for a long time. Hence, we believe that a seasonally adjusted GDP_{Flash} value is not of much practical use.

Next, another reason for not seasonally adjusting the data is that we also want to forecast the annual growth per quarter, and this is already seasonality-free.

It is our intention to provide an estimate of quarterly GDP, just two weeks after the end of a particular quarter. We make use of the most recent and available information from the CBS. This means that we make use of available Flash, RQF and ARQF data, whenever possible.

When do our new estimates become available?

We re-estimate the model parameters each year in September. We use the sample starting in 1977 quarter 1, and then end in quarter 4 of the year before the current year. This is because in September of year T, we should have reasonably precise information on the data points in all quarters in year $T-1$. That is, by then we can use the GDP_{RQF} of all quarters of year $T-1$, and the GDP_{ARQF} of all quarters of year $T-2$ and the GDP_{PD} values of year $T-3$. The models in the next sections have been constructed in September 2004, and hence cover data from 1977 to and including 2003.

We use the model parameters to make estimates of the natural log of real GDP, which we use to construct year-to-year growth per quarter as well as quarter-to-quarter growth. Based on the releases of modified GDP data, we create new estimates. In Table 4, we give a time table in calender time.

4 Model building

In this section we describe how we arrive at a suitable model linking GDP with staffing data. We first discuss a univariate analysis of the two series, and next we present our multivariate model.

Univariate analysis

The variables we have are $\log GDP_t$ and $\log S_t$, where $\log GDP_t$ is short-hand for the natural log of GDP and $\log S_t$ for the natural log of staffing. We aim to create a model

to forecast (or equivalently, fit) at time n the observation of $\log GDP_t$ at time n, or, $\log GDP_n$.

For that purpose we create models linking $\log GDP_t$ with past $\log GDP_t$ and with current and past $\log S_t$, while taking care of seasonality.

Before we can create a model linking GDP with temporary employment, we need to examine the univariate properties of the two series. As is evident from Figure 1, both series show seasonality and a trend.

To study trend and seasonality, we use the HEGY test regression for seasonal unit roots, see Hylleberg et al. (1990)[4]. For quarterly data it amounts to a regression of $\Delta_4 \log GDP_t$ on deterministic terms like an intercept, seasonal dummies, a trend and seasonal trends and on $(1 + L + L^2 + L^3) \log GDP_{t-1}$, $(-1 + L - L^2 + L^3) \log GDP_{t-1}$, $-(1 + L^2) \log GDP_{t-1}$, $-(1 + L^2) \log GDP_{t-2}$, and on lags of $\Delta_4 \log GDP_t$, where Δ_4 is defined as $\Delta_k y_t = y_t - y_{t-k}$. A $t-$test is used to examine the significance of the parameter for $(1 + L + L^2 + L^3) \log GDP_{t-1}$, and similarly, we use a $t-$test for $(-1 + L - L^2 + L^3) \log GDP_{t-1}$ and a joint $F-$test for $-(1 + L^2) \log GDP_{t-1}$ and $-(1 + L^2) \log GDP_{t-2}$. An insignificant test value indicates the presence of the associated root(s), which are 1, -1, and the pair i, $-$i, respectively. Asymptotic theory for the tests is developed in Hylleberg et al. (1990). The results are in Table 5.

With Table 5 at hand, we conclude that only root 1 is in the data, and hence that the data need to be first-differenced to achieve stationarity. This means that each series has constant seasonality, or at least approximately, and that they both have a stochastic trend. Whether they have this stochastic trend in common is studied next.

Multivariate analysis

It may be that the two series have a stochastic trend in common. The Johansen test for a model with 5 lags of first-differenced series, three seasonal dummies, and a linear restricted trend (option 4 in Eviews) gives that the first eigenvalue is estimated as 0.235

[4]Hylleberg, S., R. F. Engle, C. W. J. Granger, and B. S. Yoo (1990), Seasonal Integration and Cointegration, *Journal of Econometrics*, 44, 215-238.

with p-value 0.0014 and the second eigenvalue is 0.089 with p-value 0.1505. So, clearly there is just a single cointegration relation.

The estimation of a vector error correction model (VECM), with again 5 lags of first-differenced series, three seasonal dummies, but now no trend anymore in the cointegration relation, gives that this relation gets estimated as

$$\log GDP_t = \underset{}{7.989} + \underset{(0.031)}{0.307} \log S_t, \tag{1}$$

where standard errors are given in parentheses. The adjustment parameter in the $\log GDP_t$ equation is estimated as -0.061 with standard error 0.015, and that in the $\log S_t$ is 0.001 with standard error 0.050. Hence, adjustment due to disequilibrium errors only occurs in the equation for $\log GDP$. It should be stressed that we have no particular thoughts about the estimated parameters in (1). merely, we interpret our finding as that the two variables share a stochastic trend. This is important, as we intend to use $\log S_t$ as an important component of our EICIE.

In a next step, we specify a two-equation system with in each equation the current changes in $\log GDP_t$ or $\log S_t$. We observe that, relative to single equation specifications, the estimated parameter values as well as the estimated standard errors change only little. Hence, we continue with single equations, where we restrict our focus on the equation for $\log GDP_t$.

The first model we propose correlates the annual growth rates with explanatory variables, and it reads as

$$\begin{aligned}\log GDP_t - \log GDP_{t-4} = {} & \underset{(0.111)}{0.308} - \underset{(0.013)}{0.039} (\log GDP_{t-4} - \underset{(0.084)}{0.339} \log S_{t-4}) \\ & + \underset{(0.006)}{0.023} (\log S_t - \log S_{t-4}) \\ & + \underset{(0.087)}{0.465} (\log GDP_{t-1} - \log GDP_{t-5}) + \hat{\varepsilon}_t - \underset{(0.097)}{0.466} \hat{\varepsilon}_{t-4}, \end{aligned} \tag{2}$$

with again standard errors in parentheses. Note that the univariate tests for seasonal unit roots do not imply that $\log GDP_t$ should be analyzed after transformation to $\log GDP_t -$

$\log GDP_{t-4}$. However, the model in (2) easily passes diagnostic tests for autocorrelation, and also, the left-hand side variable is one of the variables we intend to measure.

Our second model is a model for the quarterly growth rates, and it is

$$\begin{aligned}
\log GDP_t - \log GDP_{t-1} = {} & \underset{(0.152)}{0.559} - \underset{(0.012)}{0.052}\ Q_{1,t} - \underset{(0.011)}{0.037}\ Q_{3,t} \\
& - \underset{(0.017)}{0.066}\ (\log GDP_{t-1} - \underset{(0.036)}{0.316} \log S_{t-1}) \\
& + \underset{(0.016)}{0.046}\ (\log S_t - \log S_{t-1}) \\
& + \underset{(0.018)}{0.060}\ (\log S_{t-2} - \log S_{t-3}) \\
& - \underset{(0.024)}{0.061}\ (\log S_{t-5} - \log S_{t-6}) \\
& - \underset{(0.085)}{0.545}\ (\log GDP_{t-1} - \log GDP_{t-2}) \\
& - \underset{(0.085)}{0.576}\ (\log GDP_{t-2} - \log GDP_{t-3}) \\
& - \underset{(0.087)}{0.403}\ (\log GDP_{t-3} - \log GDP_{t-4}) + \hat{\varepsilon}_t \qquad (3)
\end{aligned}$$

where $Q_{1,t}$ and $Q_{3,t}$ denote the usual seasonal dummies in quarters 1 and 3. This model also passes the diagnostic tests for residual autocorrelation.

Below, we will use both models to fit the current value of the log of GDP. This is then used to construct the estimated growth rates $\log GDP_t - \log GDP_{t-1}$ and $\log GDP_t - \log GDP_{t-4}$. Finally, we take the unweighed average of the two sets of estimates.[5] [6]

5 Algorithms

With the models in the previous section, we can estimate the value of the natural log of GDP in a particular quarter. In this section we demonstrate precisely how we do this,

[5] The forecast combination literature seems to suggest that simply taking unweighed averages is a sound strategy.

[6] We do not average the estimated $\log GDP_t$ values as this variables is a non-stationary variable.

where we use the models for the sample until and including 2003 to estimate GDP growth in 2004. We choose for quarter 3 of 2004 for illustration.

Our measure for GDP in quarter 3 in 2004 could have been released around October 15 2004. By then, we have the staffing data of the first three quarters of 2004. The algorithm to compute the value of GDP for 2004Q3 using the first model is

$$\begin{aligned}\log GDP_{2004Q3} = \log GDP_{2003Q3,RQF} &+ 0.308 \\ &- 0.039(\log GDP_{2003Q3,RQF} - 0.339 \log S_{2003Q3}) \\ &+ 0.023(\log S_{2004Q3} - \log S_{2003Q3}) \\ &+ 0.465(\log GDP_{2004Q2,Flash} - \log GDP_{2003Q2,RQF}) \\ &- 0.466\hat{\varepsilon}_{2003Q3}. \quad (4)\end{aligned}$$

The values of $\log GDP_{2003Q3,RQF}$, $\log S_{2003Q3}$, $\log S_{2004Q3}$, $\log S_{2003Q3}$, $\log GDP_{2004Q2,Flash}$, $\log GDP_{2003Q2,RQF}$, and $\hat{\varepsilon}_{2003Q3}$ are 11.401, 10.676, 10.757, 10.676. 11.455, 11.441, and -0.011, respectively, and therefore our estimate of $\log GDP_{2004Q3}$ is 11.4200. Comparing this number with $\log GDP_{2004Q2,Flash}$ (11.455) gives a quarterly growth rate of -3.45 per cent. And, comparing $\log GDP_{2004Q3}$ with $\log GDP_{2003Q3,RQF}$ (11.401) gives an annual growth rate of 1.92 per cent, in that particular quarter.

For the second model we have

$$\begin{aligned}\log GDP_{2004Q3} = \log GDP_{2004Q2,Flash} &+ 0.559 - 0.037 \\ &- 0.066(\log GDP_{2004Q2,Flash} - 0.316 \log S_{2004Q2}) \\ &+ 0.046(\log S_{2004Q3} - \log S_{2004Q2}) \\ &+ 0.060(\log S_{2004Q1} - \log S_{2003Q4}) \\ &- 0.061(\log S_{2003Q2} - \log S_{2003Q1}) \\ &- 0.545(\log GDP_{2004Q2,Flash} - \log GDP_{2004Q1,RQF}) \\ &- 0.576(\log GDP_{2004Q1,RQF} - \log GDP_{2003Q4,RQF}) \\ &- 0.403(\log GDP_{2003Q4,RQF} - \log GDP_{2003Q3,RQF}), \quad (5)\end{aligned}$$

where the -0.037 is due to the fact that we are considering quarter 3.

Additional to the above values, we have that $\log S_{2004Q2}$, $\log S_{2004Q1}$, $\log S_{2003Q4}$, $\log S_{2003Q2}$, $\log S_{2003Q1}$, $\log GDP_{2003Q4,ARQF}$, $\log GDP_{2004Q1,RQF}$, and $\log GDP_{2003Q3,ARQF}$ take the value 10.670, 10.541, 10.615, 10.646, 10.582, 11.452, 11.425 and 11.401, respectively. The estimate the natural log of GDP for the third quarter of 2004 thus equals 11.415. Comparing this number with $\log GDP_{2004Q2,Flash}$ (11.455) gives a quarterly growth rate of -3.93 per cent. And, comparing $\log GDP_{2004Q3}$ with $\log GDP_{2003Q3,RQF}$ (11.401) gives an annual growth rate of 1.44 per cent.

Finally, the average value of quarterly growth of GDP, as measured in quarter 3 (relative to quarter 2), is equal to -3.69 per cent, and that of quarterly growth in that particular quarter is 1.68 per cent.

6 Conclusion

This paper has demonstrated that real Gross Domestic Product for the Netherlands and the number of staffing personnel employed in the Netherlands through Randstad are cointegrated, and also that there are links between current and past growth rates of the two variables. Hence, changes in the direction of the economy therefore seem to run parallel in time with changes in the direction of the number of staffing personnel employed through Randstad the Netherlands. We infer from this that the Randstad data can be used for estimation of actual values of the Gross Domestic Product. As Randstad data are available on a weekly basis, we see opportunities for policy makers as the data from the CBS are available substantially later.

There are few next issues we aim to examine. First, we will compare our estimates of GDP and GDP growth with those of the CBS, and intend to compare their trajectories towards the final definitive values.

Second, as we have access to weekly data, there is a possibility that some weeks in a quarter have predictive power for the outcome of the total quarter. This entails that we might be able to release our EICIE even earlier, in fact, within the quarter itself.

Third, we aim to extend our modeling exercise to data for other countries. Randstad is also a player in the temporary staffing markets in the US, the UK, France and Germany.

It would be interesting to see if similar relations hold, and also perhaps whether changes in staffing data are correlated across countries. If so, that would allow us to predict even earlier what value of GDP growth might be expected.

Finally, it seems possible to further refine our indicator by introducing a non-linear relation between the Randstad data and GDP. It may be that at times when the both series go up, there is another relation between the two series, than when both series go down. Whether the non-linearities concern short-run correlations or the long-term cointegration relationship is a topic for further research.

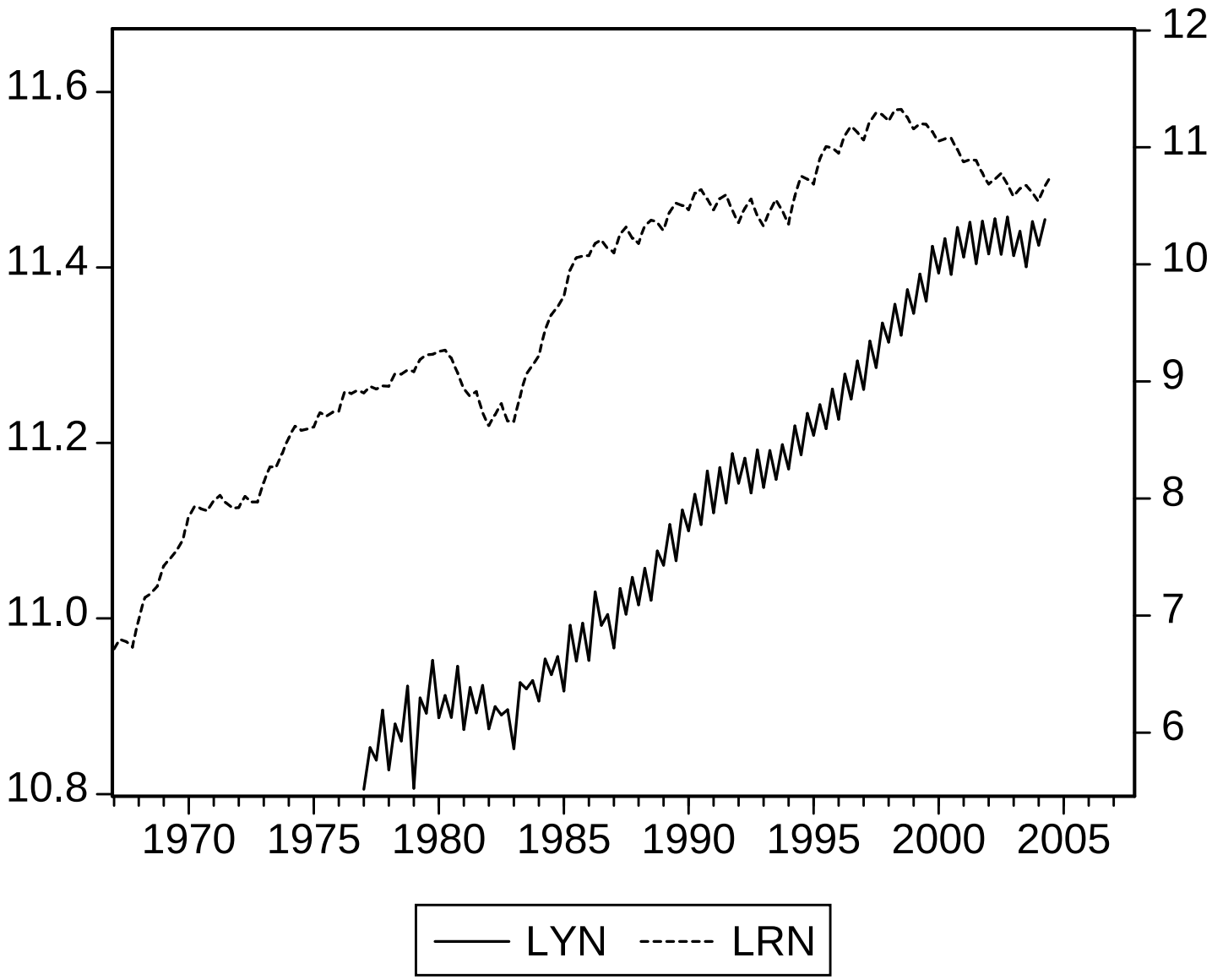

Figure 1: The log of Gross Domestic Output and the log of Staffing, observed per quarter

Table 1: The quarterly data on real GDP, as available on September 30, 2004

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1977	49282	51691	50961	53936
1978	50381	53088	52072	55444
1979	49342	54690	53746	57084
1980	53469	54838	53483	56688
1981	52764	55354	53765	55472
1982	52809	54152	53649	53956
1983	51625	55650	55267	55796
1984	54489	57181	56155	57324
1985	55123	59421	57032	59553
1986	57078	61707	59418	60149
1987	57904	61952	60159	62748
1988	60816	63387	61137	64658
1989	63608	66639	63960	67753
1990	66172	68976	66644	70815
1991	67544	71110	68282	72228
1992	69847	71859	69069	72547
1993	69522	72495	70166	72984
1994	70994	74550	72145	75647
1995	73769	76385	74329	77750
1996	75134	79102	76877	80306
1997	77744	82132	79679	83818
1998	82041	85633	82688	87073
1999	84784	88657	85967	91511
2000	88738	92281	88600	93462
2001	90365	94030	89716	94148
2002	90712	94408	90656	94579
2003	90530	93081	89393	94094

Table 2: The quarterly data on Randstad staffing services S, as available on September 30, 2004

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1967	824.5000	893.4615	876.1154	836.8462
1968	1058.519	1277.250	1323.404	1412.212
1969	1677.077	1780.461	1890.962	2071.115
1970	2540.904	2792.173	2726.961	2676.115
1971	2921.808	3058.808	2868.192	2745.654
1972	2757.000	3034.385	2881.000	2894.077
1973	3420.539	3903.077	3894.923	4390.846
1974	4997.462	5526.308	5329.846	5401.462
1975	5489.462	6210.385	6013.231	6215.500
1976	6270.231	7431.000	7302.154	7509.500
1977	7343.923	7744.231	7585.692	7801.846
1978	7783.154	8616.231	8636.077	8941.231
1979	8810.769	9763.154	10150.46	10222.15
1980	10430.31	10587.46	9882.923	8715.923
1981	7623.154	7158.923	7444.077	6236.192
1982	5563.000	6097.538	6700.904	5774.327
1983	5755.789	7117.673	8633.673	9294.173
1984	10060.96	12538.08	14332.27	15285.85
1985	16676.52	21015.29	23331.88	23582.85
1986	23711.63	26361.29	27129.40	25323.83
1987	24343.88	28364.42	30316.62	27497.55
1988	26330.31	30535.23	32149.00	31509.38
1989	29523.92	34476.46	37153.46	36427.00
1990	35157.69	40555.69	41698.15	38474.62
1991	35087.31	38586.46	39856.46	35163.85
1992	31471.08	35538.46	38547.23	33545.38
1993	30603.92	34689.92	38284.31	34911.54
1994	31106.85	39397.69	46646.23	45547.85
1995	43764.00	54262.62	60285.85	59353.62
1996	56953.00	66101.62	71670.62	68144.23
1997	63870.92	74387.92	80134.23	78993.23
1998	74775.54	82288.62	82945.08	77308.08
1999	70078.77	73109.15	72916.08	68582.23
2000	62948.15	64378.31	64753.69	58827.38
2001	52874.23	53856.38	53571.15	48080.62
2002	43813.00	45595.46	48005.92	43851.54
2003	39435.08	42043.77	43297.38	40727.92

Table 3: The Central Bureau of Statistics in the Netherlands (CBS) is responsible for releasing GDP data. The CBS follows the following sequence of events in communicating data. Source: Central Bureau of Statistics, The Hague, The Netherlands.

Number	Name of communication	When
1	Flash	Within 45 days after Quarter end, year T
2	Regular Quarterly Forecast	90 days after the Quarter end, year T
3	Adjusted Regular Quarterly Forecast	After July, in year T+1, following the annual estimate of the year T
4	Preliminary Definitive	After July, in year T+2, following the adjusted annual estimate of year T
5	Definitive	After July, in year T+3, following the adjusted and definitive annual estimate the year T

Table 4: Release dates of quarterly figures of Gross Domestic Product data and the dates when new information becomes available. EICIE is short for the Econometric Institute Current Indicator of the Economy, and CBS denotes the Dutch Central Bureau of Statistics. The CBS publishes a flash value of GDP, a regular quarterly forecast (RQF), an adjusted RQF (ARQF), a preliminary definitive (PD) value and the definitive (D) value. EICIE publishes the value of the indicated quarter, and all previous values.

Date	EICIE	CBS (Flash)	CBS (RQF)	CBS (ARQF)	CBS (PD)	CBS (D)
2003, January 15	2002Q4	2002Q3	2002Q2	2000Q1-4	1999Q1-4	1998Q1-4
2003, April 15	2003Q1	2002Q4	2002Q3			
2003, July 15	2003Q2	2003Q1	2002Q4	2001Q1-4	2000Q1-4	1999Q1-4
2003, October 15	2003Q3	2003Q2	2003Q1			
2004, January 15	2003Q4	2003Q3	2003Q2			
2004, April 15	2004Q1	2003Q4	2003Q3			
2004, July 15	2004Q2	2004Q1	2003Q4	2002Q1-4	2001Q1-4	2000Q1-4
2004, October 15	2004Q3	2004Q2	2004Q1			
2005, January 15	2004Q4	2004Q3	2004Q2			

Table 5: Testing for (seasonal) unit roots in GDP and Staffing data. The test regressions contain an intercept, three seasonal dummies and a linear trend, and ** denotes significant at a 5%level.

Series	Sample	Lags of $\Delta_4 z_t$	t_1	t_{-1}	$F_{i,-i}$
log GDP	1979.2-2003.4	5	-2.480	-3.015**	7.739**
log Staffing	1968.3-2003.4	2	-2.036	-3.350**	8.261**