Business Cycle Monitoring with PCA-DFM and Economic Structural Change

Makoto Hazama

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Very preliminary draft

Abstract

From a practical aspect, this paper is concerned about the general question of how economic structural changes matter in business cycle monitoring. Recent works provide a theoretical answer within the framework of a principal component estimation of dynamic factor model: the structural changes as parameter shifts in dynamic factor model do not affect the cyclical composite indicator as an estimated common component of a canonical time series. Not only is the effect of instability averaged out in a principal component estimation to some extent, but spurious factors absorb the effect if its magnitude is larger. Because this proposition relies on an asymptotics and some general but unverifiable conditions, this paper sees its validity using Japanese monthly 148 time series variables spanning Apr. 1983 to May. 2017. In addition, recently proposed tests for structural change are applied to this dataset.

1. Introduction

This preliminary draft provides the results of early-stage research on a general question: How do economic structural changes affect business cycles? The two terms "economic structural change" and "business cycle" are highly conceptualistic. As an example of structural change, one might be able to point to changes in industrial structure, technological progress, demographic changes, sift of monetary policy, or even catastrophic events. However, its boundaries are ambiguous. Moreover, for business cycles, while Burns and Mitchell’s (1946) adumbrative quasi-definition outlines the concept of business cycles, there are many ways to measure the amplitude or phase of those phenomenon (United Nations and Eurostat 2017).

To give an exact meaning to the general question, the framework of principal component analysis on dynamic factor models (PCA-DFM) is applicable. On the one hand, DFM is a statistical model, in which many time-series variables are commonly driven by much-less-unobserved factors. This data generating process is compatible to Burns and Mitchell’s (1946) view of business cycles as the co-movements of a wide range of time series variables. Moreover, if one can see the space of the common factors as an appropriately rotated space of macro-shocks, the classical view that macroeconomic fluctuations are generated by successive shocks is captured by DFM in reduced form.

On the other hand, PCA is a general statistical tool to reduce the dimensions of information. DFM, including a large number of time-series variables under realistic assumptions (approximate DFM), are suitably estimated by PCA (Stock and Watson 2002, Forni et al. 2000, 2005). In estimation of DFM by PCA, a large number of time series variables can be included in the model with a lighter computational burden.

In DFM, structural changes are defined as changes on factor loadings. For example, associated with a change in industrial structure, a factor that has been strongly driving the output of some industries may lose its influence on another variables. As mentioned later, although tests for structural change in empirical applications consider discontinuous or lumped changes of parameters rather than gradual changes as the alternative hypothesis, both sudden and gradual changes are considered within PCA-DFM in terms of its implications for business-cycle monitoring.

Business cycles can be measured by a cyclical composite indicator (CCI) in DFM. There are two straightforward ways to construct a business-cycle index in DFM framework: one is interpreting the factor of the single-factor model as the business cycle (Stock and Watson 1989). The other is to use the estimated common component of a canonical variable, which is thought a priori to coincide with the reference cycle (e.g., Altissimo et al. 2001, 2010). If the number of factors in the DFM is exactly one, the former is a special case of the latter. CCI calculated by a simple cross-sectional averaging method (e.g., Conference Board CCI, Cabinet Office CCI) can be seen as a special case of CCI of the single- factor model (see, for example, Stock and Watson 2016, pp.429-430).

Under the framework of PCA-DFM, the question is concretized to: what effects does the instability of factor loading in DFM have on the CCI calculated in the PCA-DFM, ignoring for instability (the effect on now-casting or forecasting is beyond this early stage paper)?

By virtue of the recent research, a theoretical answer is at hand: business-cycle monitoring with CCI, based on components' decomposition within PCA-DFM, is not confounded by structural change. Under thought-to-be mild conditions, if the magnitude of the change is small in a sense, PCA can consistently estimate the DFM (Stock and Watson 2002, Bates et al. 2013); even if the change is not small, common components and idiosyncratic components are identified with PCA (Breitung and Eickmeier 2011, Chen et al. 2014). So, CCI as an estimated common component of a canonical variable is consistent in full-sample estimation.

The intuition behind the tolerance for the small instability in PCA-DFM is that, given limited dependence of factor-loading changes across a series, the changes are mutually offset by the effect of cross-sectional averaging. The explanation of validity of the estimated common component as CCI is as follows: a sifting of factor loadings with sufficiently large magnitude is observationally equivalent to the introduction of additional factors into common components, with factor-loading unchanged. This DFM with the spurious factor has constant factor loadings, and is equivalent to the original DFM with instable factor loadings. The inflated number of factors is consistently estimated by information criterion of Bai and Ng (2002). So, a common component of spurious factor representation is identified by PCA-DFM.

Because the theoretical answer relies on the asymptotics and general but unverifiable conditions, it makes sense to see empirically whether the CCI of PCA-DFM is robust toward potential structural changes. Using Japanese monthly 148 time-series variables spanning Apr. 1983 to May 2017, this paper calculates CCI in DFM, taking into consideration the possibility of structural change (i.e. estimates based on the sub samples before and after every assumed break date), and compares it with CCI ignoring the possibility of structural change (i.e. based on the full sample). In addition, this paper presents some results of empirical application of recently proposed tests for structural change in the DFM.

The rest of this paper is organized as follows. Section 2 explains the analytical tools implemented in this paper. Section 3 describes the dataset. Section 4 shows the results of empirical analyses, and. Section 5 concludes.

2. Analytical Tools

2.1. DFM

Suppose that we observe the data for N time-series variables over a period of Ttime units. Let $i = 1, \cdots, N$ indicate each time series variable, and $t = 1, \cdots, T$ for each time so that X_{it} denotes the value of the variable i at time t. DFM without structural break is written as:

$$X_{it} = \lambda_i' F_t + \varepsilon_{it} \ , \tag{1}$$

where$(r \times 1)$ vector λ_i is factor loadings of variable i, $(r \times 1)$ vector F_t is common factors at time t, and variable ε_{it} is an idiosyncratic component. The term $\lambda_i' F_t$ is called the common component of variable i. All of factor loadings λ_i, common factors F_t, idiosyncratic components ε_{it}, and the number of common factors r are unobservable. The number of factors is far fewer than the number of time-series variables $(r \ll N)$. Although model (1) looks superficially static rather than dynamic because the relationship between the observables and the factors is contemporaneous (i.e., the common components of observables at time t are determined by common factors only at that time), redefinition of common factors $F_t \equiv (f_t', f_{t-1}', \cdots, f_{t-s}')'$ captures the dynamic relationship between the underlying dynamic factors f_t and the observables.

In DFM, each time series X_{it} is transformed appropriately so as to be stationary. In addition, it is usually assumed that the common component and idiosyncratic component are uncorrelated. See assumption (1-II) of Forni et al. (2000). As for exceptional example, moderate dependence between factors and idiosyncratic components is allowed for the purpose of consistent estimation of the number of factors (Bai and Ng 2002), and of consistent estimation of factor space (Stock and Watson 1998, 2000). Both cross-sectional correlation and serial correlation of idiosyncratic components are permissible to some extent.

2.2. Structural Break in DFM

Structural changes are defined as changes on factor loadings in DFM. For a given series i, the structural change with break date T_i^* is expressed as the below equation.

$$X_{it} = \begin{cases} \lambda_i^{(1)\prime} F_t + \varepsilon_{it} & (t = 1, \cdots, T_i^*) \\ \lambda_i^{(2)\prime} F_t + \varepsilon_{it} & (t = T_i^* + 1, \cdots, T) \end{cases} \tag{2}$$

DFM with structural change has another representation in which the factor loadings are stable and the dimensions of factor space are expanded more than the original expression.

$$X_{it} = \lambda_i^{(1)\prime} F_t + \left(\lambda_i^{(2)} - \lambda_i^{(1)}\right)^\prime (1[t > T_i^*] \times F_t) + \varepsilon_{it} = \tilde{\lambda}_i^\prime \tilde{F}_t + \varepsilon_{it}\ , \tag{3}$$

where $\tilde{\lambda}_i \equiv \left(\lambda_i^{(1)\prime}, \lambda_i^{(2)\prime} - \lambda_i^{(1)\prime}\right)^\prime Q^{-1}$ and $\tilde{F}_t \equiv \mathrm{Q}(F_t^\prime, 1[t > T_i^*] \times F_t^\prime)^\prime$ with nonsingular $(2r \times 2r)$ matrix Q appropriately defined.

2.3. CCI in DFM

To construct CCI by PCA-DFM, we exploit quarterly GDP as the reference cycle. Following Stock and Watson (1998), we handle mixed frequency data in PCA-DFM by solving the least square problem:

$$\min_{\Lambda, F} (NT)^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} D_{it} (X_{it} - \lambda_i^\prime F_t)^2 \tag{\_}$$

where D_{it} is 1 if X_{it} is observed and 0 otherwise; $(N \times r)$ matrix $\Lambda \equiv (\lambda_1 \cdots \lambda_N)^\prime$ is factor-loading matrix; $(T \times r)$ matrix $F \equiv (F_1^\prime \cdots F_T^\prime)^\prime$ is a common-factor matrix.

2.4. Estimation of the Number of Factors

For the studies on the selection of the number of factors in large dimensional DFM, we have Bai and Ng (2002, 2007), Amengual and Watson (2007), Hallin and Liska (2006), Onatski (2009, 2010), Ahn and Horenstein (2013), and Caner and Han (2014).

2.5. On Instability of DFM

As for the studies on instability of DFM, we have Stock and Watson (2009, 2012), Breitung and Eickmeier (2011), Yamamoto and Tanaka (2015), Chen, Dolado, and Gonzalo (2014), Han and Inoue (2015), Cheng, Liao, and Schorfheide (2016)

The formal test for instability in PCA-DFM is proposed by Breitung and Eickmeier (2011), Yamamoto and Tanaka (2015), Chen et al. (2014), and Han and Inoue (2015). In addition, Cheng et al. (2016) propose a way to estimate the date and type of structural break in DFM by the method implementing Lasso regression.

BE test:

Tests factor-loading instability for a given series based on the significance of the coefficient of spurious factors.

$$BE_i(\tau_0, r) \equiv \sup_{\tau \in [\tau_0, 1-\tau_0]} S_i(\tau)$$

where$S_i(\tau)$ is the Wald (LR, or LM) test statistics of $H_0: \gamma_j = 0$ in the regression:

$$X_{it} = \lambda_i' \hat{F}_t + \gamma_i' \left(1[t > \lfloor \tau T \rfloor] \times \hat{F}_t\right) + error\ .$$

YT test:

Overestimation of the number of factors tends to reduce the power of BE test.

YT test copes with non-monotonic power problem by maximizing sup-LM with respect to the number of factors in a given range.

$$YT_i(\tau_0, r) \equiv \max_{j \in \{1,\cdots,r\}} \sup_{\tau \in [\tau_0, 1-\tau_0]} S_i(\tau, j)\ ,$$

where $S_i(\tau, j)$ is the Wald (LR, or LM) test statistics of $H_0: \gamma_{ij} = 0$ in the regression:

$$X_{it} = \lambda_{ij} \hat{F}_{jt} + \gamma_{ij} \left(1[t > \lfloor \tau T \rfloor] \hat{F}_{jt}\right) + error\ .$$

The tests of Breitung and Eickmeier (2011) and the refinement thereof, Yamamoto and Tanaka (2015), deal with each factor model equation separately. That is, it is assumed that the errors for the null hypotheses by equation are independent of one another. In contrast, the tests of Chen et al. (2014) and Han and Inoue (2015) deal with all the equations in the factor model as a whole.

CDG test:

Change of factor loading under a normalization restriction in PCA is equivalent to change in second moment structure of common factors under another normalization.

Tests for factor loading instability of every series jointly by tests for instability in regression of one factor on the others.

$$\hat{F}_{1t} = \beta' \hat{F}_{(-1)t} + \delta' \left(1[t > \lfloor \tau T \rfloor] \times \hat{F}_{(-1)t}\right) + error\,.$$

HI test:

Based on instability test of sample covariance matrix of factors. Use more information than CDG test.

The test statistics is:

$$HI(\tau_0) \equiv \sup_{\tau \in [\tau_0, 1-\tau_0]} A(\tau)' \hat{S}(\tau)^{-1} A(\tau)\,,$$

where vector $A(\tau) \equiv \text{vech}\left(\tau^{-1} \sum_{t=1}^{\lfloor \tau T \rfloor} \hat{F}_t \hat{F}_t' + (1-\tau)^{-1} \sum_{t=\lfloor \tau T \rfloor + 1}^{T} \hat{F}_t \hat{F}_t'\right)$, and matrix $\hat{S}(\tau)$ is HAC estimator of $A(\tau)$.

3. Data

To obtain a comprehensive macroeconomic DFM, we use the data set consisting of monthly 148 time series variables, which cover a wide range of economic activities, i.e., production, employment and earnings, commercial sales, household consumption, house construction, inventory, asset prices, interest rates and spreads, money and credit, prices, and others. Almost all of the series are seasonally adjusted. The variables are selected under the basic concept of preference for lower aggregation level and enough time periods, and avoidance of coverage duplication. Table 1 displays the list of 148 variables. The time periods of the sample are effectively from April 1983 to May 2017, which is shortened from original data periods by preliminary transformation of the variables mentioned below.

Because DFM is suitable for the stationary process, the data are converted by logarithmic transform and first- or second-differentiations according to the results of unit root tests. The third column of Table 1 shows the transformation applied to each variable. In the baseline case, outliers are trimmed following the method adopted by the Cabinet Office of Japan within the calculation of the indexes of business conditions (see http://www.esri.cao.go.jp/en/stat/di/di2e.html for detail). In addition, following Stock and Watson (2012), the long-term variable trend is removed from every time series by the filter of bi-weight kernel with bandwidth 100 months for leads and lags respectively. Finally, all series are standardized to have a mean of 0 and variance of 1.

4. Results of Empirical Applications

4.1. Number of Common Factors

Table 2 shows the statistics related to the determination of the number of factors based on principal component estimation with factor loadings normalization restriction for the full sample period. For each number of factors in the first column, the second column displays the fraction of sum of variances of 148 series, driven by common factors up to the number, and the third column shows the marginal contribution of each factor. About 7.7% of total variance is attributable to the first factor, 6.3% to the second, 4.2% to the third, and so on. Four factors contribute about 22% of total variance, and for eight factors the percentage reaches 32%. The fourth to sixth columns show the values of the three types of information criterion of Bai and Ng (2002) respectively. ICp1 and ICp2 indicate that the number of factors is 4, while ICp3 selects a 6-factors model. The right-most column shows the ratio of two adjacent eigenvalues proposed by Ahn and Horenstein (2013), implying that the number of factors is 2.

Table 3 provides the estimated number of dynamic factors given the number of static factors following Amenguel and Watson (2007). If the number of static factors is 4, the suggested number of dynamic factors is 2.

4.2. Commonality of Common Factors

Table 4-a to 4-k display the commonality of common factors up to the ninth for each time series variable by category. As for the industrial production or producer’s shipments by goods classification (Table 4-a), producer goods has high commonality. Up to the fourth factor, more than 60% of variances of those series are attributed to common factors. At the other end, non-durable consumer goods has relatively low commonality in this group. For the operating ratio by industry sector (table 4-a), most of the variables have high commonality (more than 40% of variances are driven by up to the second factor) with petroleum & coal products, electrical machinery, and textiles exceptionally relatively low (does not exceed about 50% for up to the ninth factor). Commonality of unemployment by sex and generation is low, ranging below 2% for the first factor and from 2 to

10% for up to the ninth factor (Table 4-b). Among the category of employment, active job opening-to-applicants ratio has relatively high commonality, and scheduled hours worked too when the fourth factor is included. In the category of household consumption (Table 4-c), parts of variances of consumption expenditure for food and that for clothing & footwear increase from a few percent to about 40% by the fourth factor. Consumption expenditure for fuel, light & water charges, transportation & communication, and miscellaneous show very low commonality. In the category of sales (Table 4-d), department store sales value per unit area or per employee, large-scale retailers sales value, and general merchandise retail sales value display remarkable commonality for four or more factor models. Retail sales value of motor vehicles, of machinery & equipment, wholesale value of general merchandise, and of medicine & toiletries are relatively low. For the category of housing starts and permits (Table 4-e), except for issued houses, the commonality increase more than 20% points at the seventh factor, while reconciled to the commonality of less than 15% with six or fewer factors. For the category of orders and inventory (Table 4-f), series related to machinery orders show low commonality. Inventory ratio for capital goods, for construction goods, and for producer goods are strongly driven by the first three factors (commonalities of more than 50%). For the category of prices and wages (Table 4-g), the first two factors prove futile, while the eighth factor is highly relevant to export and import prices, the ninth factor to series related to wages. For the category of interest rates and spreads (Table 4-h), series- related interest rates on loans & discounts show relatively high commonalities. For the category of money and credit (Table 4-i), the first three or four factors have low relevance. Only average amounts outstanding of M1 attributes its variance of more than 10% to the first four factors. Several items of bank account assign about 20% or more of variance to common components with the factors from the fifth onwards. For the category of asset prices and exchange rates (Table 4-j), stock price indexes by industry classification show high commonality with two or more factors. Series-related exchange rates are highly associated with the eighth factor (more than 30%). For the other series (table 4-k), series related to import and export gradually raise its commonality from about 10% to 40% until eighth factors. Consumer confidence index enlarges its commonality by the second factor. Index of tertiary industry activities for transport & postal activities is mainly driven by the first factor.

The first factor is notably associated with several series of industrial production and shipments, inventory ratios for sum goods classifications (about 40%), active job opening-to-applicants ratio (27.0%); the second factor with stock price indexes (over a rage of 30 to 50%), most series of industrial operating ratio, spread of interest rate on loan (18.5-5.0=13.5%); the fourth factor with scheduled hours worked (34.0-8.8=25.2%), consumption expenditure for food (42.2-1.8=40.4%), clothing & footwear (39.5-5.4=34.1%), series related to department stores or large-scale retailers sales value (more than 50%).

4.3. Tolerance of CCI for Structural Change

Fig.1 shows the correlation between sub-sample CCIs and full-sample CCI. For each assumed break date, the sample is divided into before-and-after subsamples, and CCIs are calculated based on these two subsamples. The gray solid line plots correlation between CCI based on the before-subsample and CCI based on the full-sample. The black dashed line plots correlation between CCI based on the after-subsample and CCI based on the full-sample. In fig.1, CCI is the estimated common component of de-trended GDP growth in DFM of monthly 148 series and quarterly GDP. The handling of mixed frequencies data of Stock and Watson (1998) is exploited.

The correlation between before-subsample-CCI and full-sample-CCI is persistently high. The correlation between after-subsample-CCI and full-sample-CCI is high but drops remarkably at the assumed break points of Feb. 2009 and March 2011.

To calculate the CCI with subsamples in fig. 1, the number of factors is repeatedly estimated for every subsample. Fig. 2 shows the estimated number of factors for each of subsamples. Horizontal axis is assumed break date. The gray solid line plots the estimated number of factors based on the before-subsample. The black dashed line plots the estimated number of factors based on the after-subsample. The black solid line plots the total of the estimated numbers of factors based on before- and after-subsamples. The estimation of the number of factors is in terms of Bai and Ng's (2002) ICp2. In light of Cheng et al.'s (2016) argument that the sum of estimated numbers of factors for before- and after-subsample is minimized by the true break date split, the black solid line in fig. 2 incidentally implies that the date Feb. 2009 and March 2011 are the potential candidates of break date.

To take a close look at the temporary decline of correlation between after-subsample CCI and full-sample CCI, fig. 3 shows the first four relative eigenvalues in principal component analysis for each sample split.

4.4. Tests for Structural Change

Fig. 4 plots the fraction of 148 series for which the null hypothesis of no structural break at date of horizontal axis is rejected at 0.05 significance level based on the LM test of Breitung and Eickmeier (2011). The black solid line corresponds to the setting of variable variance and outlier adjusted; the gray solid line to constant variance and outlier adjusted; the black dashed line to variable variance and outlier not adjusted. 30 to 40% of series have had structural change during the late 1990s and the early 2000s.

In contrast to fig. 4, which tests for assumed known break date, fig. 5 plots the rejected rate of 148 series for unknown break date both by tests of Breitung and Eickmeier (2011) and Yamamoto and Tanaka (2015). Two tests differ when heteroscedasticity and autocorrelation consistent (HAC) estimator of variance is used. Outside of the HAC version test, the results of YT sup-Wald test are broadly similar to those of the BE sup-Wald test. In that regard, the non-monotonic power problem is not severe for our sample.

Fig. 6 plots the sup-LM test statistics of Chen et al. (2014) for the number of factors 2 to 9. Two horizontal dashed lines in every panel are the critical values of 0.10 (lower line) and 0.05 (upper line) significance levels. Because the implementation of Chen et al.'s (2014) test is not unique according to which one of factors to be regress and/or regressors, fig. 6 shows the two of them: the regression of the first factor on the rest (left rows) and the last factor on the others (right rows). If the number of factors is five, the null hypothesis of stable factor loading is rejected at 5% level, and the peak of the sup-LM test statistic is at around 1995.

Fig. 7 plots the test statistics of Han and Inoue (2015). As in fig. 6, two horizontal dashed lines indicate the critical values of 0.10 (lower line) and 0.05 (upper line) significance levels. If the number of factors is five, the null of stability is rejected at the 5% level, and the peak of sup-LM test statistic is at around 1993.

5. Concluding Remarks

We study the robustness of CCI to changes in factor loadings in DFM and conduct empirical applications of recently proposed tests for instability in large dimensional DFM. The correlation between CCI calculated based on split subsample and CCI based on full sample is persistently high except the temporary declines at Feb. 2009 and March 2011 for after-subsample CCI.

While the structural break is detected, cursory application of tests for structural change in DFM for Japanese 148 monthly variables from April 1984 to May 2017 provides no clear-cut results about break date. Quick application of the sophisticated methods demonstrate the necessity for more advanced empirical analyses.

Meanwhile, in this study, structural change is defined as a onetime change in factor loading; the tests conducted have power against two or more changes. Though the change is sudden, CCI is also theoretically robust to gradual change in some extent. In spite of the preliminarily conversion of the data series to de-mean or de-trend the variables, the driver of long-term swing in the data may also confound short- and medium-term modeling in the DFM (Stock and Watson 2016, p.514).

Finally, diagnostics show low commonality of common factors. Poor fitness of dynamic factor models to the Japanese economy will discourage the introduction of factor-model-based economic monitoring.

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Figures and Tables

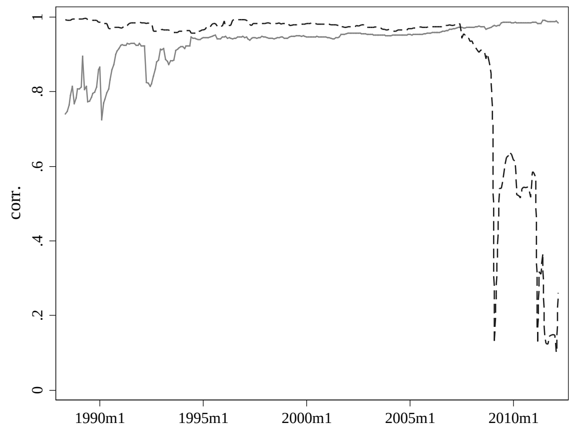


Fig. 1 Correlation Between Sub-sample CCIs and Full-sample CCI.

Notes. Horizontal axis is assumed break date. Gray solid line plots correlation between CCI based on the before-subsample and CCI based on the full-sample. Black dashed line plots correlation between CCI based on the after-subsample and CCI based on the full-sample. CCI is the estimated common component of de-trended GDP growth.

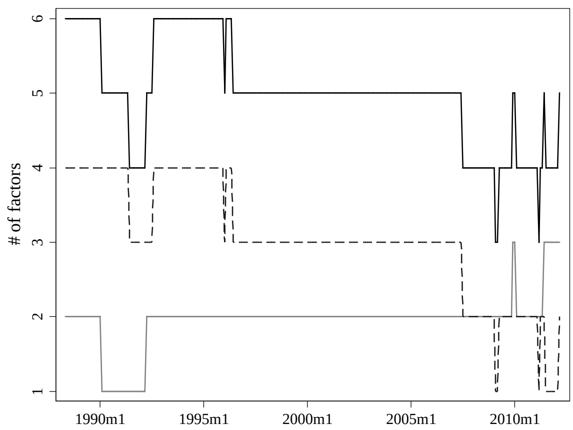


Fig. 2 Estimated Number of Factors for Sub-samples.

Notes. Horizontal axis is assumed break date. Gray solid line plots the estimated number of factors based on the before-subsample. Black dashed line plots the estimated number of factors based on the after-subsample. Black solid line plots the total of the estimated numbers of factors based on before- and after-subsamples. The estimation of the number of factors is in terms of Bai and Ng's (2002) ICp2.

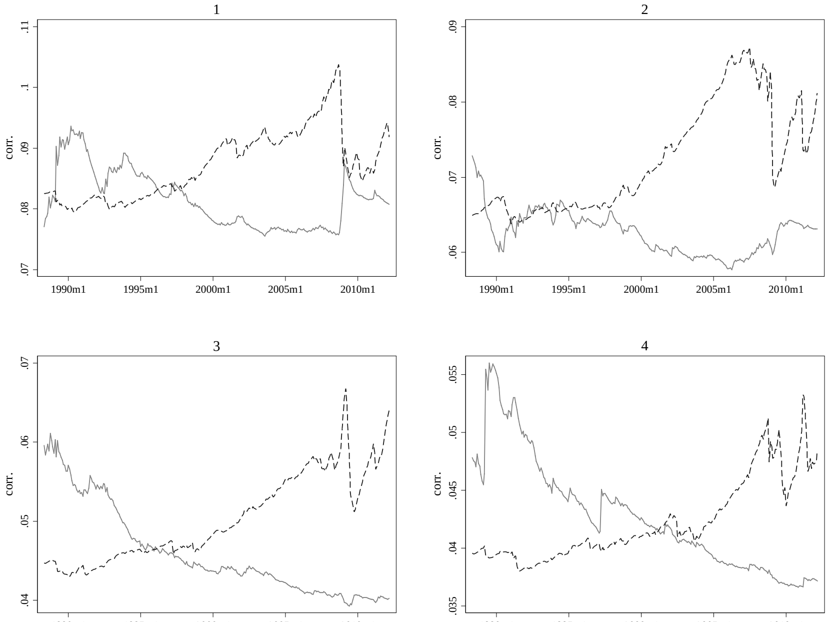
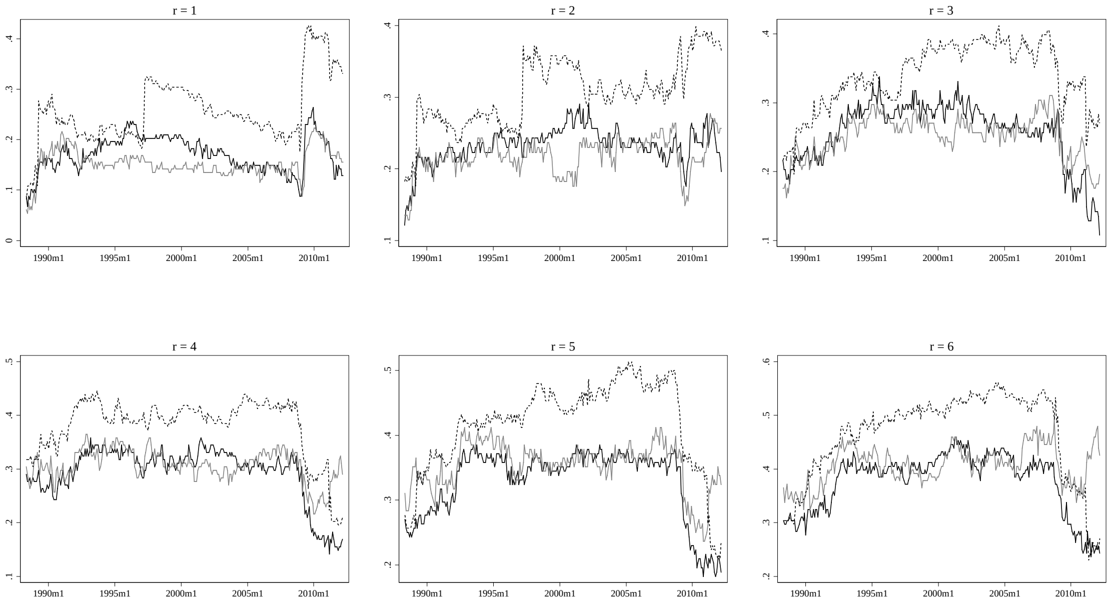


Fig. 3 Trace R2 of factors for before- and after-subsamples (the title of y-axis "corr." is incorrect!)

Notes: Horizontal axis is assumed break date. Gray solid line plots the relative eigenvalue associated with each factor based on the before-subsample. Black dashed line corresponds to the after-subsample.



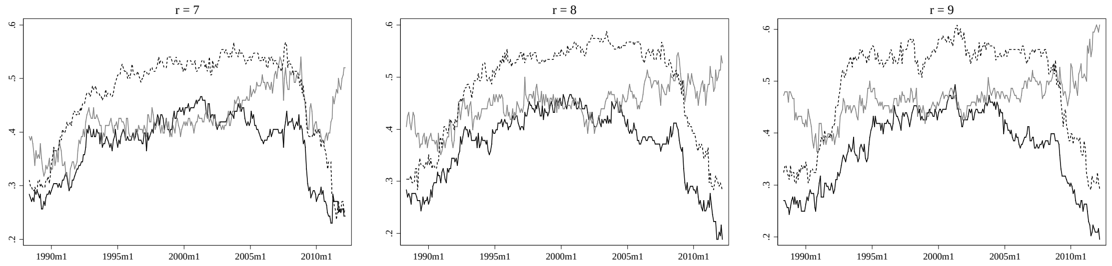


Fig. 4 Fraction of Rejected Series in Japanese 148 Variables DFM by BE LM Test

Notes. Black solid line: variable variance and outlier adjusted. Gray solid line: constant variance and outlier adjusted. Black dashed line: variable variance and outlier not adjusted. The significance level is 0.05.

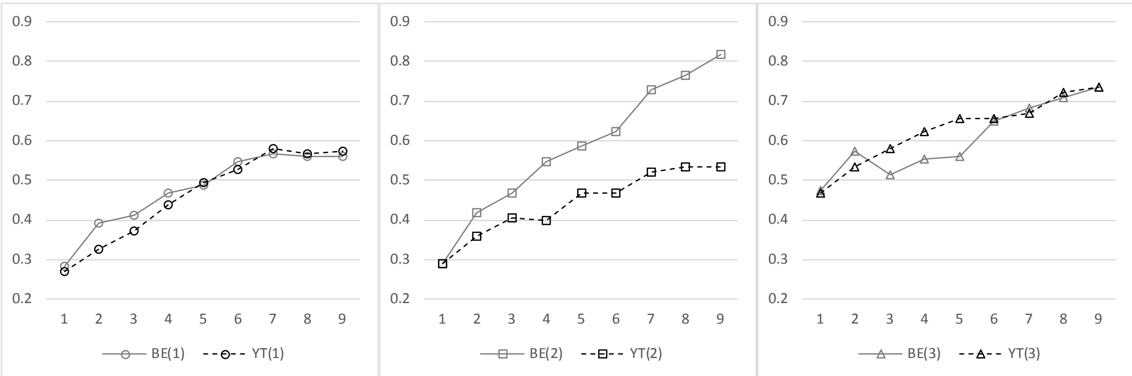
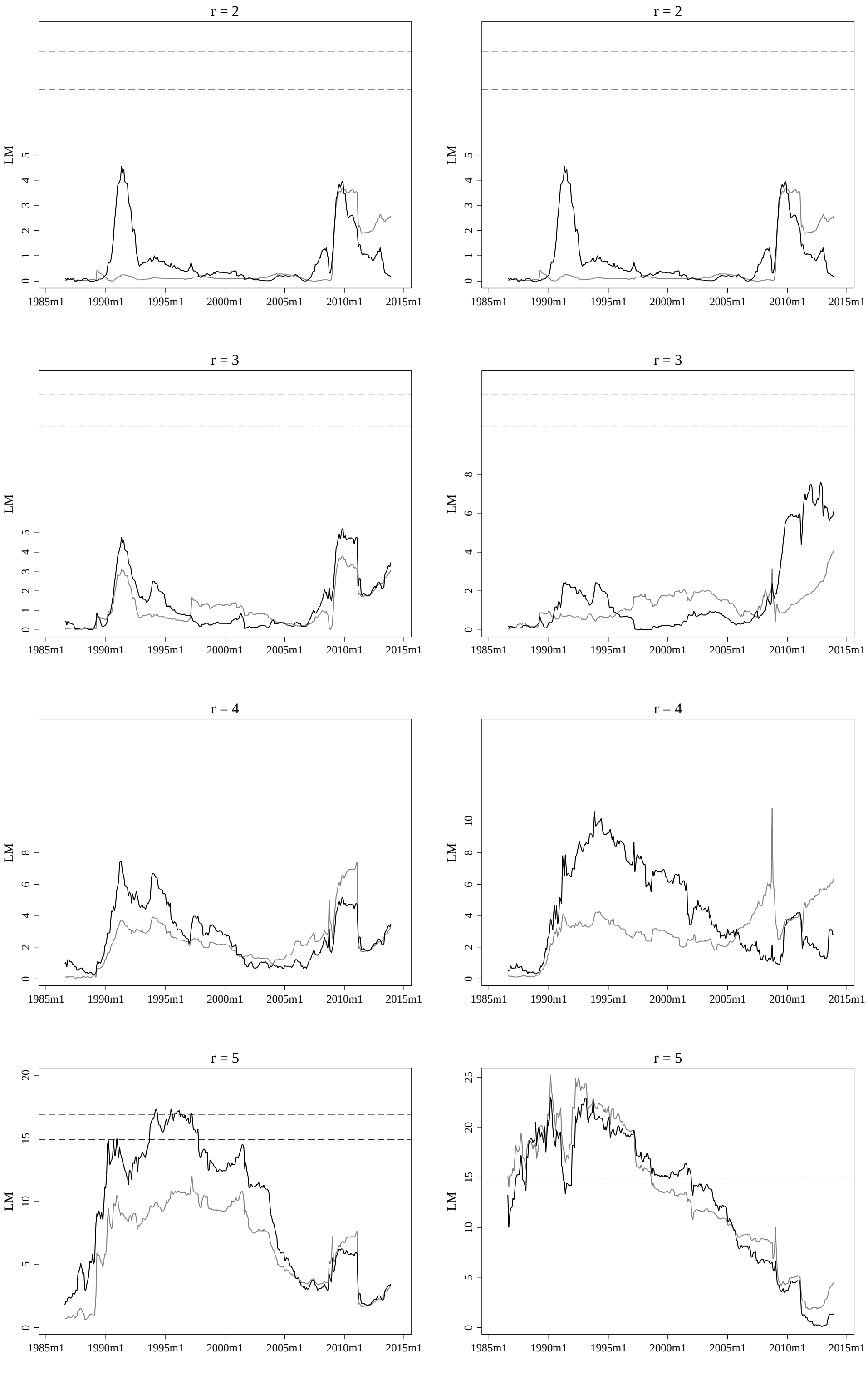


Fig. 5 Fraction of Rejected Series in 148 Series DFM by BE and YT sup-Wald Test

Notes. X-axis: number of factors. Y-axis: fraction of rejected series for each tests. BE(1): BE Wald test with outlier adjusted. BE(2): BE Wald test with HAC estimation of variance and outlier adjusted. BE(3): BE Wald test with HAC estimation of variance and outlier not adjusted.YT(1): YT Wald test with outlier adjusted. YT(2): YT Wald test with HAC estimation of variance and outlier adjusted. YT(3): YT Wald test with HAC estimation of variance and outlier not adjusted.


r = 2
r = 2
r = 3
r = 3
r = 4
r = 4
r = 5
r = 5
LM
1985m1
1990m1
1995m1
2000m1
2005m1
2010m1
2015m1

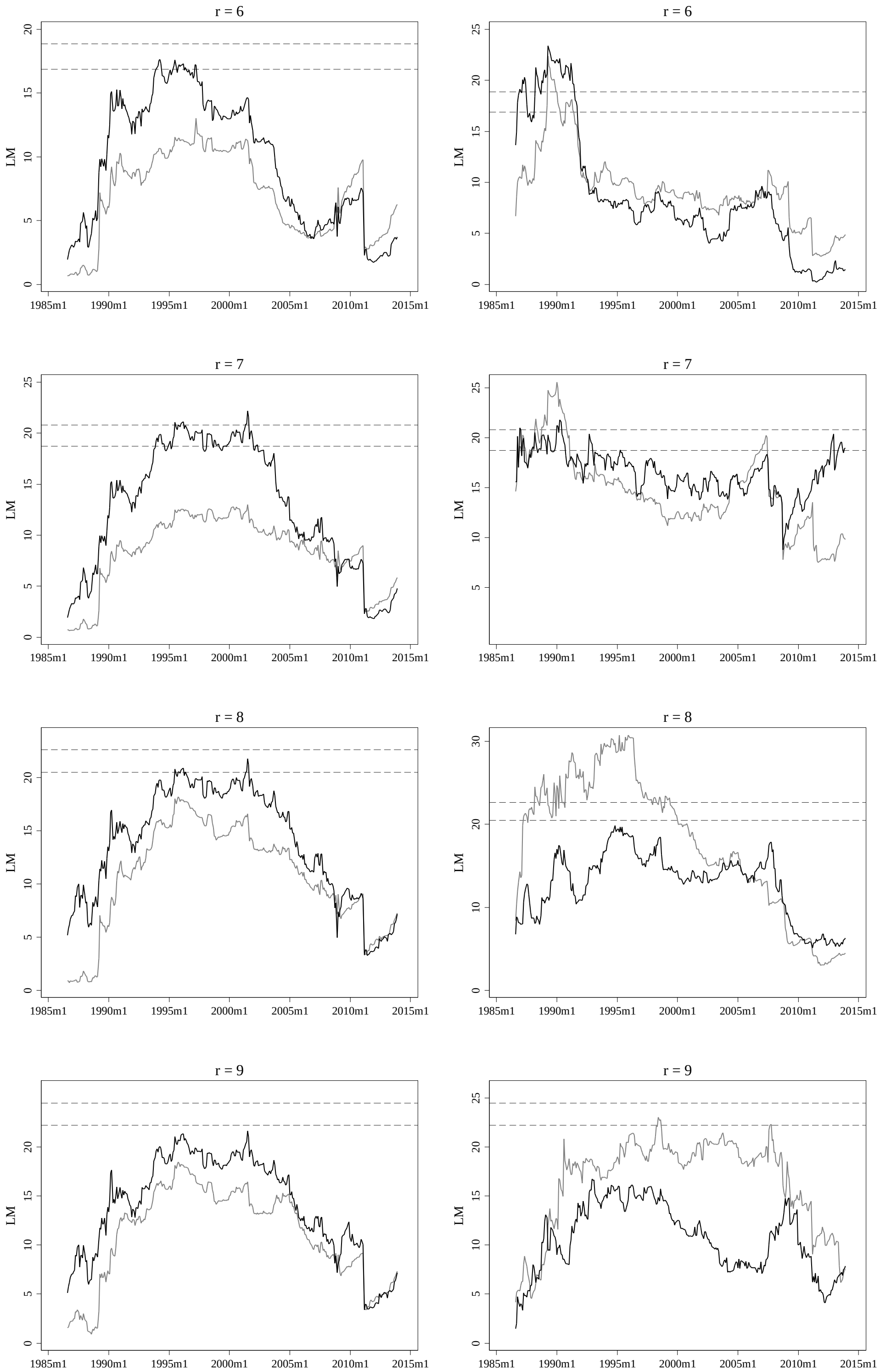


Fig. 6 Sup-LM Test of CDG2014 for Japanese 148 Variables DFM

Notes. Left panels: regressions of the first factor on the others. Right panels: regressions of the last factor on the others. Two horizontal dashed lines indicate critical values for significance level of 0.05 (upper) and 0.10 (lower).

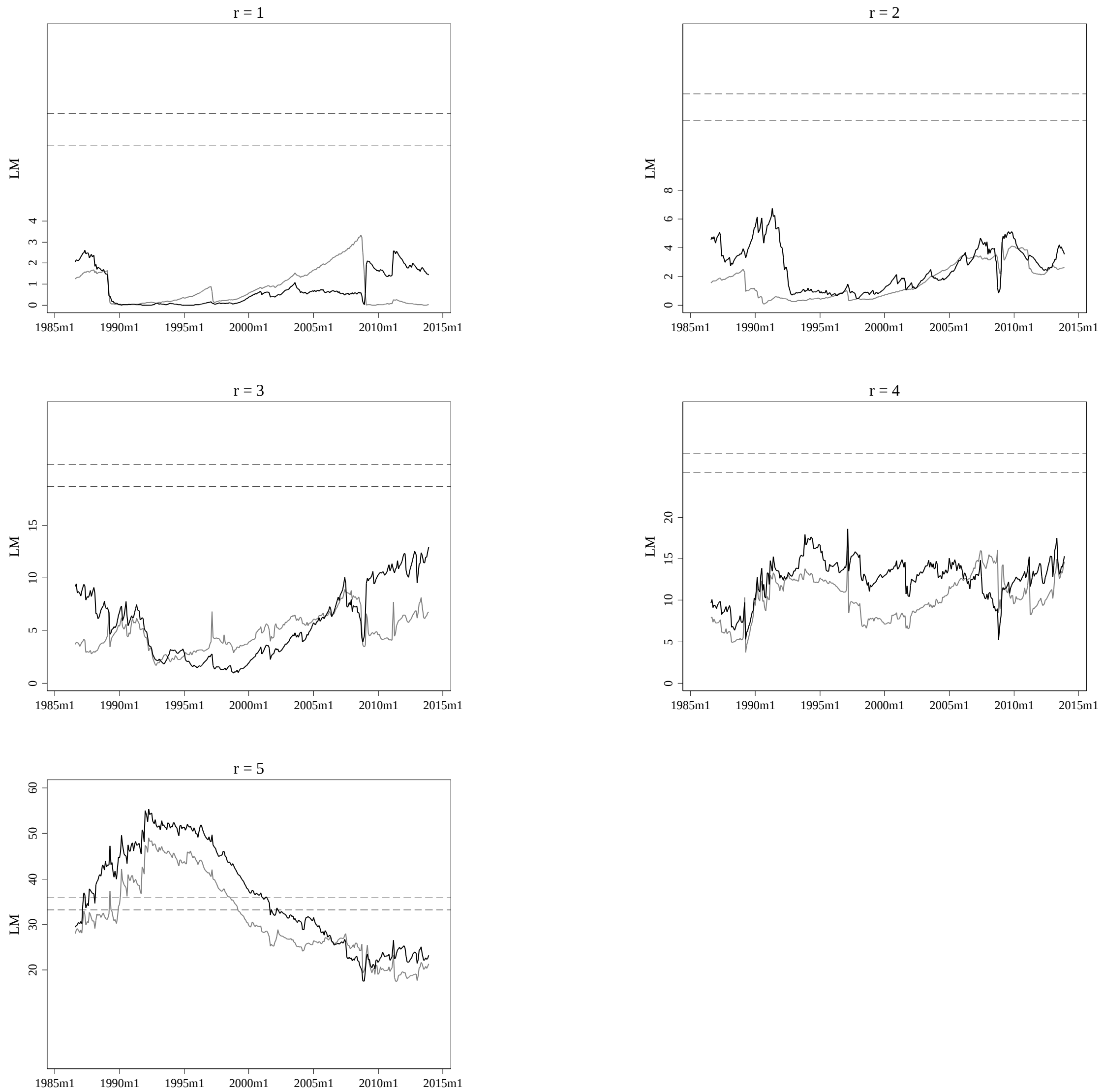


Fig.7 Sup-LM Test of HI2015 for Japanese 148 Variables DFM

Notes. Black line: outlier adjusted. Gray line: outlier unadjusted. Two horizontal dashed lines indicate critical values for significance level of 0.05 (upper) and 0.10 (lower).

Table 1

i	Series	T
1	Index of production, Capital goods	5
2	Construction goods	5
3	Durable consumer goods	5
4	Non-durable consumer goods	5
5	Producer goods	5
6	Index of producer's shipments, Capital goods	5
7	Construction goods	5
8	Durable consumer goods	5
9	Non-durable consumer goods	5
10	Producer goods	5
11	Index of operating ratio, Iron & steel	1
12	Non-ferrous metals	1
13	Fabricated metals	1
14	Transport equipment	1
15	Ceramics, stone & clay products	1
16	Chemicals	1
17	Petroleum & coal products	1
18	Pulp, paper & paper products	1
19	Textiles	1
20	Electrical machinery	1
21	Disposable income (worker's households)	5
22	Regular employment index, industries covered (30 more persons)	5
23	Non-scheduled hours worked index, industries covered (30 more persons)	5
24	Scheduled hours worked index, industries covered (30 more persons)	5
25	Unemployment rate, Male, 15-24 years old	2
26	25-34 years old	2
27	35-44 years old	2
28	45-54 years old	2
29	55-64 years old	2

Notes. The 3rd column indicates the way of transformation of series. 1=level, 2=first difference, 3=log, 4=second differences, 5=first difference of log, 6=second differences of log.

Table 1 (continued)

i	Series	T
30	Unemployment rate, Female, 15-24 years old	2
31	25-34 years old	2
32	35-44 years old	2
33	45-54 years old	2
34	55-64 years old	2
35	Active job opening-to-applicants ratio	2
36	New applications, Part timers	5
37	Excluding part timers	5
38	Department stores sales value per unit area	5
39	Department store sales value per employee	5
40	Large-scale retailers sales value	5
41	Retail sales value, General merchandise	5
42	Fabrics, apparel & accessories	5
43	Food & beverages	5
44	Motor vehicles	5
45	Machinery & equipment	5
46	Wholesale sales value, General merchandise	5
47	Textiles	5
48	Apparel & accessories	5
49	Livestock & aquatic products	5
50	Food & beverages	5
51	Building materials	5
52	Chemicals	5
53	Minerals & metals	5
54	Machinery & equipment	5
55	Medicine & toiletries	5
56	Total floor area of new dwelling units, Owned houses	5
57	Rented houses	5
58	Issued houses	5
59	Ready built houses	5

Notes. The 3-rd column indicates the way of transformation of series. 1=level, 2=first difference, 3=log, 4=second differences, 5=first difference of log, 6=second differences of log.

Table 1. (continued)

i	Series	T
60	New dwelling unit, Owned houses	5
61	Rented houses	5
62	Issued houses	5
63	Ready built houses	5
64	Index of producer's inventory ratio, Capital goods	1
65	Construction goods	1
66	Durable consumer goods	1
67	Non-durable consumer goods	1
68	Producer goods	1
69	Machinery orders, Non-manufacturing (excluding volatile orders)	5
70	Manufacturing	5
71	TSE stock price index, 1-st section, Construction	5
72	Chemicals	5
73	Machinery	5
74	Electric appliances	5
75	Transportation equipment	5
76	Information & communication	5
77	Wholesale trade	5
78	Retail trade	5
79	Banks	5
80	Services	5
81	Producer price index, Scrap & waste	5
82	Nikkei index of commodity prices (42 items, monthly)	5
83	Exchange rates, yen per US$ (spot, middle, monthly average)	5
84	Effective exchange rate (real)	5
85	Basic loan rate (official discount rate)	2
86	Prime interest rate (long term credit banks, end of month)	2
87	Yields to subscribers, Government bond, Interest bearing (10 years)	2
88	Average interest rates on loans & discounts, Domestic banks	2
89	Ave. int. rates on loan & dis., Domestic banks, Short term loan	2
90	Ave. int. rates on certificates of deposit, Domestically banks	2

Notes. The 3rd column indicates the way of transformation of series. 1=level, 2=first difference, 3=log, 4=second differences, 5=first difference of log, 6=second differences of log.

Table 1 (continued)

i	Series	T
91	Prime interest rate - Basic loan rate Spread	1
92	Yields to subscribers (government bond) - Basic loan rate spread	1
93	Average interest rate on loan - Basic loan rate spread	1
94	Money stock, Average amounts outstanding, M1	5
95	M2	5
96	Money stock, Amounts outstanding at end of the period, M1	5
97	Monetary base, Average amounts outstanding	5
98	Bank account of city banks, Asset, Cash	5
99	Deposits	5
100	Call loans	5
101	Securities	5
102	Bank account of city banks, Liabilities, Deposits	5
103	Call money	5
104	Certificates of deposit	5
105	Bank account of regional banks, Asset, Cash	5
106	Deposits	5
107	Securities	5
108	Bank account of regional banks, Liabilities, Deposits	5
109	Call money	5
110	Certificates of deposit	5
111	Producer price index, Manufacturing industry products	6
112	Agriculture, forestry & fishery products	6
113	Minerals	6
114	Electric power, gas & water	6
115	Consumer price index, Food	6
116	Housing	6
117	Fuel, light water charges	6
118	Furniture & household utensils	6

Notes. The 3rd column indicates the way of transformation of series. 1=level, 2=first difference, 3=log, 4=second differences, 5=first difference of log, 6=second differences of log.

Table 1 (continued)

i	Series	T
119	Consumer price index, Clothes & footwear	6
120	Transportation & communication	6
121	Culture & recreation	6
122	Miscellaneous	6
123	Export price index (yen basis), All commodities	6
124	Import price index (yen basis), All commodities	6
125	Wage index, total cash earnings, industries covered (30 or more persons)	5
126	Real wage index, total cash earnings, industries covered (30 or more persons)	5
127	MOF quantum index, Exports, total	5
128	Import, total	5
129	Customs clearance, value of exports, grand total (yen)	5
130	Bank clearing, all clearing houses (number)	5
131	(value)	5
132	Consumer confidence index (all households)	2
133	Monthly survey of small business, Sales D.I.	2
134	Sales forecast D.I.	2
135	Profits D.I.	2
136	Index of consumption expenditure level, Food	5
137	Housing	5
138	Fuel, light & water charges	5
139	Furniture & household utensils	5
140	Clothing & footwear	5
141	Medical care	5
142	Transportation & communication	5
143	Education	5
144	Culture & recreation	5
145	Miscellaneous	5
146	Index of tertiary industry activities, Business related services	5
147	Transport & postal activities	5
148	Corporation tax revenue (including tax refunds)	5

Notes. The 3rd column indicates the way of transformation of series. 1=level, 2=first difference, 3=log, 4=second differences, 5=first difference of log, 6=second differences of log.

Table 2 Statistics for Estimating the Number of Static Factors

# of static factors	trace R2	marginal trace R2	ICp1	ICp2	ICp3	AH
1	0.077	0.077	-0.04	-0.037	-0.049	1.239
2	0.140	0.063	-0.067	-0.061	-0.086	**1.502**
3	0.182	0.042	-0.073	-0.065	-0.102	1.078
4	0.220	0.039	**-0.079**	**-0.067**	-0.116	1.288
5	0.250	0.030	-0.075	-0.061	-0.122	1.138
6	0.277	0.026	-0.067	-0.05	**-0.124**	1.109
7	0.300	0.024	-0.058	-0.038	-0.123	1.190
8	0.320	0.020	-0.043	-0.021	-0.118	1.044
9	0.339	0.019	-0.029	-0.003	-0.113	1.089

Notes: trace R2 is the accumulation of relative eigenvalues for each number of factors. Marginal trace R2 is the relative eigenvalue for each principal component. ICp1, ICp2, and ICp3 are three mutually alternative information criteria of Bai and Ng (2002). AH is the consecutive eigenvalue ratio of Ahn and Horenstein (2013).

Table 3. Amenguel-Watson estimate of number of dynamic factors: BN-ICp2 values

# of dynamic factors	# of static factors								
	1	2	3	4	5	6	7	8	9
1	-0.095	-0.069	-0.07	-0.1	-0.001	0.019	0.088	0.108	0.064
2		**-0.077**	**-0.099**	**-0.145**	-0.066	-0.048	0.01	0.028	0.003
3			-0.092	-0.132	-0.115	-0.09	-0.026	-0.051	-0.049
4				-0.117	**-0.117**	**-0.111**	-0.061	-0.08	-0.094
5					-0.099	-0.11	-0.084	**-0.092**	**-0.107**
6						-0.091	**-0.087**	-0.089	-0.096
7							-0.068	-0.071	-0.08
8								-0.049	-0.058
9									-0.036

Notes: Following Amenguel and Watson (2007), each cell reports the value of BN-ICp2 for each number of dynamic factors in the first row given the number of static factors in the first column. The number of lags in VAR for static factors is set to 2.

Table 4-a Commonality for Industrial Production Category

		Factor								
i	Series	1	2	3	4	5	6	7	8	9
1	Index of production, Capital goods	0.261	0.278	0.364	0.390	0.390	0.417	0.419	0.424	0.468
2	Construction goods	0.189	0.193	0.293	0.322	0.323	0.332	0.334	0.335	0.336
3	Durable consumer goods	0.273	0.305	0.450	0.512	0.512	0.512	0.518	0.549	0.647
4	Non-durable consumer goods	0.135	0.149	0.238	0.264	0.267	0.276	0.312	0.385	0.386
5	Producer goods	0.312	0.404	0.513	0.612	0.636	0.662	0.670	0.685	0.731
6	Index of producer's shipments, Capital goods	0.218	0.232	0.287	0.316	0.319	0.350	0.351	0.352	0.354
7	Construction goods	0.243	0.250	0.405	0.408	0.410	0.410	0.410	0.413	0.417
8	Durable consumer goods	0.210	0.235	0.342	0.392	0.392	0.396	0.397	0.413	0.534
9	Non-durable consumer goods	0.148	0.165	0.293	0.293	0.307	0.318	0.353	0.447	0.451
10	Producer goods	0.352	0.457	0.611	0.683	0.697	0.711	0.719	0.746	0.776
11	Index of operating ratio, Iron & steel	0.263	0.625	0.746	0.749	0.767	0.771	0.771	0.771	0.773
12	Non-ferrous metals	0.365	0.705	0.808	0.808	0.822	0.825	0.825	0.826	0.827
13	Fabricated metals	0.099	0.426	0.478	0.482	0.518	0.546	0.547	0.554	0.560
14	Transport equipment	0.249	0.508	0.557	0.559	0.594	0.614	0.617	0.621	0.634
15	Ceramics, stone & clay products	0.262	0.613	0.741	0.743	0.766	0.768	0.770	0.770	0.770
16	Chemicals	0.381	0.605	0.703	0.703	0.703	0.703	0.703	0.708	0.708
17	Petroleum & coal products	0.024	0.155	0.182	0.184	0.213	0.223	0.223	0.237	0.239
18	Pulp, paper & paper products	0.356	0.640	0.755	0.763	0.765	0.765	0.765	0.776	0.778
19	Textiles	0.141	0.389	0.450	0.451	0.479	0.499	0.500	0.503	0.503
20	Electrical machinery	0.211	0.341	0.373	0.375	0.383	0.383	0.386	0.386	0.392

Note: The value of R2 of the regression of each variable on common factors up to the number in column head.

Table 4-b Commonality for Employment and Unemployment Category

		Factor								
i	Series	1	2	3	4	5	6	7	8	9
22	Regular employment index, industries covered (30 or more persons)	0.050	0.188	0.209	0.210	0.215	0.238	0.246	0.256	0.259
23	Non-scheduled hours worked index, industries covered (30 or more persons)	0.133	0.163	0.167	0.195	0.239	0.321	0.323	0.344	0.346
24	Scheduled hours worked index, industries covered (30 or more persons)	0.059	0.067	0.088	0.340	0.349	0.443	0.449	0.452	0.505
25	Unemployment rate, Male, 15-24 years old	0.009	0.010	0.014	0.027	0.029	0.032	0.033	0.037	0.038
26	25-34 years old	0.013	0.019	0.020	0.020	0.023	0.023	0.024	0.026	0.026
27	35-44 years old	0.008	0.008	0.012	0.014	0.014	0.017	0.018	0.035	0.039
28	45-54 years old	0.003	0.014	0.014	0.024	0.026	0.031	0.035	0.038	0.065
29	55-64 years old	0.006	0.019	0.019	0.042	0.043	0.044	0.045	0.048	0.059
30	Unemployment rate, Female, 15-24 years old	0.001	0.001	0.004	0.009	0.009	0.009	0.022	0.041	0.046
31	25-34 years old	0.005	0.008	0.010	0.011	0.013	0.017	0.021	0.022	0.025
32	35-44 years old	0.015	0.017	0.019	0.020	0.020	0.021	0.039	0.040	0.040
33	45-54 years old	0.000	0.001	0.005	0.007	0.008	0.018	0.032	0.032	0.032
34	55-64 years old	0.002	0.009	0.009	0.011	0.011	0.031	0.050	0.055	0.102
35	Active job opening-to-applicants ratio	0.270	0.271	0.288	0.288	0.337	0.439	0.442	0.523	0.535
36	New applications, Part timers	0.037	0.071	0.074	0.090	0.114	0.131	0.143	0.155	0.164
37	Excluding part timers	0.091	0.120	0.122	0.134	0.146	0.177	0.198	0.209	0.217

Note: The value of R2 of the regression of each variable on common factors up to the number in column head.

Table 4-c　Commonality for Household Consumption Category

		Factor								
i	Series	1	2	3	4	5	6	7	8	9
136	Index of consumption expenditure level, Food	0.003	0.003	0.018	0.422	0.423	0.485	0.486	0.498	0.499
137	Housing	0.010	0.020	0.021	0.029	0.032	0.074	0.087	0.091	0.173
138	Fuel, light & water charges	0.001	0.012	0.013	0.016	0.018	0.025	0.029	0.034	0.102
139	Furniture & household utensils	0.014	0.014	0.039	0.209	0.209	0.211	0.215	0.221	0.231
140	Clothing & footwear	0.010	0.010	0.054	0.395	0.396	0.427	0.449	0.449	0.451
141	Medical care	0.033	0.040	0.063	0.069	0.069	0.088	0.109	0.142	0.144
142	Transportation & communication	0.001	0.002	0.002	0.003	0.007	0.011	0.019	0.025	0.027
143	Education	0.004	0.010	0.011	0.082	0.082	0.116	0.140	0.140	0.144
144	Culture & recreation	0.007	0.009	0.028	0.128	0.130	0.131	0.142	0.151	0.159
145	Miscellaneous	0.001	0.001	0.004	0.007	0.007	0.012	0.013	0.013	0.033

Note: The value of R2 of the regression of each variable on common factors up to the number in column head.

Table 4-d Commonality for Sales Category

		Factor								
i	Series	1	2	3	4	5	6	7	8	9
38	Department stores sales value per unit area	0.062	0.062	0.101	0.649	0.649	0.662	0.676	0.678	0.691
39	Department store sales value per employee	0.087	0.096	0.155	0.567	0.569	0.570	0.594	0.596	0.601
40	Large-scale retailers sales value	0.042	0.042	0.109	0.705	0.723	0.756	0.770	0.773	0.779
41	Retail sales value, General merchandise	0.127	0.129	0.223	0.647	0.673	0.673	0.690	0.696	0.697
42	Fabrics, apparel & accessories	0.087	0.087	0.241	0.405	0.426	0.431	0.432	0.433	0.433
43	Food & beverages	0.063	0.066	0.081	0.153	0.171	0.201	0.201	0.206	0.207
44	Motor vehicles	0.036	0.045	0.094	0.094	0.098	0.098	0.100	0.112	0.112
45	Machinery & equipment	0.027	0.030	0.048	0.127	0.135	0.140	0.141	0.150	0.174
46	Wholesale sales value, General merchandise	0.074	0.074	0.086	0.090	0.090	0.091	0.117	0.129	0.129
47	Textiles	0.138	0.145	0.190	0.197	0.202	0.226	0.226	0.226	0.271
48	Apparel & accessories	0.084	0.086	0.149	0.227	0.250	0.299	0.299	0.315	0.341
49	Livestock & aquatic products	0.064	0.074	0.109	0.112	0.128	0.156	0.190	0.206	0.207
50	Food & beverages	0.083	0.095	0.130	0.186	0.209	0.243	0.249	0.251	0.332
51	Building materials	0.139	0.140	0.185	0.190	0.190	0.227	0.243	0.249	0.339
52	Chemicals	0.278	0.291	0.369	0.369	0.374	0.398	0.400	0.403	0.417
53	Minerals & metals	0.265	0.268	0.292	0.292	0.295	0.296	0.303	0.304	0.312
54	Machinery & equipment	0.202	0.202	0.257	0.258	0.261	0.278	0.278	0.285	0.291
55	Medicine & toiletries	0.068	0.076	0.111	0.116	0.126	0.169	0.178	0.180	0.220

Note: The value of R2 of the regression of each variable on common factors up to the number in column head.

Table 4-e Commonality for Housing Starts and Permits Category

		Factor								
i	Series	1	2	3	4	5	6	7	8	9
56	Total floor area of new dwelling units, Owned houses	0.004	0.034	0.039	0.052	0.053	0.107	0.285	0.326	0.327
57	Rented houses	0.014	0.021	0.025	0.049	0.049	0.104	0.335	0.379	0.392
58	Issued houses	0.000	0.000	0.006	0.028	0.035	0.035	0.046	0.057	0.185
59	Ready built houses	0.012	0.016	0.018	0.024	0.025	0.032	0.319	0.327	0.332
60	New dwelling unit, Owned houses	0.004	0.033	0.039	0.051	0.051	0.109	0.289	0.330	0.331
61	Rented houses	0.021	0.032	0.036	0.062	0.062	0.133	0.360	0.395	0.411
62	Issued houses	0.001	0.003	0.008	0.018	0.038	0.039	0.040	0.056	0.174
63	Ready built houses	0.017	0.023	0.025	0.031	0.032	0.042	0.325	0.331	0.335

Note: The value of R2 of the regression of each variable on common factors up to the number in column head.

Table 4-f Commonality for Orders and Inventory Category

		Factor								
i	Series	1	2	3	4	5	6	7	8	9
64	Index of producer's inventory ratio, Capital goods	0.379	0.528	0.630	0.632	0.632	0.640	0.642	0.667	0.672
65	Construction goods	0.424	0.494	0.532	0.537	0.537	0.548	0.549	0.562	0.599
66	Durable consumer goods	0.150	0.159	0.159	0.168	0.190	0.222	0.224	0.239	0.241
67	Non-durable consumer goods	0.094	0.137	0.145	0.145	0.153	0.203	0.203	0.209	0.218
68	Producer goods	0.437	0.554	0.609	0.621	0.622	0.632	0.635	0.647	0.657
69	Machinery orders, Non-manufacturing (excluding volatile orders)	0.011	0.011	0.022	0.022	0.030	0.031	0.043	0.043	0.057
70	Manufacturing	0.037	0.042	0.043	0.058	0.068	0.070	0.071	0.078	0.093

Note: The value of R2 of the regression of each variable on common factors up to the number in column head.

Table 4-g Commonality for Prices and Wages Category

		Factor								
i	Series	1	2	3	4	5	6	7	8	9
111	Producer price index, Manufacturing industry products	0.002	0.015	0.109	0.119	0.146	0.151	0.226	0.228	0.230
112	Agriculture, forestry & fishery products	0.010	0.014	0.016	0.016	0.018	0.039	0.064	0.064	0.065
113	Minerals	0.000	0.004	0.017	0.031	0.031	0.034	0.043	0.050	0.070
114	Electric power, gas & water	0.000	0.001	0.001	0.001	0.001	0.002	0.008	0.020	0.023
115	Consumer price index, Food	0.002	0.002	0.007	0.011	0.015	0.015	0.062	0.070	0.116
116	Housing	0.001	0.001	0.005	0.017	0.038	0.041	0.041	0.054	0.075
117	Fuel, light water charges	0.001	0.007	0.017	0.023	0.023	0.023	0.031	0.048	0.048
118	Furniture & household utensils	0.001	0.001	0.001	0.016	0.016	0.021	0.028	0.031	0.054
119	Consumer price index, Clothes & footwear	0.001	0.001	0.009	0.035	0.045	0.047	0.052	0.094	0.107
120	Transportation & communication	0.000	0.002	0.018	0.044	0.050	0.052	0.060	0.060	0.061
121	Culture & recreation	0.000	0.001	0.015	0.017	0.018	0.033	0.089	0.103	0.161
122	Miscellaneous	0.000	0.002	0.003	0.011	0.013	0.015	0.015	0.016	0.016
123	Export price index (yen basis), All commodities	0.003	0.014	0.077	0.093	0.100	0.125	0.255	0.585	0.588
124	Import price index (yen basis), All commodities	0.005	0.016	0.068	0.069	0.073	0.103	0.284	0.557	0.560
125	Wage index, total cash earnings, industries covered	0.010	0.010	0.012	0.018	0.023	0.026	0.041	0.041	0.268
126	Real wage index, total cash earnings, industries covered	0.006	0.007	0.008	0.022	0.029	0.032	0.040	0.040	0.210

Note: The value of R2 of the regression of each variable on common factors up to the number in column head.

Table 4-h Commonality for Interest Rates and Spreads Category

		Factor								
i	Series	1	2	3	4	5	6	7	8	9
85	Basic loan rate (official discount rate)	0.060	0.062	0.082	0.085	0.097	0.111	0.126	0.128	0.128
86	Prime interest rate (long term credit banks, end of month)	0.041	0.041	0.061	0.067	0.079	0.136	0.148	0.159	0.160
87	Yields to subscribers, Government bond, Interest bearing (10 years)	0.021	0.022	0.046	0.049	0.117	0.156	0.177	0.179	0.182
88	Average interest rates on loans & discounts, Domestic banks	0.186	0.300	0.332	0.335	0.352	0.416	0.418	0.434	0.454
89	Ave. int. rates on loan & dis., Domestic banks, Short term loan	0.171	0.244	0.289	0.300	0.335	0.386	0.391	0.402	0.412
90	Ave. int. rates on certificates of deposit, Domestic banks	0.124	0.128	0.155	0.158	0.395	0.396	0.420	0.422	0.429
91	Prime interest rate - Basic loan rate spread	0.001	0.010	0.018	0.031	0.076	0.163	0.166	0.207	0.219
92	Yields to subscribers (government bond) - Basic loan rate spread	0.010	0.031	0.037	0.047	0.131	0.255	0.258	0.304	0.334
93	Average interest rate on loan - Basic loan rate spread	0.050	0.185	0.226	0.233	0.243	0.254	0.269	0.287	0.330

Note: The value of R2 of the regression of each variable on common factors up to the number in column head.

Table 4-i Commonality for Money and Credit Category

		Factor								
i	Series	1	2	3	4	5	6	7	8	9
94	Money stock, Average amounts outstanding, M1	0.016	0.055	0.055	0.173	0.200	0.222	0.246	0.274	0.276
95	M2	0.009	0.025	0.034	0.070	0.169	0.220	0.222	0.297	0.310
96	Money stock, Amounts outstanding at end of the period, M1	0.015	0.023	0.033	0.040	0.040	0.043	0.044	0.045	0.118
97	Monetary base, Average amounts outstanding	0.004	0.004	0.007	0.025	0.063	0.064	0.065	0.066	0.071
98	Bank account of city banks, Asset, Cash	0.001	0.003	0.016	0.028	0.299	0.418	0.424	0.425	0.426
99	Deposits	0.006	0.012	0.028	0.039	0.219	0.264	0.340	0.342	0.351
100	Call loans	0.000	0.007	0.010	0.013	0.018	0.020	0.022	0.030	0.040
101	Securities	0.000	0.018	0.023	0.023	0.035	0.041	0.052	0.052	0.053
102	Bank account of city banks, Liabilities, Deposits	0.001	0.015	0.062	0.089	0.449	0.526	0.530	0.534	0.535
103	Call money	0.002	0.004	0.015	0.017	0.037	0.053	0.078	0.084	0.088
104	Certificates of deposit	0.005	0.006	0.018	0.026	0.067	0.074	0.080	0.099	0.121
105	Bank account of regional banks, Asset, Cash	0.010	0.016	0.031	0.078	0.471	0.699	0.723	0.733	0.735
106	Deposits	0.010	0.017	0.023	0.058	0.322	0.506	0.516	0.541	0.546
107	Securities	0.011	0.034	0.052	0.070	0.106	0.149	0.165	0.168	0.179
108	Bank account of regional banks, Liabilities, Deposits	0.010	0.018	0.033	0.113	0.515	0.684	0.711	0.727	0.731
109	Call money	0.002	0.002	0.005	0.027	0.183	0.261	0.263	0.265	0.276
110	Certificates of deposit	0.000	0.008	0.021	0.030	0.045	0.059	0.060	0.066	0.081

Note: The value of R2 of the regression of each variable on common factors up to the number in column head.

Table 4-j Commonality for Asset Prices and Exchange Rates Category

		Factor								
i	Series	1	2	3	4	5	6	7	8	9
71	TSE stock price index, 1-st section, Construction	0.031	0.401	0.551	0.567	0.644	0.664	0.670	0.676	0.676
72	Chemicals	0.059	0.583	0.788	0.795	0.843	0.850	0.863	0.866	0.868
73	Machinery	0.087	0.604	0.809	0.813	0.844	0.844	0.849	0.850	0.850
74	Electric appliances	0.077	0.547	0.719	0.721	0.741	0.741	0.752	0.755	0.755
75	Transportation equipment	0.082	0.578	0.736	0.738	0.760	0.763	0.763	0.764	0.766
76	Information & communication	0.049	0.389	0.465	0.467	0.527	0.533	0.559	0.568	0.569
77	Wholesale trade	0.065	0.537	0.732	0.735	0.785	0.789	0.808	0.811	0.811
78	Retail trade	0.050	0.443	0.564	0.567	0.687	0.694	0.714	0.719	0.719
79	Banks	0.048	0.338	0.450	0.458	0.519	0.534	0.534	0.535	0.535
80	Services	0.048	0.466	0.596	0.600	0.655	0.673	0.703	0.711	0.712
81	Producer price index, Scrap & waste	0.019	0.033	0.065	0.072	0.129	0.179	0.186	0.186	0.195
82	Nikkei index of commodity prices (42 items, monthly)	0.132	0.152	0.245	0.247	0.274	0.342	0.389	0.411	0.430
83	Exchange rates, yen per US. $ (spot, middle, monthly average)	0.010	0.024	0.149	0.158	0.177	0.202	0.329	0.638	0.662
84	Effective exchange rate (real)	0.016	0.041	0.154	0.159	0.180	0.214	0.347	0.654	0.697

Note: The value of R2 of the regression of each variable on common factors up to the number in column head.

Table 4-k Commonality for Other Category

		Factor								
i	Series	1	2	3	4	5	6	7	8	9
21	Disposable income (worker's households)	0.005	0.009	0.009	0.031	0.031	0.039	0.041	0.047	0.052
127	MOF quantum index, Exports, total	0.152	0.164	0.226	0.358	0.359	0.360	0.361	0.388	0.389
128	Import, total	0.093	0.112	0.137	0.264	0.264	0.373	0.373	0.375	0.393
129	Customs clearance, value of exports, grand total (yen)	0.162	0.181	0.197	0.268	0.295	0.298	0.318	0.371	0.375
130	Bank clearing, all clearing houses (number)	0.007	0.011	0.012	0.029	0.038	0.090	0.130	0.162	0.246
131	(value)	0.004	0.011	0.013	0.033	0.035	0.083	0.116	0.153	0.197
132	Consumer confidence index (all households)	0.009	0.155	0.167	0.167	0.169	0.221	0.227	0.238	0.253
133	Monthly survey of small business, Sales D.I.	0.025	0.130	0.134	0.135	0.153	0.267	0.315	0.326	0.344
134	Sales forecast D.I.	0.057	0.104	0.116	0.158	0.189	0.191	0.199	0.206	0.249
135	Profits D.I.	0.041	0.096	0.102	0.105	0.148	0.208	0.244	0.255	0.265
146	Index of tertiary industry activities, Business related services	0.109	0.117	0.136	0.138	0.148	0.154	0.169	0.170	0.170
147	Transport & postal activities	0.194	0.210	0.310	0.320	0.321	0.321	0.321	0.341	0.342
148	Corporation tax revenue (including tax refunds)	0.014	0.016	0.022	0.029	0.029	0.049	0.055	0.067	0.146

Note: The value of R2 of the regression of each variable on common factors up to the number in column head.