Global Financial Crisis and the Decoupling Hypothesis

Joanna Wyrobek, Zbigniew Stańczyk and Marek Zachara

Abstract The purpose of the paper is to assess the decoupling hypothesis which states that the performance of the emerging economies is relatively independent from the changes in developed economies. Christiano-Fitzgerald's band-pass filter and spectral analysis have been applied to examine the hypothesis. Comparing the deviations of GDPs from their long-term trend, it can be claimed that the synchronization of business cycles between emerging and developed economies was already high before the last global crisis in 2008. The analysis presented in this paper shows that the synchronization (coupling) of the economies actually increased after this time. Therefore, this paper presents evidence against the commonly accepted decoupling hypothesis, and at the same time it raises doubts whether the high rates of growth in emerging economies are sustainable in the presence of the slowdown in the developed economies.

Keywords Business cycle synchronization · Decoupling · Spectral analysis

1 Introduction

The decoupling hypothesis has its origins in the spectacular successes of the economies of China and India, whose high growth rates do not seem to be influenced by the parlous state or the shocks sustained by them. It appeared as if the decoupling hypothesis could be applied, not only to certain Asian countries, but also to describe the performance of certain Latin American countries, e.g. Brazil.

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Indeed, some Latin American countries started to grow faster than the U.S. economy and their growth path seemed to have become independent of the economic situation in the U.S.

Research conducted before the last global financial crisis did not provide an answer as to whether the decoupling hypothesis was valid or not: in fact, research papers were almost equally divided between confirming and rejecting this hypothesis. The most often quoted paper supporting the hypothesis is that of Kose et al. [6], who examined the degree of synchronization in 106 economies during the years 1960–2005. In this extensive study, a sample of countries was divided into three groups: developed economies, emerging market economies and other developing economies, and three time series were taken into account: GDP, investment, and consumption. The variances of the time series were decomposed into variances of three factors and an idiosyncratic component. The following factors were taken into account: the global factor, which was related to fluctuations in all countries; the group factor which characterized the fluctuations of every group of countries; and finally the country specific factor. Kose reported that their most important finding was that synchronization of cycles increased independently for developed and emerging economies in the years 1985–2005. On the other hand, according to the authors, the impact of the global factor decreased when periods 1960–1984 and 1985–2005 were compared, and this finding is supposed to show that a decoupling of developed and emerging economies had taken place.

Their results were supported by the IMF's World Economic Outlook [12], but the authors of this report grouped the countries, not according to level of development, but according to certain regional criteria. Table 1 presents the results of variance decomposition into global, regional, country-specific, and idiosyncratic factors. The report then claims, that in the years 1985–2005 regional, and not global, factors were more important for GDP fluctuations (see Table 1).

A study by Wälti [11] is one of the most important papers which rejects the decoupling hypothesis. Conducting calculations for 34 emerging markets and 29 developed economies, he examined GDP deviations from its long-term trend and compared them for a different time shift. The emerging market economies came from four different regions of the world: eight East and South Asian economies, nine Latin American countries, thirteen Eastern and South European economies, and four other economies from Africa and Middle East. Developed economies were grouped in four classes: all developed economies, the European group, the G7 group and United States alone. The Hodrick-Prescott filter and spectral analyses were used for the period of 1980–2007. The results presented by Wälti refuted the decoupling hypothesis—the strength of ties for countries from different continents turned to be similar to that between developed and emerging economies. He also quotes other papers that reject this hypothesis.

Doubts about decoupling became even more pronounced after the subprime crisis when practically all countries (from all regions, both rich and poor) were affected by the crisis. Certain economists, e.g. Krugman [7] stated that the decoupling has never existed, and others [4, 5] suggested that the change in the

Table 1 Contributions to output (unweighted averages for every region; percentages)

Itemized	Global factor	Regional factor	Country factor	Idiosyncratic
1960–2005				
North America	16.9	51.7	14.8	16.6
Western Europe	22.7	21.6	34.6	21.1
Emerging Asia and Japan	7.0	21.9	47.4	23.7
Latin America	9.1	16.6	48.6	25.7
1960–85				
North America	31.4	36.4	15.7	16.5
Western Europe	26.6	20.5	31.6	21.3
Emerging Asia and Japan	10.6	9.5	50.5	29.4
Latin America	16.2	19.4	41.2	23.2
1986–2005				
North America	5.0	62.8	8.2	24.0
Western Europe	5.6	38.3	27.6	28.5
Emerging Asia and Japan	6.5	34.7	31.1	27.7
Latin America	7.8	8.7	51.7	31.8

Source World Economic Outlook [12], p. 14

economic conditions occurred, which resulted in re-coupling after a phase of decoupling.

The aim of the paper is to verify the hypothesis whether the changes which occurred during and after the global crisis support the theory of re-coupling or whether the whole decoupling hypothesis should be rejected.

2 Brief Description of the Methods Used in the Paper

The time trend has to be removed from the time series (which is the GDP data from the World Bank database) in order to analyze relations between deviations from the long-term trend. Once the trend is removed the time series are processed by Christiano-Fitzgerald filter, followed by a spectral analysis. These two methods are briefly presented below.

2.1 An Outline of Christiano-Fitzgerald Band-Pass Filter

As it has been mentioned, Christiano-Fitzgerald band-pass filter is used to extract the cyclical part of the time series. The filter has been chosen because of its applicability to almost all time series and its advantages (takes into account stochastic structure of the decomposed variable, removes non-seasonal fluctuations, etc.) [2].

Christiano-Fitzgerald filter requires testing of the stationarity of the time series. The filter requires the removal of time-trend (if it is present) and the drift must also be removed if present [9].

The idea of calculating the cyclic component in the band pass filter is based on the following formula[1] [8]:

$$\hat{y}_t^c = \hat{B}_t(L)y_t, \quad where \;\; \hat{B}_t(L) = \sum_{j=-(T-t)}^{t-1} \hat{B}_{j,t}L^j \quad for \;\; t = 1, 2..., T \tag{1}$$

where: y_t—time series, $\hat{y}_t^c$-approximation of y_t, L—lag (backshift) operator defined as $L^j y_t \equiv y_{t-j}$, j—number of time delays applied to the backshift operator, T—number of observations, t—time variable, $\hat{B}$—a set of weights [formulae for their calculation is given in (2)]. A set of weights $\hat{B}$ is the solution of the equation:

$$\min_{\hat{B}_{j,t}, j=-(T-t),\ldots,t-1} \int_{-\pi}^{\pi} \left|B\left(\mathrm{e}^{-i\omega}\right) - \hat{B}_t\left(\mathrm{e}^{-i\omega}\right)\right|^2 S_y(\omega)d\omega \quad for \;\; t = 1, 2, \ldots, T \tag{2}$$

where $B(\mathrm{e}^{-i\omega})$ represents the reinforcement of the "ideal" band-pass filter, $\hat{B}_t(\mathrm{e}^{-i\omega})$ represents the reinforcement of the approximated filter, $S_y(\omega)$ is the (pseudo) power spectrum of the filtered process (either white noise I(0) process or random walk I(1) process). For the CF filter for the *I(1)* series there is an additional (limiting) condition:

$$\sum_{j=-(T-t)}^{t-1} \hat{B}_{j,t} = 0 \quad for \;\; t = 1, 2, \ldots, T \tag{3}$$

which provides a removal the stochastic trend. Operation of the filter, involving removal of the frequencies which are too low or too high to be treated as part of the business cycle, is based on function $B(\mathrm{e}^{-i\omega})$, which for the "ideal" filter is defined as:

$$B\left(\mathrm{e}^{-i\omega}\right) \equiv \begin{cases} 1 & for \;\; \omega \in [-\bar{\omega}, -\underline{\omega}] \cup [\underline{\omega}, \bar{\omega}], \\ 0 & for \;\; \omega \in [-\pi, -\bar{\omega}) \cup (-\underline{\omega}, \underline{\omega}) \cup (\bar{\omega}, \pi], \end{cases} \tag{4}$$

where: $\omega = 2\pi/\tau$ is the frequency expressed in radians with a period equal to τ. Expressions: $\underline{\omega} = 2\pi/\tau_U$ and $\bar{\omega} = 2\pi/\tau_L (0 < \underline{\omega} < \bar{\omega} < \pi)$ determine the lower and

[1]Detailed derivation of presented formulae can be found in [2].

upper frequency of the filter, which causes the filter to cut off fluctuations with a period longer than τ_U and less than τ_L. The calculations assumed $\tau_U = 32$ and $\tau_L = 6$.

2.2 An Outline of a Single Spectrum Analysis Method

The origin of spectral analysis is based on the idea of representing time series as the sum of sinusoids at various frequencies (cycles). Spectral analysis of cyclic data requires the Fourier transform [1], which is used to transform the time domain representation of the series into the frequency domain representation of the series. In order to determine the significance of different frequencies in data one calculates a spectrogram.

A spectrogram displays the power of a signal as a function of both: time and frequency simultaneously. According to [10]: "power spectrum of a stochastic process with discrete time $\{y_t\}_{t=-\infty}^{+\infty}$ with a zero mean and stationary covariance function is defined as the Fourier transform of autocovariance series $\{y_k^y\}_{k=-\infty}^{+\infty}$ of this process and is given as:

$$S_y(\omega) = \frac{1}{2\pi} \sum_{k=-\infty}^{+\infty} \gamma_k^y \mathrm{e}^{-i\varpi k} \quad for \;\; \omega \in [-\pi, \pi] \tag{5}$$

where: $\omega = 2\pi/\tau$ is the frequency corresponding to the period τ".

Due to the fact that the spectrogram calculated using the above method is very "fuzzy", certain methods can be used to reduce this variability (smoothing methods), with one of the most popular being the Parzen window. The power spectrum estimator then takes the form (6)–(8), where empirical autocovariances are:

$$\hat{S}(\omega) = \frac{1}{2\pi} \sum_{k=-H}^{H} w_k \hat{\gamma}_k^y \mathrm{e}^{-i\omega k} = \frac{1}{2\pi} \left[w_0 \hat{\gamma}_0^y + 2 \sum_{k=1}^{H} w_k \hat{\gamma}_k^y \cos(\omega k) \right] \tag{6}$$

$$\hat{\gamma}_k^y = \frac{1}{T} \sum_{t=1+k}^{T} (y_t - \bar{y})(y_{t-k} - \bar{y}) \quad for \;\; t = 0, 1, \ldots, T-1 \tag{7}$$

and Parzen window weights are:

$$w_k = \begin{cases} 1 - 6(k/H)^2 + 6(|k|/H)^3 \, dla |k| \le H/2, \\ 2(1 - |k|/H)^3 \, dla H/2 \le |k| \le H, \\ 0 \, dla |k| > H. \end{cases} \tag{8}$$

Maximum allowable lag time for Parzen window, called the truncation lag is chosen according to the rule: $H = int(2\sqrt{T})$.

2.3 Outline of the Cross-Spectral Analysis

Cross spectral analysis can be used to determine the relationship between two cycles. There are several methods of calculating the cross-spectrum, one of which is given by Bloomfield [1]. The time series X and Y can first be "combined" in the time domain (before the Fourier transform) by calculating the lagged cross-covariance function. The resulting function is then subjected to a Fourier transform and a cross spectrum periodogram is obtained. Cross-covariance can be written as:

$$\hat{\gamma}_k^{yx} = \frac{1}{T}\sum_{t=1+k}^{T}(y_t - \bar{y})(x_{t-k} - \bar{x}) \quad for \;\; t = 0, 1, \ldots, T-1 \tag{9}$$

where k represents the time lag of one series relative to the other. The Fourier transform is then carried out to obtain the cross-spectrum periodogram [3]:

$$S_{yx}(\omega) = \frac{1}{2\pi}\sum_{k=-\infty}^{+\infty}\gamma_k^{yx}\mathrm{e}^{-i\varpi k} \quad for \;\; \omega \in [-\pi, \pi] \tag{10}$$

Similarly to the single spectrum periodogram (spectrogram), the cross-spectrum periodogram is also smoothed, e.g. by the Parzen window.

For the purpose of the cross-spectrum analysis, the following three measures are usually calculated: squared coherence, gain value and time shift between the series. Squared coherence measures strength of association between two series, gain (value) estimates magnitude of changes of one time series in relation to the other for a certain frequency, phase shift estimates to which extent each frequency component of one series leads the other.

Quoting Skrzypczyński [9]: "if we assume that a stochastic process with discrete time $\{x_t\}_{t=-\infty}^{+\infty}$ with zero mean and stationary covariance function is an independent variable, whereas the process $\{y_t\}_{t=-\infty}^{+\infty}$ of the analogous properties is the dependent variable, then the cross power spectrum (cross-spectral density, cross-spectrum) of these variables is defined as the Fourier transform of the cross-covariance series of these variables and is given by the formula:

$$S_{yx}(\omega) = \frac{1}{2\pi}\sum_{k=-\infty}^{+\infty}\gamma_k^{yx}\mathrm{e}^{-i\omega k} = c_{yx}(\omega) - iq_{yx}(\omega) \quad for \;\; \omega \in [-\pi, \pi] \tag{11}$$

where:

$$c_{yx}(\omega) = (2\pi)^{-1}\sum_{k=-\infty}^{+\infty}\gamma_k^{yx}\cos(\omega k) \tag{12}$$

is called co-spectrum and is a real part of cross-spectrum, while

$$q_{yx}(\omega) = (2\pi)^{-1} \sum_{k=-\infty}^{+\infty} \gamma_k^{yx} \sin(\omega k) \tag{13}$$

is called the quadrature spectrum, is a negative imaginary part of the cross-spectrum. It is possible to define three cross-spectral statistics on the basis of cross power spectrum: gain value (G), phase shift (φ), and squared coherence K^2:

$$G_{yx}(\omega) = \frac{\left(c_{yx}^2(\omega) + q_{yx}^2(\omega)\right)^{\frac{1}{2}}}{S_x(\omega)} \quad \mathit{for} \;\; \omega \in [-\pi, \pi] \tag{14}$$

$$\varphi_{yx}(\omega) = \tan^{-1}\left(\frac{-q_{yx}(\omega)}{c_{yx}(\omega)}\right) \quad \mathit{for} \;\; \omega \in [-\pi, \pi] \tag{15}$$

$$K_{yx}^2(\omega) = \frac{c_{yx}^2(\omega) + q_{yx}^2(\omega)}{S_y(\omega)S_x(\omega)} \quad \mathit{for} \;\; \omega \in [-\pi, \pi] \tag{16}$$

where $S_x(\omega)$ is the power spectrum of the process $\{x_t\}$, while $S_y(\omega)$ is the power spectrum of the process $\{y_t\}$".

3 Results

The strength of the relationship between cycles (in addition to the length of the business cycle) of a particular country with other countries may indicate a strong relationship between their economies. In the case of spectral analysis, the strength of the relationship between cycles is measured by the squared coherence; the higher the coherence, the stronger the relationship.

As can be seen in Tables 2 and 3, when the squared coherences for different frequencies (lengths of cycles) are considered, business cycles all over the world were quite similar even before the global financial crisis, and it is more evident for longer and very short cycles. The results are presented from Poland's perspective and it can be seen that countries on one continent do have strong connection with each other. In this case, Poland's business cycle is very similar to other European countries cycles. Nonetheless, when long business cycles are considered, Poland had a stronger coherence with the United States than with any European country, even its main economic partner, Germany, which became especially visible during the global economic crisis. Also, assuming high coherences with small Asian

Table 2 Coherence coefficients between business cycle in Poland and other countries (different cycle length); calculations for years 1995–2006, grouped by continents (calculations based on World Bank data)

Europe

Country	**24**	**16**	**12**	**9.6**	**8**	**6.9**	**6**
Austria	**85.50%**	56.70%	30.70%	59.70%	49.20%	51.40%	50.80%
Belgium	**83.30%**	59.60%	43.90%	**83.80%**	**87.00%**	74.90%	51.90%
Croatia	**83.30%**	55.60%	68.20%	79.10%	63.80%	62.60%	52.50%
Czech Rep.	**86.30%**	44.60%	4.90%	6.40%	46.50%	70.60%	73.40%
Denmark	**81.60%**	49.10%	24.70%	10.40%	5.90%	10.20%	5.80%
Estonia	26.60%	6.70%	15.50%	32.20%	51.40%	62.40%	44.10%
Finland	**85.40%**	67.30%	60.70%	34.20%	8.30%	5.60%	23.60%
France	**92.50%**	**81.80%**	64.70%	59.00%	44.50%	58.30%	68.30%
Georgia	15.40%	7.20%	8.80%	4.80%	14.50%	7.20%	55.80%
Germany	**87.30%**	65.10%	50.00%	33.20%	35.10%	66.40%	59.00%
Great Britain	**93.20%**	**80.80%**	62.90%	34.70%	45.60%	62.50%	55.40%
Hungary	76.40%	41.10%	28.70%	28.80%	17.90%	42.20%	29.30%
Iceland	26.80%	5.10%	16.20%	54.60%	79.60%	65.90%	48.40%
Ireland	**83.10%**	53.50%	45.60%	31.90%	26.30%	28.90%	41.80%
Italy	**87.50%**	76.20%	68.20%	61.00%	39.80%	45.20%	72.40%
Latvia	61.70%	22.40%	16.70%	34.20%	37.00%	56.10%	62.40%
Lithuania	1.60%	6.60%	12.20%	41.10%	48.60%	47.40%	31.70%
Netherlands	**94.30%**	77.70%	48.80%	27.30%	26.70%	57.10%	59.90%
Norway	10.90%	10.40%	19.10%	70.20%	**81.00%**	64.20%	48.20%
Portugal	**90.70%**	59.20%	8.40%	46.60%	57.00%	75.00%	71.30%
Russia	**94.70%**	**81.50%**	79.60%	74.70%	72.00%	73.70%	**80.00%**
Slovakia	51.10%	56.80%	49.10%	65.00%	**84.10%**	66.50%	17.80%
Slovenia	79.90%	42.80%	40.50%	38.70%	4.40%	5.90%	30.10%
Spain	**92.00%**	68.10%	53.30%	72.10%	66.30%	56.40%	67.50%
Sweden	**87.10%**	62.20%	50.40%	53.30%	46.10%	32.90%	40.70%
Switzerland	**84.80%**	64.90%	64.00%	75.20%	48.00%	4.80%	4.70%
Turkey	67.60%	48.40%	63.30%	49.70%	32.70%	2.00%	20.40%
Country	**24**	**16**	**12**	**9.6**	**8**	**6.9**	**6**
EU 27	**90.30%**	73.30%	62.70%	47.60%	45.20%	63.20%	71.00%
Euro 17	**90.10%**	73.20%	62.90%	52.00%	48.50%	65.80%	78.60%

North and South America

Country	**24**	**16**	**12**	**9,6**	**8**	**6,90**	**6**
Argentina	64.60%	28.40%	54.00%	28.50%	13.20%	27.70%	54.20%
Bolivia	60.20%	32.80%	18.30%	64.90%	67.40%	39.60%	31.90%
Brazil	**81.00%**	65.40%	40.80%	24.30%	2.00%	12.40%	24.80%
Canada	**88.50%**	69.40%	66.80%	45.30%	2.60%	15.30%	20.50%
Chile	2.20%	16.70%	38.60%	73.70%	**81.50%**	**83.60%**	76.20%
Colombia	58.20%	35.10%	49.60%	78.20%	**83.30%**	**84.60%**	62.00%
Mexico	**80.30%**	58.90%	59.10%	37.40%	34.80%	50.50%	45.90%
Peru	49.80%	7.60%	48.40%	62.50%	19.50%	2.80%	11.50%
USA	**94.30%**	**81.60%**	62.10%	23.20%	7.30%	16.30%	7.60%

Asia

Country	**24**	**16**	**12**	**9,6**	**8**	**6,90**	**6**
China	62.30%	27.30%	19.10%	3.20%	29.60%	48.00%	58.00%
Hong Kong	68.70%	51.20%	42.00%	51.00%	30.10%	35.40%	39.70%
India	63.90%	32.20%	0.90%	26.60%	34.00%	57.60%	71.10%
Indonesia	68.50%	24.20%	15.70%	63.70%	79.00%	72.90%	64.10%
Iran	53.00%	11.40%	7.70%	15.40%	37.20%	30.00%	15.40%
Israel	**87.60%**	**86.30%**	73.10%	55.70%	34.60%	2.70%	26.70%
Japan	61.80%	49.10%	36.30%	5.50%	12.70%	6.70%	16.40%
Malaysia	38.80%	22.00%	52.00%	72.50%	65.40%	70.00%	69.60%
Philippines	22.40%	4.70%	40.40%	14.50%	23.80%	3.30%	14.70%
Singapore	**84.70%**	77.80%	64.60%	52.00%	33.60%	41.50%	35.90%
South Korea	76.40%	28.10%	40.60%	66.00%	42.30%	45.50%	56.90%
Taiwan	**98.60%**	**97.50%**	**86.70%**	34.50%	7.90%	3.30%	22.50%
Thailand	50.90%	17.30%	31.90%	53.10%	45.60%	68.20%	79.00%

Australia and Oceania

Country	**24**	**16**	**12**	**9,6**	**8**	**6,90**	**6**
Australia	56.80%	42.50%	19.10%	10.00%	2.00%	8.10%	23.90%
New Zealand	39.80%	45.10%	77.80%	**85.00%**	70.20%	40.10%	9.70%

Africa

Country	**24**	**16**	**12**	**9,6**	**8**	**6,90**	**6**
Morocco	45.10%	45.40%	43.20%	46.40%	56.30%	67.00%	36.90%
South Africa	**87.40%**	45.50%	19.90%	17.20%	10.50%	37.10%	61.30%

Table 3 Coherence coefficients between business cycle in Poland and other countries (different cycle length); calculations for years 1995–2009, grouped by continents (calculations based on World Bank data)

Europe

Country	30	20	15	12	10	8.57	7.5	6.67	6
Austria	**84.80%**	76.10%	72.20%	46.70%	46.40%	60.50%	39.00%	14.40%	20.30%
Belgium	65.10%	51.30%	57.70%	35.40%	41.70%	63.40%	59.90%	49.90%	25.00%
Croatia	68.30%	60.70%	62.10%	64.80%	**80.90%**	77.20%	51.60%	70.20%	77.30%
Czech Rep.	63.90%	55.20%	58.80%	50.70%	42.40%	14.00%	1.20%	44.70%	**84.00%**
Denmark	**83.20%**	75.10%	71.40%	78.20%	77.70%	56.00%	11.90%	4.50%	38.90%
Estonia	63.40%	43.70%	36.90%	64.20%	**84.70%**	71.50%	14.00%	26.20%	65.40%
Finland	**87.40%**	**82.90%**	**82.00%**	**82.70%**	**83.90%**	68.20%	17.30%	6.00%	44.10%
France	**85.20%**	**80.80%**	**82.30%**	**85.40%**	**87.30%**	**80.10%**	45.60%	9.80%	28.20%
Georgia	32.60%	32.20%	58.40%	73.20%	46.90%	45.70%	54.90%	27.60%	**88.70%**
Germany	79.60%	69.20%	72.30%	**85.00%**	**89.00%**	74.40%	27.30%	21.20%	65.90%
Great Britain	**86.30%**	**84.40%**	**84.90%**	**81.30%**	79.90%	70.70%	30.20%	12.10%	63.70%
Hungary	**88.40%**	**83.80%**	73.40%	72.70%	**80.60%**	65.20%	22.50%	16.70%	67.80%
Iceland	75.10%	47.40%	53.90%	58.00%	24.90%	0.40%	32.10%	70.30%	**84.50%**
Ireland	**80.00%**	71.80%	73.60%	**85.80%**	**89.40%**	77.20%	33.80%	15.60%	2.00%
Country	**30**	**20**	**15**	**12**	**10**	**8.57**	**7.5**	**6.67**	**6**
Italy	76.90%	67.50%	68.50%	**81.10%**	**88.50%**	77.70%	33.40%	8.60%	28.20%
Latvia	77.40%	60.00%	52.60%	62.00%	76.70%	71.80%	33.40%	8.40%	19.00%
Lithuania	49.90%	30.90%	33.70%	58.60%	73.30%	59.20%	17.80%	21.00%	61.50%
Netherlands	**91.70%**	**88.40%**	**84.60%**	**80.40%**	77.20%	71.00%	38.80%	8.80%	59.10%
Norway	60.70%	40.00%	61.30%	64.20%	78.90%	**85.00%**	66.60%	12.40%	19.10%
Portugal	**81.30%**	72.50%	67.80%	45.80%	43.60%	70.60%	71.20%	30.90%	29.10%
Russia	**83.80%**	**83.20%**	**92.00%**	**95.20%**	**91.20%**	**82.80%**	51.30%	18.40%	60.30%
Slovakia	37.00%	30.10%	37.90%	45.90%	35.10%	10.90%	6.20%	17.60%	25.10%
Slovenia	**85.20%**	76.70%	72.50%	64.90%	66.30%	63.90%	22.20%	7.50%	44.00%
Spain	**90.10%**	**84.90%**	**82.30%**	72.90%	71.60%	73.70%	50.20%	2.80%	28.60%
Sweden	**90.00%**	**90.40%**	**83.60%**	77.10%	**86.50%**	76.40%	25.20%	6.00%	35.30%
Switzerland	**87.40%**	72.50%	57.80%	69.90%	**87.60%**	77.90%	25.70%	8.90%	38.00%
Turkey	71.40%	63.30%	77.70%	**89.70%**	**83.70%**	42.50%	3.20%	1.90%	35.00%
EU 27	**86.50%**	**83.00%**	**82.10%**	**83.80%**	**86.80%**	76.30%	30.00%	13.80%	63.20%
Euro 17	**86.50%**	**81.50%**	**80.00%**	**83.70%**	**87.90%**	78.40%	33.00%	14.00%	63.90%

North and South America

Country	30	20	15	12	10	8,57	7,5	6,67	6
Argentina	64.00%	20.30%	25.20%	22.50%	17.10%	3.90%	3.10%	40.20%	**88.00%**
Bolivia	14.00%	25.10%	52.00%	28.90%	73.70%	62.30%	32.20%	34.40%	18.80%
Brazil	78.90%	79.60%	**89.90%**	69.90%	69.60%	54.40%	6.20%	21.20%	18.30%
Canada	37.60%	19.50%	56.60%	65.10%	**87.30%**	**86.70%**	59.70%	72.40%	**83.50%**
Chile	**88.60%**	**84.90%**	78.60%	**81.00%**	**87.50%**	66.80%	15.40%	4.60%	29.40%
Colombia	10.00%	19.50%	32.70%	48.40%	76.90%	77.70%	67.90%	64.70%	43.90%
Mexico	**81.30%**	78.10%	**80.10%**	**88.00%**	**90.10%**	58.20%	8.80%	18.00%	61.50%
Peru	44.10%	35.00%	34.30%	27.60%	67.30%	79.60%	31.50%	23.80%	35.80%
USA	**88.40%**	**89.70%**	**88.20%**	**88.00%**	**81.20%**	57.90%	11.40%	7.70%	24.10%

Asia

Country	30	20	15	12	10	8,57	7,5	6,67	6
China	**83.10%**	60.70%	31.30%	43.90%	57.80%	63.20%	38.90%	1.70%	61.10%
Hong Kong	53.00%	53.50%	70.90%	70.00%	**86.10%**	78.00%	36.60%	13.30%	45.40%
India	51.70%	18.90%	62.60%	43.60%	9.40%	22.20%	5.40%	61.50%	**84.40%**
Indonesia	53.00%	36.20%	43.40%	2.40%	31.20%	66.80%	60.10%	76.80%	**81.00%**
Iran	1.60%	14.40%	54.70%	58.90%	29.00%	20.30%	15.60%	20.70%	44.50%
Israel	64.10%	52.70%	62.10%	76.70%	77.10%	44.30%	4.10%	11.70%	6.50%
Japan	50.20%	54.60%	79.80%	**85.60%**	72.70%	45.00%	16.00%	1.90%	14.20%
Malaysia	12.30%	41.60%	79.90%	75.80%	**83.10%**	**80.00%**	45.10%	29.50%	65.10%
Philippines	54.90%	4.90%	40.20%	31.50%	10.50%	29.90%	24.70%	24.80%	44.70%
Singapore	68.70%	68.10%	**81.40%**	**86.60%**	**84.80%**	71.60%	40.70%	42.20%	52.50%
South Korea	36.00%	41.20%	62.80%	49.80%	72.60%	78.50%	42.30%	27.40%	61.90%
Taiwan	77.90%	**83.20%**	**90.10%**	**87.70%**	**80.60%**	48.10%	9.30%	2.40%	36.90%
Thailand	9.40%	38.20%	75.80%	62.60%	60.20%	68.10%	40.40%	29.90%	67.80%

Australia and Oceania

Country	30	20	15	12	10	8.57	7.5	6.67	6
Australia	16.80%	7.50%	36.90%	63.20%	49.10%	25.90%	3.50%	26.80%	27.60%
New Zealand	66.70%	70.20%	**86.10%**	77.40%	**81.20%**	78.50%	53.90%	26.80%	2.70%

Africa

Country	30	20	15	12	10	8.57	7.5	6.67	6
Morocco	36.60%	17.40%	28.20%	49.50%	76.30%	57.20%	15.70%	33.10%	35.50%
South Africa	68.00%	60.70%	65.50%	60.70%	63.30%	51.10%	6.40%	17.40%	67.40%

countries irrelevant, Poland had a relatively high coherence with another huge economy—China.

When short business cycles are to be considered, Poland's economy visibly belonged to the group of the European countries, especially, members of the EU.

4 Conclusions

Relations between economic variables can be superficial or accidental, but taking into account the domestic US consumer demand, the role of the US investment funds, rating agencies and the US stock exchanges, the created information and sentiment based transmission channels, it is hard to ignore the evidence that a long-term Poland's cycle seems to be highly dependent on the changes in the US economy (Poland is preceded by the U.S. economy by 1–2 quarters, depending on the analyzed frequency). Moreover, until recently, Poland preceded almost all EU economies, lagging only behind very few world economies, including the U.S. one. Therefore, there is little ground to reject the hypothesis that the state of the US economy is followed by the changes in Polish economy and also by other countries around the world.

Considering all the evidence presented in this paper, as long as the econometric methods used are not invalidated, it is clear that the decoupling hypothesis have to be rejected, at least for the long business cycles. On the contrary, there seem to be a very strong synchronization between the GDP changes of various economies.

The synchronization became especially visible during the last global financial crisis. Some countries, like China, showed some resistance to the global shocks (that impacted other countries), but generally the cyclical part of GDP in both developed and emerging countries deflected down in relation to GDP long-term trend.

Hence, there seems to exist evidence of quite strong synchronization of GDP changes between developed and emerging economies which raises the question whether the high rates of growth in emerging economies are sustainable without a recovery in developed economies.

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