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Macroeconomic performance of countries across monetary policy regimes from 2000 to 2017

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ABSTRACT

The goal of the article is to compare macroeconomic performance of 27 advanced and emerging OECD countries through the lens of their monetary policy frameworks. We find no advantage of the euro area countries and countries whose central banks follow a dual mandate in inflation and output stabilisation as compared to full-fledged inflation targeters including strongly inflation-averse central banks. The study contributes to the unresolved discussion on optimal monetary policy after the Great Recession. The novelty relies on employing a synthetic median-based measure adjusted for initial macroeconomic conditions. The failure to account for the initial conditions leads to underestimation of performance of countries with an originally unfavourable economic situation. We verify the results with panel data models using macroeconomic variables of key importance for monetary policy after the Great Recession. Overall, the study suggests that assigning a special role to money or output in a monetary policy strategy is not required for successful macroeconomic performance.

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1. Introduction

The 2007 global financial crisis and nominal interest rates close to their effective lower boundary sparked the discussions on the optimal monetary policy strategy (Svensson, 2020). The aim of the article is to evaluate the macroeconomic results attained by the 27 advanced and emerging OECD countries¹ from the perspective of their monetary policy strategies in the time period from 2000 to 2017. We group the countries according to their monetary policy strategies and look for associations between those strategies and achievements in inflation and output stabilisation.

It must be noted however that studies evaluating cross-country performance typically have common limitations. First, inflation and economic growth could differ on average across countries owing to differences in average growth rates of population, employment, total hours worked, and many other country-specific factors. Second,

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the global economic and financial crisis was an important event during the period of analysis, and one that impacted different countries to different extents. Therefore, the rankings of macroeconomic performance may be more related to the impact of the crisis on specific countries owing more to non-central-bank factors than to the monetary policy frameworks.

It is hard to eliminate the afore-mentioned drawbacks due to the complexity of the economic relations. For instance, the popular ‘difference in difference’ approach evaluating the effects of inflation targeting (I.T.) (Kose et al., 2018) is vulnerable to the Lucas critique. The reason is that the macroeconomic effects may result from changes in non-central-bank factors, and not from the monetary policy strategy itself.

The doubts concerning the role of monetary policy regimes do not, however, invalidate our general findings: (1) strict inflation targeters achieved quite surprisingly satisfactory macroeconomic outcomes as compared to non-targeters; (2) a dual mandate does not necessarily outperform more inflation-averse regimes even though they are hit by an economic downturn of similar strength. The results are puzzling since a dual mandate assigns more importance to output stabilisation than an inflation-averse regime by definition. One could reasonably expect that not attaching importance to the output gap in the central bank reaction function increases economic volatility and deteriorates present and longer run welfare.

Nevertheless, we rejected the hypothesis of the alleged inferior performance of ‘inflation nutters’ (after King, 1997) – that is strongly inflation-averse central banks. Additionally, the results of the various types and specifications of the panel data models surprisingly showed no unique benefits of a dual mandate in boosting real output as compared to flexible and strict I.T.

The results can be struck against findings of considerable role of resource utilisation (Debortoli et al., 2019; Rosengren, 2014). For instance, Mishkin and Schmidt-Hebbel (2007) show that non-inflation-targeters exhibit better macroeconomic performance and have more efficient monetary policy than inflation targeters.

Why do we write the article now? The reason is the literature’s inconclusiveness on optimal monetary policy. The 2007 financial crisis re-evoked a discussion on central bank policy objectives and the role of money in economic stabilisation (Ryczkowski, 2019). After the crisis, Stiglitz (2008) appealed that I.T. needs serious rethinking or abandonment. The suggested modifications to I.T. framework include raising the average target for inflation (De Grauwe & Ji, 2019), placing larger weight on the output gap (Gust et al., 2017) switching to price level targeting (Billi, 2018) or monetary targeting (Belongia & Ireland, 2018; Taylor, 2019). Finally, some researchers argue to adapt a dual mandate (Debortoli et al., 2019) while others evidence that flexible I.T. is optimal during and after the financial crisis (Kočenda & Varga, 2018).

The novelty of the article relies on employing an economic performance measure adjusted for initial macroeconomic conditions. The failure to account for the initial conditions leads to underestimation of macroeconomic performance of countries with an originally unfavourable economic situation. We are the first to employ a Weber-median for this purpose, which delivers finest results especially when diagnostic variables exhibit asymmetrical distribution (Walesiak & Gatnar, 2009, p. 67). We create

thus a more fair balance for joint evaluation of advanced economies with post-transition countries characterised by larger output and unemployment volatility.

Our rankings of countries are confronted with panel data models. The models use macroeconomic variables which played a key role after the Great Recession. The role played by the monetary policy in counteracting the global financial crisis and boosting the real output is undisputed. Unconventional policies were even dubbed ‘the only game in town’ in absence of necessary decisions of the politicians and limited room for fiscal stimulus (Rajan, 2015). The question arises if some monetary policy regimes allow for faster economic growth than others – especially in the new post-crisis environment of rapid changes in the expectation formation (Szyszko et al., 2020).

We compare inflation targeters with five official non-targeters: the U.S., Australia, Denmark, Japan and the euro area. It can be opposed to studies that consider a larger number of non-targeters (Lin & Ye, [2009] account for fifteen non-targeters). Our approach creates a challenging setting for inflation targeters. It makes the favourable performance of I.T. even more striking.

The article is organised as follows: the second section reviews the literature and elaborates on the classification of monetary policy strategies for the sample economies; the third one describes the methodology; the fourth section presents the data followed by the results and the discussion.

2. Literature review and monetary policy strategies

Kose et al. (2018) argue that I.T. is superior in terms of inflation stabilisation but neutral for economic growth. Similarly, Kurihara (2018) detects no clear association between I.T. and economic growth. Rose (2014) finds, in turn, no evidence that I.T. improves macroeconomic performance. As opposed to it, Gonçalves and Salles (2008) demonstrate that I.T. regimes experience larger drops in inflation and output volatility as compared to non-targeters. Huang et al. (2019), Andersen et al. (2015) and De Carvalho Filho (2011) argue greater macroeconomic benefits of I.T. as well.

The advantages of I.T. evidenced in numerous studies translate into a growing number of central banks that follow its so-called ‘flexible’ version. The popular framework allows for discretion to respond to output stabilisation without risks for inflation target, central bank’s credibility and inflation expectations. The deviations from complete price stability are to improve welfare (Raissi, 2015).

However, Krugman (2012) and Friedman (2008), among others, argue that I.T. is not enough during an economic downturn and propose a dual mandate. Dual mandate implies aiming for both price stability and economic stabilisation. Debortoli et al. (2019) show that simple loss functions of central banks should place a high weight on measures of economic activity to bring underemployment to normal levels more swiftly. Therefore, an optimal monetary policy allows overshooting the inflation target for a certain time (Rudebusch & Williams, 2016).

Meanwhile and rather surprisingly, evidence for some advanced and emerging economies suggests that the estimates of output gap coefficients in central banks reaction functions are statistically insignificant. The kind of evidence was found in New Zealand (Paez-Farrell, 2015), Canada, Great Britain (Nikolsko-Rzhevskyy, 2011) and

Table 1. Characteristics of the monetary policy regimes for the sample OECD countries.

| Region, country | Variables | | | | Intermediate target /remarks |
|-----------------|--|---|--|--|---|
| | Single or multiple policy goals | Quantitative definition of price stability | Official goals related to resource utilisation | Time horizon | |
| Australia* | Multiple goals without weights assigned to them | CPI 2-3% | The stability of the currency, full employment, and the economic prosperity and welfare of the Australian people | Medium term | No |
| Canada | Single, price stability | CPI 2%+/-1 p.p. | No | Two years | No |
| Chile | Single, price stability | CPI 3%+/-1 p.p. | No | Two years | No |
| Czech Republic | Single, price stability | CPI 2%+/-1 p.p. from 2010, earlier 3%+/-1 p.p. | No | Two years | No |
| Denmark | Keeping the exchange rate of the krone stable against the euro | HICP below but close to 2% | No | Medium term | Exchange rate |
| Iceland | Single, price stability | CPI 2.5%+/-1.5 p.p. | No | One year | No |
| Israel | Single, price stability | CPI 1-3% | No | One year | No |
| Japan | Multiple from 2016, single from 1998 to 2016, previously multiple and not price stability | CPI 2% | No | From 2013 a commitment to achieving the target at the earliest possible time | From 2016 Quantitative and Qualitative Monetary Easing with Yield Curve Control |
| Korea | Single, price stability | CPI 2% | No | Medium term | No |
| New Zealand | Single, price stability before 2019; from 2019 multiple goals without weights assigned to them | CPI all groups as published by Statistics New Zealand: 2%+/-1 p.p. | The Bank uses monetary policy to support the maximum sustainable level of employment from 2019 | Medium term | No |
| Norway | Single, price stability | From 2018 CPI 2%, earlier: CPI 2.5%+/-1 p.p. | No | Medium term | No |
| Poland | Single, price stability | CPI 2.5%+/-1 p.p., before 2004 higher annual inflation targets following the disinflation strategy 1998-2003 ^a | No | Medium term | No |

(continued)

Table 1. Continued.

| Region, country | Variables | | | | | Intermediate target /remarks |
|----------------------------|---|--|--|--------------------|-----------|---|
| | Single or multiple policy goals | Quantitative definition of price stability | Official goals related to resource utilisation | Time horizon | | |
| Sweden | Single, price stability | CPI 2%+/-1 p.p. | No | Two years | No | |
| Great Britain | Single, price stability | CPI 2%+/-1 p.p. | No | Medium term | No | |
| United States [*] | Multiple goals without weights assigned to them | From 2012 CPI 2%, earlier: none. | maximum employment and moderate long-term interest rates | Not applicable | | From 2019 the estimates of the longer run normal rate of unemployment ranged from 3.5 to 4.5% |
| Euro area | Single, price stability | HICP below but close to 2% | No | Medium term | | From 2003 the reference value for M3 was abandoned, no intermediate targets, but the bank follows a two-pillar approach to analyse the risks to price stability |

Notes: Strict I.T. are typeset bold. Flexible I.T. are highlighted in grey. Australia and the U.S. – both official dual mandates – are marked with an asterisk (*). a1998: <9.5%; 1999: 6.6–7.8; 2000: 5.4–6.8%; 2001: 6–8%; 2003: <4%.

Source: Own elaboration using information from the central banks' websites (December, 2019).

Table 2. Monetary policy regimes in the panel regressions from 2000 to 2017.

| Monetary policy regime | Sample countries |
|----------------------------------|--|
| Dual Mandate | Australia, the United States |
| Flexible I.T.* | Chile, the Czech Republic, Iceland, Israel, Korea, Norway, Sweden |
| Strict I.T.* | Canada, New Zealand [^] , Great Britain, Poland |
| Two-pillar strategy of the ECB** | Austria, Belgium, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Slovak Republic, Slovenia, Spain |
| Other | Denmark, Japan [‡] |

Notes: *It is a full list of the full-fledged OECD inflation targeters with minimum a decade long experience before 2010 (South Africa was skipped due to gaps in time series on wages and unemployment); **The considered countries account for 97% of the euro area GDP (PPP) in 2017; ‡ Japan implemented I.T. in 2013; [^]New Zealand is a dual mandate since 2019.

Source: Own elaboration using information from the central banks' websites (December, 2019) and the OECD statistics.

Poland (Ryckowski, 2016; Vašíček, 2010). Additionally, in New Zealand and the U.K., the status of the central bank is stricter than for most inflation targeters. In New Zealand, the governor can be dismissed if the inflation performance is unsatisfactory. In the U.K., the governor is obliged to write a letter to the Chancellor of Exchequer if inflation diverges of more than one percentage point from the target. The National Bank of Poland is, in turn, an inflation-averse central bank (Sznajderska, 2014) with a successful disinflation record and no official goals assigned neither to output nor employment. Even the unconventional time related to the forward guidance has not made professional forecasters perceive GDP to exert strong effect on interest rates (Baranowski & Gajewski, 2016).

In contrast to the 'inflation nutters',² the U.S. Federal Reserve (Fed) follows a dual mandate to promote maximum employment and price stability from 1977. Only for the period following January 2012, Fed announced an explicit long-run inflation target of 2%, but made clear sustaining the dual mandate (Clarida, 2019) (Table 1).

The yet another dual mandate is Australia (DeBelle, 2018). The Reserve Bank Act from 1959 states that monetary policy contributes to the stability of the currency, full employment, and the economic prosperity and welfare of the Australian people. Despite the official declaration similar to the Fed's one, the Federal Reserve Bank of Australia (RBA) is frequently treated as a flexible inflation targeter rather than a dual mandate (Table 2).

The ECB stands out from the major central banks. It follows a unique 'two-pillar' monetary policy strategy with a goal to maintain inflation below 2% without any explicit reference to economic activity. Instead, the bank assigns a special role to the monetary analysis. The latter is used to cross-check the information relevant for assessing the risks to price stability. The initial reference value for M3 of 4.5% was abandoned already in 2003 due to permanent and large overshoots not accompanied by inflation risks. The strategy of the ECB is thus not a pure I.T. (Constâncio, 2018) but also not a monetary targeting. The refusal of pure I.T. was justified by the theoretical reason that it depreciates the role of money.

Meanwhile, after the Great Recession 2007–2009 it became clear that money (Hossain, 2019) played an important role in the propagation and origination of the crisis with implications for the monetary policy. Therefore, the macroeconomic performance of the ECB constitutes an interesting background for our study.

3. Methodology

We use the Macroeconomic Quality Measure (MQM) to rank the macroeconomic performance attained by the OECD countries. The core of the concept is a synthetic variable based on a distance from the abstract pattern like in the Technique for Order of Preference by Similarity to Ideal Solution (Balcerzak & Pietrzak, 2016). The MQM is contained in the interval $[0, 1]$ and describes the proximity of a country's macroeconomic performance to the ideal solution. If MQM equals to zero (unity), it means that the country attained the worst (the best) possible macroeconomic performance from all of the sample economies. To construct the MQM, we consider four diagnostic variables: X1 – Inflation variance (destimulant – that is the lower the better, see: Walesiak, 2016); X2 – Decrease in inflation (stimulant – that is the larger the better); X3 – Variance of the real GDP growth rate (destimulant); X4 – Decrease in the unemployment rate (stimulant, see: Walesiak, 2016).

The synthetic aggregate MQM_i^t based on the Weber-median σ takes the form (Młodak, 2006, 136–138):

$$MQM_i^t = 1 - \frac{\varphi_{i0}^t}{\text{Med}(\varphi) + 2.5\text{Mad}(\varphi)}, i = 1, 2, \dots, n, \quad (1)$$

where: $\varphi = (\varphi_1, \varphi_2, \dots, \varphi_n)$ is a vector of distance according to the formula (2); $\text{Mad}(\varphi) = \text{Med}_{i=1,2,\dots,n} |\varphi_{i0}^t - \text{Med}(\varphi)|$ is the median absolute deviation; i refers to the index of a country; t stands for time in years. The distance of the diagnostic variables z_{ij} from the pattern Ψ_j (ideal solution) is the median of partial differences (2). The ideal solution is a vector of the maximum values of the diagnostic variables (3) normalised according to the formula (4) (Walesiak & Gatnar, 2009, p. 68) and transformed into stimulants by multiplying those z_{ij} which are destimulants by (-1):

$$\varphi_{i0}^t = \text{med}_{i=1,2,\dots,n} |z_{ij} - \Psi_j|, i = 1, 2, \dots, n. \quad (2)$$

$$\Psi_j = \max_{i=1,2,\dots,n} z_{ij}, j = 1, 2, \dots, n. \quad (3)$$

$$z_{ij} = \frac{x_{ij} - \sigma_{0j}}{\mu \cdot \widetilde{\text{mad}}(X_j)}, i = 1, 2, \dots, n. \quad (4)$$

where: μ is a constant equal to 1.4826 and $\widetilde{\text{mad}}(X_j)$ is the median absolute deviation. The distance from the positive ideal solution is based on the Weber's median vector:

$$\widetilde{\text{mad}}(X_j) = \text{med}_{i=1,2,\dots,n} |x_{ij} - \sigma_{0j}|, j = 1, 2, \dots, m \quad (5)$$

Next, we group the countries using the positional grouping method (three medians):

- Group I: $\{MQM_i \in MQM : MQM_i^t > \text{Med}_1(MQM)\}$;
- Group II: $\{MQM_i \in MQM : \text{Med}(MQM) < MQM_i^t \leq \text{Med}_1(MQM)\}$;
- Group III: $\{MQM_i \in MQM : \text{Med}_2(MQM) < MQM_i^t \leq \text{Med}(MQM)\}$;
- Group IV: $\{MQM_i \in MQM : MQM_i^t \leq \text{Med}_2(MQM)\}$;

Group I is, thus, made up of countries with the highest *MQM*, and group IV is made up of countries with the lowest *MQM*. We apply the Spearman rank order correlation coefficient to investigate the strength and direction of the association between the rankings:

$$r_s = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n(n^2 - 1)} \quad (6)$$

where: $d_i = x_i - y_i$ is the difference between the positions of a given country across rankings for n countries. We construct two alternate measures: $MQM_1 = f(X1, X3)$ and $MQM_2 = f(X1, X2, X3, X4)$. MQM_1 evaluates the stability of the macroeconomy similar to Mishkin and Schmidt-Hebbel (2007). The authors analysed quadratic output and inflation deviations. MQM_2 additionally accounts for achievements in disinflation and reducing unemployment rates.

Next, we employ panel data models to verify whether the choice of a monetary policy regime affects real output. We apply: pooled OLS, fixed effects, random effects, between effects and Hausman-Taylor models. We consider their various specifications to increase the robustness of the results. The significance of our modelling approach is that deciding on the ‘true’ determinants of the real GDP is hard especially after the Great Recession.

We use macroeconomic variables of major interest for economists after the Great Recession: policy rates; real wages; unemployment rates; inflation and exchange rates. As concerns wages, its pro or counter cyclicity is heavily discussed since 2007 (Otrok & Pourpourides, 2019; Verdugo, 2016). Likewise, the linkage between output and unemployment (i.e., Okun’s Law) has been widely debated since the Great Recession (Grant, 2018). Similarly, the dynamics of output and inflation as explained by the traditional Phillips curve were altered at that time (Huang & Luo, 2018). The depreciation of the U.S. dollar has brought consequences for financial imbalances in other countries (Rajan, 2011; Tervala, 2019).³

4. Data

The annual data for the OECD countries range from 2000 to 2017. The analysed time span allows for a balance between normal times and financial distress by considering seven years preceding the 2007–2009 Great Recession and the difficult post-Great Recession time period of similar length. As concerns I.T., we account for the OECD inflation targeters that adopted I.T. before 2002 (that is for Chile [1999], the Czech Republic [1997], Iceland [2001], Israel [1997], South Korea [2001], Norway [2001], Sweden [1993], Canada [1991], New Zealand [1990], Great Britain [1992], and Poland [1998]). Therefore, we analyse the macroeconomic outcomes of full-fledged inflation targeters where I.T. is sufficiently grounded.

The time series include: real GDP; short-term interest rates; harmonised unemployment rate; consumer prices for all items; average exchange rates in national currency per U.S. dollar; and real wages at 2017 USD PPPs. The data come from the OECD data warehouse. The missing interest rates for Chile from 2012 to 2015 were

Table 3. Descriptive statistics of the variables for the MQM from 2000 to 2017.

| Variable name | Weber's median (σ) | Median (Med) | Median absolute deviation (Mod) | Variation coefficient (V_p) | Variable type |
|--------------------------------------|-----------------------------|--------------|---------------------------------|---------------------------------|---------------|
| Inflation variance | 1.65 | 1.33 | 0.80 | 60.3% | Destimulant |
| Decrease in inflation | 2.21 | 2.45 | 1.02 | 41.5% | Stimulant |
| Variance of the real GDP growth rate | 4.98 | 4.49 | 2.20 | 48.9% | Destimulant |
| Decrease in the unemployment rate | -0.42 | -0.63 | 1.43 | -226.3% | Stimulant |

Source: Own elaboration.

Table 4. Skewness of the diagnostic variables.

| Statistics | Inflation variance | Disinflation | Economic growth variance | Decreased unemployment rate |
|---------------------------|--------------------|--------------|--------------------------|-----------------------------|
| Skewness | 1.72 | 1.77 | 3.17 | 0.42 |
| Weber-median | 1.37 | 0.93 | 3.61 | 0.39 |
| Median | 1.17 | 1.25 | 3.78 | 0.14 |
| median absolute deviation | 0.63 | 0.78 | 1.49 | 1.33 |
| Coefficient of variation | 54.30 | 62.82 | 39.50 | 941.18 |

Source: Own elaboration.

Table 5. Monetary policy regimes and their descriptive statistics from 2000 to 2017.

| Monetary policy regime | Average inflation | Standard deviation of inflation | Average real output growth | Standard deviation of output growth | Average unemployment rate | Standard deviation of unemployment rate | Average short-term interest rates |
|--------------------------------|-------------------|---------------------------------|----------------------------|-------------------------------------|---------------------------|---|-----------------------------------|
| Dual Mandate | 2.46 | 1.83 | 2.47 | 2.78 | 5.82 | 4.21 | 3.19 |
| Flexible I.T. | 2.54 | 2.01 | 3.12 | 3.06 | 5.79 | 4.64 | 3.88 |
| Strict I.T. | 2.17 | 1.94 | 2.65 | 2.97 | 7.53 | 4.47 | 3.92 |
| Two-pillar strategy of the ECB | 2.13 | 1.83 | 1.81 | 2.80 | 5.82 | 4.21 | 3.19 |
| Other | 0.90 | 2.09 | 1.08 | 3.64 | 4.94 | 4.44 | 1.21 |

Notes: see notes to Table 1.

Source: Own elaboration.

linearly interpolated. The missing interest rates for Japan and Slovenia (three and two initial years respectively) and the missing unemployment rate for Iceland (three initial years) were extrapolated with the ETS and ARIMA models according to the AIC, AICc and BIC information criteria.⁴

The diagnostic variables used to construct the MQM have a sizeable variability. The share of the median absolute deviation (Mod) in the median (Med) is higher than the assumed threshold of $V_g = 0.1$. The coefficient of variation for diagnostic variables ranges from 41.5% to |226.3%|. It indicates their high informative value strongly discriminating the examined countries (Table 3). The asymmetrical distribution is strongly (first three diagnostic variables) or moderately right-skewed (Table 4).

Table 5 reveals satisfactory achievements of inflation targeters (including the 'inflation nutters'). They have the highest average real output growth. At the same time, the average inflation is the largest in flexible I.T. adopters and remains large in strict I.T. adopters. It suggests that there existed a room to decelerate the inflation rate at the cost of weaker output growth. The room was, however, not used in spite of the inflation-averse attitude of the I.T.

Table 6. Macroeconomic performance (MQM_1) of the OECD countries from 2000 to 2017.

| Countries | Normalised variables | | MQM_1 | Rank | Group |
|-----------------------|-------------------------|-------------------------------|-------------|-----------|-----------|
| | Inflation variance (X1) | Economic growth variance (X3) | | | |
| Australia* | 0.42 | 0.41 | 0.98 | 1 | I |
| France | 0.67 | -0.27 | 0.97 | 2 | I |
| Norway | 0.46 | -0.08 | 0.96 | 3 | I |
| Canada | 0.81 | -0.54 | 0.96 | 4 | I |
| Austria | 0.73 | -0.66 | 0.95 | 5 | I |
| Belgium | 0.20 | -0.27 | 0.94 | 6 | I |
| New Zealand | 0.28 | -0.44 | 0.94 | 7 | II |
| United Kingdom | 0.51 | -0.75 | 0.94 | 8 | II |
| United States* | 0.14 | -0.40 | 0.94 | 9 | II |
| Denmark | 0.52 | -1.01 | 0.93 | 10 | II |
| Netherlands | 0.43 | -0.93 | 0.93 | 11 | II |
| Japan | 0.47 | -1.10 | 0.92 | 12 | II |
| Germany | 0.83 | -1.57 | 0.92 | 13 | II |
| Korea | 0.18 | -1.15 | 0.91 | 14 | III |
| Italy | 0.28 | -1.30 | 0.91 | 15 | III |
| Portugal | -0.59 | -1.30 | 0.87 | 16 | III |
| Sweden | 0.14 | -2.23 | 0.86 | 17 | III |
| Chile | -1.46 | -1.60 | 0.82 | 18 | III |
| Israel | -1.36 | -1.79 | 0.82 | 19 | III |
| Spain | -0.71 | -2.45 | 0.83 | 20 | III |
| Czech Republic | -0.96 | -3.02 | 0.78 | 21 | IV |
| Poland | -4.01 | -0.49 | 0.76 | 22 | IV |
| Slovenia | -5.55 | -4.59 | 0.53 | 23 | IV |
| Greece | -2.22 | -8.58 | 0.50 | 24 | IV |
| Slovak Republic | -8.29 | -4.49 | 0.42 | 25 | IV |
| Iceland | -7.04 | -6.20 | 0.40 | 26 | IV |
| Ireland | -4.39 | -17.65 | 0.03 | 27 | IV |

Notes: Spearman's correlation coefficient: 0.88. Strict I.T. are typeset bold. Flexible I.T. are highlighted in grey. Australia and the U.S. – both official dual mandated regimes – are marked with an asterisk (*).

Source: Own elaboration.

5. Results

5.1. Macroeconomic quality rankings

The MQM_1 (Table 6) that evaluates output and inflation stabilisation revealed that countries which attained the most successful macroeconomic performance include Australia, France, Norway, Canada, Austria and Belgium (group I). As expected, the worst performing countries (group IV) include many of the so-called GIIPS⁵ economies (that is, the weakest economies during the European debt crisis) like Iceland, Ireland, Greece and post-socialist countries (Slovak Republic, Slovenia and Poland). The MQM_1 seems to capture well the differences in macroeconomic performance across countries from 2000 to 2017. For example, Norway attained significantly better performance than Iceland, although they are both I.T. The reason was the Icelandic systemic banking collapse in 2008 with a serious negative impact on the economy. In consequence, Iceland is occasionally included into the GIIPS group of countries.

The MQM_1 dispels the fears that being a strongly inflation-averse central bank decreases the quality of real economy stabilisation. Excluding post-socialist Poland, there is no significant difference between the average performance of the strict targeters (Canada, New Zealand and the U.K.) on the one hand and Australia and the U.S. on the other hand – while both latter countries officially operate under a dual mandate.

Table 7. Macroeconomic performance (MQM_2) of the OECD countries from 2000 to 2017.

| Countries | Normalised variables | | | | MQM_2 | Rank | Group |
|-----------------------|-------------------------|-------------------|-------------------------------|----------------------------------|-------------|-----------|-----------|
| | Inflation variance (X1) | Disinflation (X2) | Economic growth variance (X3) | Decreased unemployment rate (X4) | | | |
| Poland | -4.01 | 6.51 | -0.49 | 4.23 | 0.79 | 1 | I |
| Australia* | 0.42 | 1.15 | 0.41 | -0.29 | 0.73 | 2 | I |
| Germany | 0.83 | -1.68 | -1.57 | 1.24 | 0.72 | 3 | I |
| New Zealand | 0.28 | -0.61 | -0.44 | 0.03 | 0.72 | 4 | I |
| Israel | -1.36 | -0.49 | -1.79 | 1.37 | 0.72 | 5 | I |
| Slovak Republic | -8.29 | 9.43 | -4.49 | 4.05 | 0.72 | 6 | I |
| France | 0.67 | -0.73 | -0.27 | -0.53 | 0.70 | 7 | II |
| Japan | 0.47 | -2.54 | -1.11 | 0.23 | 0.69 | 8 | II |
| United Kingdom | 0.51 | -3.20 | -0.75 | -0.16 | 0.69 | 9 | II |
| Canada | 0.81 | -0.25 | -0.54 | -0.39 | 0.69 | 10 | II |
| Belgium | 0.20 | -0.96 | -0.27 | -0.69 | 0.69 | 11 | II |
| Norway | 0.46 | -0.16 | -0.08 | -0.99 | 0.68 | 12 | II |
| Czech Republic | -0.96 | -0.05 | -3.02 | 1.94 | 0.68 | 13 | II |
| United States* | 0.14 | -0.12 | -0.40 | -0.74 | 0.68 | 14 | III |
| Chile | -1.46 | 0.29 | -1.60 | 0.70 | 0.68 | 15 | III |
| Korea | 0.18 | -1.06 | -1.15 | -0.27 | 0.66 | 16 | III |
| Austria | 0.73 | -1.12 | -0.66 | -1.27 | 0.64 | 17 | III |
| Netherlands | 0.42 | -0.39 | -0.93 | -1.10 | 0.63 | 18 | III |
| Denmark | 0.52 | 0.39 | -1.00 | -1.19 | 0.62 | 19 | III |
| Italy | 0.28 | -0.06 | -1.30 | -1.10 | 0.61 | 20 | III |
| Sweden | 0.14 | -2.29 | -2.24 | -1.06 | 0.56 | 21 | IV |
| Portugal | -0.59 | 0.12 | -1.30 | -2.29 | 0.54 | 22 | IV |
| Slovenia | -5.55 | 6.17 | -4.59 | -0.53 | 0.46 | 23 | IV |
| Spain | -0.71 | 0.11 | -2.46 | -2.88 | 0.45 | 24 | IV |
| Ireland | -4.39 | 3.91 | -17.66 | -1.56 | 0.37 | 25 | IV |
| Iceland | -7.04 | 2.02 | -6.20 | -0.27 | 0.22 | 26 | IV |
| Greece | -2.22 | 0.67 | -8.58 | -5.02 | 0.01 | 27 | IV |

Notes: Spearman's correlation coefficient: 0.87. Strict I.T. are typeset bold. Flexible I.T. are highlighted in grey. Australia and the U.S. – both official dual mandated regimes – are marked with an asterisk (*). Source: Own elaboration.

Poland, in turn, attained a favourable output stabilisation performance among the Central and Eastern Europe post-transition countries. Despite evidence of assigning positive weights to output gaps in the Czech Republic (Orlowski, 2010; Vašíček, 2010) and the Slovak Republic (Neupauerová, 2006; Vašíček, 2010), neither of the two countries significantly outperformed Poland for both versions of the synthetic measure (Tables 6 and 7). Moreover, empirical studies typically show that the RBA is a flexible inflation targeter that place smaller positive weight on output than on deviations of inflation from the target (Chevapatrakul & Paez-Farrell, 2014). Then, the evidence against the remarkable performance of a dual mandate weakens even more.

However, even if to maintain the assumption of RBA's dual mandate – the ranking changes considerably when to adjust the MQM_1 for achievements in disinflation and unemployment reduction (MQM_2, Table 7). Such an approach is important for post-transition inflation targeters. In studies, where authors base their judgement solely on achievements in minimising the quadratic inflation and output deviations, a successful disinflation strategy paradoxically dooms the emerging country to be inferior-evaluated as compared to countries with long history of stable inflation. Therefore, while MQM_1 favours countries with good economic record, MQM_2 evaluates both the economic record and improvements in macroeconomic performance.

Table 8. The two-sample t-tests for the OECD monetary policy regimes from 2000 to 2017.

| H ₁ : the side has larger mean of the MQM_2 than the header | Dual Mandate | Strict I.T. | Flexible I.T. | Flexible I.T. less Iceland | Euro area | Euro area less GIIPS |
|--|--|---|--|--|---|--|
| Dual Mandate | X | t=-0.61 p ₁ =0.71 p ₂ =0.70 | t = 1.45 p₁=0.10 p₂=0.04 | t = 1.19 p ₁ =0.16 p ₂ =0.15 | t = 2.50 p₁=0.01 p₂=0.004 | t = 1.48 p₁=0.10 p₂=0.06 |
| Strict I.T. | t = 0.61 p ₁ =0.29 p ₂ =0.33 | X | t = 1.75 p₁=0.06 p₂=0.01 | t = 1.85 p₁=0.05 p₂=0.03 | t = 2.83 p₁=0.01 p₂=0.002 | t = 2.03 p₁=0.04 p₂=0.02 |
| Flexible I.T. | t=-1.45 p ₁ =0.91 p ₂ =0.97 | t=-1.75 p ₁ =0.94 p ₂ =0.99 | X | t=-0.91 p ₁ =0.80 p ₂ =0.87 | t = 0.63 p ₁ =0.27 p ₂ =0.31 | t=-0.61 p ₁ =0.72 p ₂ =0.77 |
| Flexible I.T. less Iceland | t=-1.19 p ₁ =0.84 p ₂ =0.87 | t=-1.85 p ₁ =0.95 p ₂ =0.97 | t = 0.91 p ₁ =0.20 p ₂ =0.13 | X | t = 1.90 p₁=0.04 p₂=0.01 | t = 0.50 p ₁ =0.31 p ₂ =0.31 |
| Euro area | t=-2.50 p ₁ =0.99 p ₂ =0.99 | t=-2.83 p ₁ =0.99 p ₂ =0.99 | t=-0.63 p ₁ =0.73 p ₂ =0.67 | t=-1.90 p ₁ =0.96 p ₂ =0.99 | X | t=-1.52 p ₁ =0.93 p ₂ =0.96 |
| Euro area less GIIPS | t=-1.48 p ₁ =0.90 p ₂ =0.95 | t=-2.03 p ₁ =0.96 p ₂ =0.99 | t = 0.61 p ₁ =0.28 p ₂ =0.23 | t=-0.50 p ₁ =0.69 p ₂ =0.72 | t = 1.52 p₁=0.07 p₂=0.05 | X |

Notes: see notes to Table 6. The p₁ and p₂ stand for the p-values of the Welsh t-test and the bootstrapped t-test with 1,000 replicates, respectively. The bolded p-values suggest rejection of H₀ at 10%.

Source: Own elaboration.

According to the MQM_2, the countries that attained the most favourable macroeconomic results are both advanced economies (Australia, Germany, New Zealand, and Israel characterised by successful stabilisation of inflation and output), and post-transition Poland and Slovak Republic as well. In the latter countries, there appeared a considerable fall in inflation and unemployment rate. Again the worst performing group included many of the GIIPS countries. In particular, Greece attained the worst performance with the MQM_2 close to zero (Table 7).

The considerable fall of unemployment rate and successful disinflation after the transition is a valid explanation for an outstanding result of Poland. Alternatively, the National Bank of Poland successfully stabilises the output gap during specific sub-periods (Mackiewicz-Łyziak, 2016) using asymmetric reaction function (Klose, 2019). Moreover, Poland was not that much struck by the 2007–2009 financial crisis, but still New Zealand (Paez-Farrell, 2015), Canada and the U.K. (Nikolsko-Rzhevskyy, 2011) achieved better stabilisation results than Fed (Table 7), although: (1) they have stricter central bank status than Fed; (2) they were empirically proved in some studies to be primarily concerned about inflation; and (3) they experienced a GDP slowdown of similar or larger magnitude than Fed did during the initial phase of the Great Recession.⁶

For the MQM_2, we failed to reject the null hypothesis that the macroeconomic performance of strict inflation targeters is statistically the same as of dual mandates (Table 8). Strict targeters significantly outperformed Fed (t = 1.925, p-value = 0.08). Finally, even if we argue that the considered banks (that is: New Zealand, the U.K., Canada and Poland) are not ‘inflation nutters’, we still fail to reject the hypothesis that the macroeconomic performance of flexible targeters excluding Iceland (one of the GIIPS economies) is statistically the same as of dual mandates (Table 8 and 9).

Table 9. Average macroeconomic performance according to the MQM_1 and MQM_2 for the OECD monetary policy regimes from 2000 to 2017.

| Average | Dual Mandate | Strict I.T. | Flexible I.T. | Flexible I.T. less Iceland | Euro area | Euro area less GIIPS |
|---------|--------------|-------------|---------------|----------------------------|-----------|----------------------|
| MQM_1 | 0.96 | 0.90 | 0.79 | 0.86 | 0.73 | 0.82 |
| MQM_2 | 0.70 | 0.72 | 0.60 | 0.66 | 0.44 | 0.65 |

Notes: GIIPS countries are Portugal, Ireland, Iceland, Greece, and Spain.

Source: Own elaboration.

Table 10. Pooled OLS of the real GDP growth determinants for the sample OECD economies from 2000 to 2017.

| Variable | Coefficient | Std. error | t-ratio |
|--------------------------------------|-------------|------------|-----------|
| Const. | 0.52 | (0.08) | 6.70 *** |
| Dual Mandate | 0.71 | (0.27) | 2.64 ** |
| Flexible inflation targeters | 1.12 | (0.23) | 4.77 *** |
| Strict inflation targeters | 0.57 | (0.13) | 4.38 *** |
| The 'Two-pillar' ECB's strategy | 0.41 | (0.23) | 1.80 * |
| Δ real GDP ($l=1$) | 0.32 | (0.04) | 7.32 *** |
| Δ interest rates | 0.55 | (0.11) | 4.92 *** |
| Δ interest rates ($l=1$) | -0.34 | (0.12) | -2.74 ** |
| Δ interest rates ($l=2$) | -0.13 | (0.11) | -1.17 |
| Δ real wages | 0.0003 | (0.00) | 2.27 ** |
| Δ real wages ($l=1$) | 0.00 | (0.00) | -0.50 |
| Δ real wages ($l=2$) | 0.0002 | (0.00) | 2.16 ** |
| Δ unemployment rate | -1.08 | (0.15) | -7.30 *** |
| Δ unemployment rate ($l=1$) | 0.39 | (0.10) | 3.75 *** |
| Δ unemployment rate ($l=2$) | -0.30 | (0.13) | -2.23 ** |
| Δ inflation | -0.11 | (0.06) | -1.68 |
| Δ inflation ($l=1$) | -0.25 | (0.08) | -3.73 *** |
| Δ inflation ($l=2$) | -0.10 | (0.12) | -0.85 |
| Δ exchange rate | -0.01 | (0.00) | -3.17 *** |
| Δ exchange rate ($l=1$) | 0.001 | (0.00) | 5.52 *** |
| Δ exchange rate ($l=2$) | -0.001 | (0.00) | -2.77 ** |

Number of observations $N=405$; $R\text{-sq.}=0.61$; Adjusted $R\text{-sq.}=0.59$; F -statistic = 209.62 [$p\text{-value} = 8.75\text{e-}24$]; $\rho = -0.06$; $DW = 2.09$; White's test: $LM = 34.1$ [$p\text{-value} = 0.56$]; Pesaran CD test for cross-sectional dependence: $z = 10.36$ [$p\text{-value} = 3.73\text{e-}025$]; Avg. absolute correlation = 0.3. Model with robust HAC std. err.

Notes: l stands for lags in years. Asterisks denote significance for the three commonly used levels: 0.01; 0.05, and 0.1.

Source: Own elaboration.

5.2. Panel data models

According to the pooled OLS, the impact of the monetary policy regimes on real GDP is significant and positive (Table 10) – even for strict inflation targeters. The most efficient in this respect are flexible inflation targeters that outperformed the dual mandated regimes. Strict targeters are inferior to flexible targeters and to a lesser extent to a dual mandate. The inferior performance of the ECB's two-pillar approach may stem from the inclusion of the GIIPS (Greece, Ireland, Italy, Portugal, and Spain) countries in our estimations and insufficient monetary stimulus in response to the European sovereign debt crisis.

For the random effects model with the Swamy and Arora estimator, we have not rejected the null hypothesis of the Breusch-Pagan Lagrange Multiplier for random effects ($X^2 = 2.15$; $p\text{-value} = 0.14$). That is, we found no significant differences across countries and thus the pooled OLS regression is preferable. Despite that, when we

Table 11. H.T. Panel Data Model of the real GDP growth determinants for the sample OECD economies from 2000 to 2017.

| Variable | Coefficient | Std. error | z-value | |
|--------------------------------------|-------------|------------|---------|-----|
| Const. | 0.63 | (0.21) | 3.00 | ** |
| Dual mandate | 1.03 | (0.29) | 3.50 | *** |
| Flexible inflation targeters | 1.41 | (0.26) | 5.45 | *** |
| Strict inflation targeters | 1.01 | (0.26) | 3.84 | *** |
| The 'Two-pillar' ECB's strategy | 0.64 | (0.22) | 2.90 | ** |
| Δ real GDP ($l=1$) | 0.19 | (0.07) | 2.96 | ** |
| Δ interest rates | 0.54 | (0.14) | 3.99 | *** |
| Δ interest rates ($l=1$) | -0.38 | (0.13) | -2.95 | ** |
| Δ real wages | 0.0003 | (0.0002) | 2.16 | * |
| Δ real wages ($l=1$) | 0.0001 | (0.0002) | 1.09 | |
| Δ unemployment rate | -1.04 | (0.15) | -7.08 | *** |
| Δ unemployment rate ($l=1$) | 0.12 | (0.16) | 0.74 | |
| Δ inflation | -0.01 | (0.10) | -0.08 | |
| Δ inflation ($l=1$) | -0.07 | (0.10) | -0.69 | |
| Δ exchange rate | -0.01 | (0.01) | -1.04 | |
| Δ exchange rate ($l=1$) | 0.003 | (0.01) | 0.51 | |

Number of observations $N=432$; R-sq. = 0.58; Adjusted R-sq.= 0.56; F-statistic:=14.38 [p-value = 2.22e-16]; explained sum of squares = 0.50; coefficient of correlation between the fitted values and the response = 0.58; residual sum of squares = 0.57.

Notes: l stands for lags in years. Asterisks denote significance for the three commonly used levels: 0.01; 0.05, and 0.1.

Source: Own elaboration.

estimated various random effects models with different lags up to two years, inflation targeters (both strict and flexible) reported the most favourable outcomes. In turn, the within and between effects as well as the Hausman Test suggested to choose a fixed effect model. The Hausman-Taylor Panel Data Model (H.T.) allows distinguishing between time-varying variables and time-invariant dummies related to the monetary policy regimes (Table 10).

The estimates of the H.T. largely conform to the earlier findings. From 2000 to 2017, the primary determinants of real GDP growth were interest rates, real wages and unemployment rates, whereas the most favourable strategy was flexible I.T. Interestingly, the H.T. evidence against the alleged benefits of a dual mandate is even stronger. The estimates suggest that dual mandate has similar potential to 'inflation nutters' in providing favourable conditions for economic growth (Table 11).

The impact of interest rates on the real GDP is in line with expectations. The influence of interest rates on GDP was evidenced by Wesolowski (2018) and Simionescu et al. (2017), among others. Higher (lower) growth of real GDP is related to higher (lower) interest rates in the same time period to decrease/accelerate consumer inflation. The sign of the coefficients' estimates on the one year-lagged interest rates is opposite to the real GDP change. Interest rates lagged two years are statistically insignificant in explaining the real output.

6. Discussion

The findings suggest that the benefits of a dual mandate may be overstated (Putnam & Azzarello, 2015). Indeed, we evidenced that the macroeconomic performance of inflation targeters (without Iceland, but including 'inflation nutters') is statistically the same as of dual mandated regimes (Table 8). Additionally, according to the panel

data models, the estimated impact of the monetary policy regimes on real GDP is larger for flexible inflation targeters than for the dual mandated regimes (Tables 10, 11). Moreover, the estimates in Table 11 suggest that the dual mandated regimes have similar potential to 'inflation nutters' in increasing economic growth.

The favourable results of inflation targeters confirm the 'divine coincidence' described by Blanchard and Galí, (2007) which is the ability of the monetary authority to simultaneously stabilise the inflation rate and the output gap. The possible explanation of this ability could be that unemployment and output gap might be present in the reaction functions of inflation targeters as forecasts of future inflation. Central banks may be thus dual mandated 'at heart' regardless of the formal status (Rosengren, 2014; Ryczkowski, 2016). In line with such an interpretation, Punnoose and Wadsworth (2018) find that the responses of monetary policy in New Zealand and the U.S. to changes in inflation and output were similar.

Finally, the results presented in Tables 8, 10 and 11 show that the euro area countries attained inferior macroeconomic performance and the ECB boosted economic growth to a lesser extent than inflation targeters including strongly inflation-averse central banks. In sum, the confrontation of the dubious benefits of both dual mandate and the ECB's two-pillar strategy evidenced by us with the well-known objections against the two conceptions in the subject literature, suggests that I.T. remains the preferable strategy. The statement of Friedman (2008) that I.T. is unlikely to be consistent with pursuing price stability and real economy objectives seems to be false.

7. Conclusion

The article evaluates macroeconomic performance of the 27 OECD countries through the lens of their monetary policy regimes from 2000 to 2017. The time span allows assessing the inflation and resource utilisation during the seven years preceding the 2007–2009 global financial crisis and during the post-Great Recession environment of similar length. The results are relevant for practitioners, economics theory and the design of monetary policy after the Great Recession.

The contribution of the article is threefold. First, we propose a new synthetic indicator adjusted for the initial economic conditions. The failure to account for them leads to underestimation of the macroeconomic performance of countries with originally unfavourable situation. Second, the indicator is median-based, which is useful as the sample countries have strongly diversified output and unemployment dynamics. Third, we apply a range of panel data models to robustify our findings. The models are augmented with macroeconomic variables that played a key role in monetary policy after the Great Recession.

Accounting for achievements in disinflation and unemployment reduction, we found no advantage of the euro area countries and countries the whose central banks follow a dual mandate in inflation and output stabilisation as compared to full-fledged inflation targeters (omitting Iceland with its systemic banking collapse in 2008). Interestingly, the group of strongly inflation-averse central banks achieved similar macroeconomic performance to the group made up of the Fed and the Reserve Bank of Australia. Without the highly prosperous Reserve Bank of Australia,

strict targeters significantly outperformed Fed. The considered euro area countries attained the least favourable macroeconomic performance. Even without the so-called GIIPS economies (that is, the weakest economies during the European debt crisis: Greece, Ireland, Italy, Portugal, and Spain), the macroeconomic performance of the euro area countries was significantly inferior to ‘inflation nutters’, the dual mandated regimes but comparable to flexible inflation targeters.

The countries that attained the most favourable macroeconomic results are both advanced economies (Australia, Germany, New Zealand, and Israel characterised by successful stabilisation of inflation and output), and post-transition Poland and the Slovak Republic as well. In the latter countries, there appeared a considerable fall in inflation and unemployment rate. The worst performing group included many of the GIIPS countries. In particular, Greece attained the worst performance with our macroeconomic performance measure close to zero.

When we analysed solely the achievements in minimising the inflation and output deviations, that is without accounting for achievements in disinflation and unemployment reduction, the ranking changed in line with expectations. The group of countries which attained the most successful macroeconomic performance included Australia, France, Norway, Canada, Austria and Belgium. As expected, the worst performing countries included many of the GIIPS economies such as Iceland, Ireland, Greece but also the post-socialist countries (the Slovak Republic, Slovenia and Poland). The comparison of both rankings confirms that the failure to account for the initial conditions leads to underestimation of performance of countries with an originally unfavourable economic situation.

According to the panel data models, the group of flexible I.T. countries was the most successful in boosting of the real GDP growth. Moreover, our estimates suggest that a dual mandate has similar or only slightly higher potential than ‘inflation nutters’ in influencing the economic growth. Finally, we show that the ECB’s ‘two-pillars’ had the weakest impact on the real GDP growth. Overall, the study suggests that assigning official roles to output/employment (dual mandate) and money (the ECB’s two-pillar strategy) in monetary policy framework is not required for a successful macroeconomic performance.

Notes

1. Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, South Korea, Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, the U.K., and the U.S.
2. The term ‘inflation nutters’ is somehow arbitrary. For example, Great Britain employed quantitative easing to support the economy in response to the Great Recession 2007–2009. Nevertheless, the deflation threat also justified such a policy. In the period following 2009, inflation was close to the 2% inflation target (the peak inflation of 3.8% was in 2011 but in 2012 it dropped to 2.6% and was near the 2% inflation target). Any doubts concerning the question whether particular central banks are inflation nutters do not, however, invalidate the general findings for the I.T. strategy.
3. Certainly, much more variables can determine economic growth including, for instance, higher initial schooling, life expectancy or fertility as Barro (1996) finds in his panel study

of around 100 countries. Nevertheless, we neglect them since our time span is relatively short while at least some of the variables seem to affect growth in the longer run. Moreover, we compare developed OECD economies between each other so that we do not expect that large differences of the afore-mentioned variables as in case of a large group of countries used by Barro (1996).

4. Japan: ETS (M,N,N) model ($\alpha = 0.99$; initial states = 0.05; $\sigma = 0.50$), Slovenia: ETS (A,N,N) model ($\alpha = 0.99$; initial states = -0.15 ; $\sigma = 1.20$); Iceland: ARIMA (1,0,0) ($\sigma^2 = 1.61$; log Likelihood = -24.15).
5. GIIPS countries are sometimes abbreviated PIIGS. The latter is, however, a derisory and pejorative acronym.
6. In the U.S., the real GDP growth rate fell by 2.0 p.p. from 2007 to 2008 [that is from a real growth of 1.9% in 2007 to -0.1% in 2008]. The fall of the real GDP growth was larger in the U.K. and New Zealand. In the U.K., the real GDP growth rate fell by 2.2 p.p. [that is from a real growth of 2.5% in 2007 to -0.3% in 2008]. In New Zealand, the real GDP growth rate fell by 3.2 p.p. [that is from real growth of 3.3% in 2007 to 0.1% in 2008]. In Canada, the real GDP growth rate fell by 1.1 p.p. [that is from real growth of 2.1% in 2007 to 1.0% in 2008]. For quarterly data [the timing of the recession varied from country to country], Canada experienced a GDP slowdown of larger magnitude than Fed. The U.K. experienced a GDP slowdown of similar magnitude to Fed when an initial slowdown of economic growth has appeared for the first time. The fall of quarterly seasonally adjusted real GDP. amounted to 1.1 p.p.; 0.6 p.p. and 2.0 p.p. in the U.K., New Zealand and Canada, respectively. The analogous value in the U.S. was 1.2 p.p. (1q/2q 2008).

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