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FISCAL POLICY AND INFLATION VOLATILITY

by Philipp C. Rother

EUROPEAN CENTRAL BANK

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In 2004 all publications will carry a motif taken from the €100 banknote.

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Abstract

Among the harmful effects of inflation, the negative consequences of inflation volatility are of particular concern. These include higher risk premia, hedging costs and unforeseen redistribution of wealth. This paper presents panel estimations for a sample of OECD countries which suggest that activist fiscal policies may have an important impact on CPI inflation volatility. Major results are robust for unconditional and conditional inflation volatility, the latter derived from country-specific GARCH models, and across different data frequencies, time periods and econometric methodologies. From a policy perspective, these results point to the possibility of further destabilising effects of discretionary fiscal policies, in addition to their potential to destabilise output.

JEL classification: E 31, E 62

Keywords: inflation volatility; fiscal policy

Non-technical summary

A lack of price stability exerts harmful effects on the economy not only through changes in the price level but also through increased price level uncertainty. High volatility of inflation over time raises such price level uncertainty. In a world with nominal contracts this induces risk premia for long-term arrangements, raises costs for hedging against inflation risks and leads to unanticipated redistribution of wealth. Thus, inflation volatility can impede growth even if inflation on average remains restrained.

This paper investigates whether activist fiscal policies may have an impact on inflation volatility. The reasoning behind this conjecture is the following: Discretionary fiscal policy changes can have an impact on aggregate demand which may result in changes in output and or the price level. In addition, the price level can be affected as changes in public wages can spill over into the private sector and changes in tax rates can affect marginal costs and consumption.

While in the longer run monetary policies may be able to offset the short term inflationary impact of discretionary fiscal policies, this impact may well manifest itself in short run fluctuations of the price level, in other words inflation volatility. The offsetting effect of monetary policy may also explain why empirical studies have in may cases found only inconclusive evidence regarding the link between fiscal policies and inflation. With the relevant fiscal variables being available only at annual frequency, empirical approaches may fail to capture inflationary effects at higher, e.g. monthly, frequencies.

To uncover possible links between discretionary fiscal policies and inflation volatility, this paper presents panel data regressions for 15 OECD countries covering the past 35 years. In particular, different measures of inflation volatility are regressed on a variable reflecting the degree of fiscal policy activism and on a number of additional explanatory variables, such as the output gap, monetary and exchange rate variables. The different measures for inflation volatility include the unconditional volatility of monthly CPI and core inflation as well as conditional inflation volatility derived from

GARCH models for each individual country. In addition, regressions were run for annual fiscal data and for non-overlapping five year intervals as well as for different sample periods.

The empirical results suggest that volatility in discretionary fiscal policies has contributed to inflation volatility in the sample analysed. The results are robust with regard to changes in the specification of inflation volatility, the data frequency, the sample period and econometric methodology. Regarding the size of the impact, an increase in discretionary fiscal policy volatility by one standard deviation is could raise inflation volatility by 10% to 17%.

From a policy perspective, the results provide further evidence that discretionary fiscal policies may have de-stabilising rather than stabilising effects on the economy. Previous results have shown that discretionary fiscal policies can increase output volatility. Possible reasons for these findings include the fact that such measures tend to take time to decide and implement, making them effective only when the business cycle has turned. In addition, as discretionary measures are usually not reversed automatically with a changing economic environment, further discretionary acts are necessary to revert to the long-term fiscal balance. The present study suggests that such effects are not limited to output volatility but extend to inflation.

1. Introduction

Among the harmful effects of inflation, the negative consequences of inflation volatility are of particular concern. High variability of inflation over time makes expectations over the future price level more uncertain. In a world with nominal contracts this induces risk premia for long-term arrangements, raises costs for hedging against inflation risks and leads to unanticipated redistribution of wealth. Thus, inflation volatility can impede growth even if inflation on average remains restrained.

The purpose of this paper is to provide evidence suggesting that discretionary fiscal policies may have contributed to higher inflation volatility. Possible channels through which fiscal policies can affect inflation include their impact on aggregate demand, spillovers from public wages into private sector as well as taxes affecting marginal costs and private consumption. In addition, fiscal policy can affect inflation through public expectations regarding the ability of future governments to redeem the outstanding public debt.

Empirical results in the literature regarding the impact of fiscal policies on inflation are mixed. While there is some support for a link when looking at instances of high inflation, findings outside such environments tend to suggest at best a weak relationship. A possible reason for the relatively weak empirical results lies in the ability of monetary policy to offset short term inflationary effects of fiscal policies, neutralising them in the long run. As fiscal policy data are generally available only at relatively large intervals, empirical analyses may fail to detect existing short-run relationships.

The approach adopted in this paper accounts for the empirical problems by analysing the impact of annual changes in discretionary fiscal policies on higher frequency price developments. In particular, this paper analyses the impact of the volatility of discretionary fiscal policies on the volatility of inflation rates, taking other possible explanatory factors into account. This approach is similar to Fatas and Mihov (2003) who find that discretionary fiscal policies have contributed significantly to output volatility in a wide range of countries. Applying their basic approach to inflation, this study finds empirical support for the view that changes in the fiscal policy stance show a significant positive correlation with inflation volatility, based on panel data for 15 OECD countries over the past 35 years. The results are robust regarding unconditional and conditional inflation volatility as well as regarding changes in the time period, data frequency and econometric methods. I interpret these findings as suggestive of an important impact of activist fiscal policy on inflation volatility.

The paper is structured as follows. The next section presents a survey of the literature on two areas of interest for this study, namely the impact of inflation volatility on growth and the empirical link between fiscal policies and inflation. The third section presents the empirical set-up and the fourth section the results. The final section concludes.

2. Literature

2.1. Growth effects of inflation volatility

The importance of inflation volatility has been a major aspect in the literature on the relationship between inflation and growth. While there is broad agreement that high inflation and associated high inflation volatility are generally harmful to growth, only few studies focus on disentangling the individual channels through which such effects occur. Nevertheless, Judson and Orphanides (1999) find some evidence that inflation volatility, measured by the standard deviation of intra-year inflation rates, has contributed significantly to lower economic growth in a wide panel of countries. This supports Friedman's (1977) conjecture that the harmful effect of inflation on growth is driven by inflation volatility. Additional evidence in this direction is provided by Froyen and Waud (1987), who find that high inflation induces high inflation volatility and uncertainty in the USA, Germany, Canada and UK. For the latter two they also report a negative impact of inflation uncertainty on growth. Similarly, Al-Marhubi (1998) finds negative growth effects of conditional and unconditional inflation volatility for a panel of 78 countries. Finally, Blanchard and Simon (2001) find a strong positive link between inflation volatility and output volatility for large industrialised countries.

2.2. Fiscal policies and inflation

The empirical literature on the link between fiscal policies and inflation can be broadly classified into two strands. Literature belonging to the first strand tends to look at the longer term, trying primarily to establish to what extent large and persistent deficit levels have an impact on inflation. The second strand consists of more recent contributions focusing on the impact of changes in fiscal policies, i.e., fiscal shocks, on inflation. The two categories, reviewed below, share the problem that empirical investigations have generally found only relatively small and statistically weak effects from fiscal policies to inflation. A third approach linking the two variables is provided by the fiscal theory of the price level, presented at the end of this section.

Fiscal deficits and inflation

Taking the monetary nature of inflation as a starting point, the theory-based part of the literature investigates the relationship between fiscal policies and monetary policies and the resulting impact on inflation. The question under study is under which conditions fiscal policy considerations could drive

monetary policies and, eventually, inflation. One link is through a dependent central bank. If the government has a strong saying in monetary policy, there is a high probability that it will use its power for its own objectives. Thus, the government might simply resort to the central bank to finance deficits directly or it might put pressure on the central bank to keep the interest rate level low and reduce government borrowing costs. Similarly, in conflicts over economic policies strong governments may force the central bank into accommodating their policies (Sargent and Wallace, 1981). But also independent central banks might have an incentive to generate surprise inflation in response to fiscal developments. Similar to the time inconsistency problem applied to the central bank problem by Barro and Gordon (1983), independent central banks may induce higher inflation if they perceive maintaining fiscal sustainability through consolidation as more costly for the economy. Such conflicts could be addressed through adopting a conservative central banker (Rogoff, 1985) or through adopting particular policy rules, e.g., defining inflation as the principal policy objective.

The empirical support for a causal relationship between the level of fiscal deficits and inflation through the monetary channel is somewhat mixed. A range of studies finds that separating the central bank from the government has indeed resulted in lower inflation rates, thus lending support to the hypothesis that government influence on monetary policy raises inflation. However, other studies (Fuhrer 1997, Campillo and Miron, 1996, also surveying the literature supporting the importance of central bank independence) indicate that the impact of central bank independence declines once other factors are accounted for.

Direct empirical approaches linking the level of government deficits (and debt) to inflation performance also appear to yield strong results only for restricted country samples. For example, while Fischer, Sahay and Vegh (2002) find a strong relation in a broad country sample between fiscal deficits and high inflation, they do not find such a link for low inflation rates. Similarly, Cottarelli et al. (1998) find a strong impact of fiscal deficits on inflation in countries where securities markets are not strongly developed, suggesting that limited access to financial markets drives governments to resort to central banks for financing needs. This interpretation is supported by the findings of Catao and Terrones (2001) who report a strong positive deficit-inflation relationship for a panel of 23 emerging market countries using a dynamic panel estimation. Finally, for ten accession countries Arratibel et al. (2002) provide evidence of a significant impact of fiscal deficits on inflation. In this study, the results are derived from a model assuming an independent central bank behaving optimally, which would preclude the central bank channel as the link between the deficit and inflation.

Fiscal shocks and inflation

This strand of literature tends to focus on the impact of fiscal policy shocks on inflation and other macroeconomic variables, abstracting from rigid theoretical models. Similar to the longer-term studies

it has generally found only loose relationships between fiscal policy shocks and inflation. The VAR based analyses study the macroeconomic impact of fiscal policies relying only on a limited set of identifying restrictions. For example, Perotti (2002) sets up a VAR for 5 OECD countries to study the impact of fiscal policy on GDP and its components, the price level and the short term interest rate. He finds a small positive impact of fiscal policies on prices about 4 quarters after the shock for all countries excluding the US, while he also points to a relatively large degree of uncertainty around these results. For the four largest euro area countries, also Marcellino (2002) finds a small positive relationship, although differences across countries are large. For the US, Perotti's findings are supported by Fatas and Mihov (2002). Similarly, Mountford and Uhlig (2002) report for the US a weak link between fiscal policies and inflation which depends to a large extent on the respective model specification.

A major issue in such studies is the identification of independent fiscal policy shocks. Four alternative approaches have been applied in the literature. First, fiscal policy shocks can be identified by looking at specific episodes, such as the requirements to finance wars in the US history. The second alternative is to use sign restrictions, identifying fiscal shocks through exogenous assumptions on the co-movement of a set of variables (e.g., Mountford and Uhlig (2002)). For example, a positive revenue shock would require an increase in revenues while expenditures remain constant. Third, researchers have employed Choleski ordering, imposing the restriction that fiscal shocks affect contemporaneously the endogenous macroeconomic variables but not vice versa (e.g. Fatas and Mihov (2002)). The fourth approach, also adopted by Perotti (2002) and Marcellino (2002), consists in exploiting the institutional information and lag structure of fiscal policies. In particular, discretionary fiscal policies take at least one quarter to be implemented so that contemporaneous changes of fiscal and macroeconomic variables can only be the result of automatic reactions. Using estimates of the elasticities of the automatic fiscal reactions then allows to derive the discretionary fiscal shocks.

Fiscal theory of the price level

A relatively recent theory suggests an immediate impact of fiscal policies on the price level independent of monetary variables.[2] This fiscal theory of the price level considers the price level as the crucial adjustment variable to ensure the fulfillment of the government's intertemporal budget constraint. This constraint equates in real terms the government's current liabilities to the net present value of government revenues, i.e., future primary surpluses and revenues from money creation. Under the condition that Ricardian equivalence does not hold and with a strongly committed and independent central bank, imbalances in the intertemporal budget constraint need to be adjusted through shifts in the price level. In other words, if future primary surpluses are perceived as insufficient to guarantee

[2] See Giammarioli and Strauch (2002) for a comprehensive discussion.

fiscal solvency and the central bank will not generate seigniorage, balance is achieved through an adjustment in the price level. The adjustment is driven by a wealth effect. Absent Ricardian behaviour, individuals perceive government deficits as increases in wealth which induce them to raise spending, thus driving up the price level. By contrast, with Ricardian equivalence, the wealth effect of deficits would be neutral, leaving the central bank in control of the price level.

Empirical studies regarding the fiscal theory of the price level are scarce and their results are mixed. Studies take the identification of Ricardian v. non-Ricardian behaviour as the core prerequisite for the validity of the theory. However, a major obstacle lies in the fact that such behaviour can only be identified if the government's intertemporal budget constraint is not balanced, while in practice only the equilibrium realisations of the constraint can be observed. Thus, the studies analyse to what extent observed behaviour of fiscal and price variables is in line with the underlying assumptions of the fiscal theory. Using this approach, Canzoneri et al. (2001) conclude that US data are more in line with Ricardian behaviour. By contrast, Cochrane (1998) and Woodford (1998) find evidence of non-Ricardian behaviour, at least for some periods in the US history. For the EU, Afonso (2002) reports Ricardian government behaviour.

3. Empirical approach

The empirical approach in this paper is based on the fiscal shock approach described above. The relatively weak findings in this literature regarding the impact of fiscal policies on inflation may be due to the higher rigidity of fiscal policies relative to monetary policies. As fiscal policies are usually only decided and implemented at annual frequency, a fiscal impact on annual inflation rates may be difficult to detect, if monetary policies react in a more flexible way to offset possible inflationary effects. Thus, such effects become purely transitory as the price impact of discretionary fiscal policies would show only for a limited period after which it is compensated by monetary policies. In fact, the literature on the interaction between monetary and fiscal policies has identified a tendency of those policies to offset each other in industrialised countries (Melitz (1997), von Hagen et al. (2001), van Aarle et al. (2001), Muscatelli et al. (2002)).

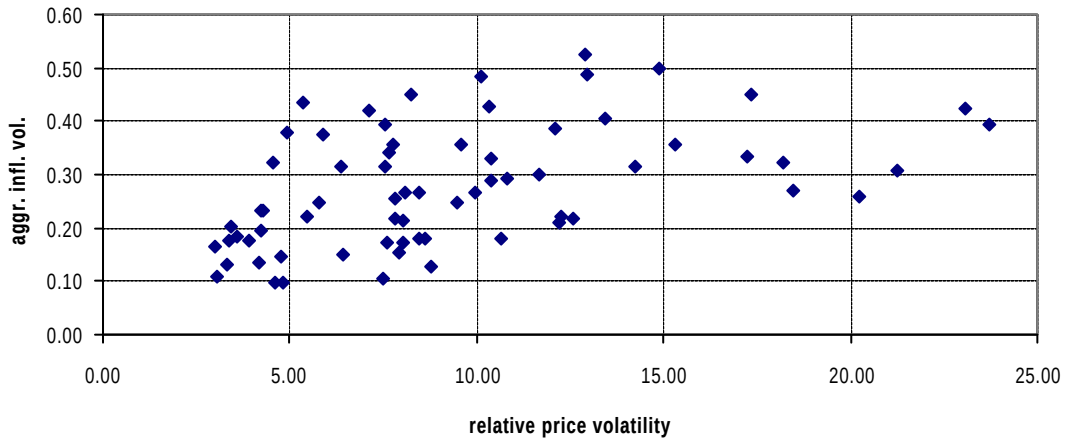
3.1. Relative price uncertainty

Before turning to the empirical implementation of the above considerations it is worthwhile to address a separate aspect of price uncertainty. In particular, it has been noted that uncertainty of economic agents over prices of specific goods or good classes relative to other goods may affect economic decisions. Most importantly, investment could be negatively affected if producers have to base their decisions on uncertain projections of future relative prices (see Neumann and von Hagen (1991)).

While a full analysis of relative price volatility is beyond the scope of this paper, evidence from European countries suggests that aggregate inflation volatility as analysed in this paper is positively related to the variability of relative prices. The analysis is based on 40 COICOP goods classes for which harmonised monthly data from 1996 to 2001 are available for the European countries in this study.[3] For these, relative monthly price changes were calculated as the month-on-month change in the price level of a particular goods class relative to the price level of the CPI basket. The variability of relative prices was then computed as the weighted sum of squared relative price changes using CPI basket weights. Thus, months with widely diverging relative price changes represent instances of high relative price variability, whereas the measure is zero if the price changes are equal for all goods classes. Finally, annual observations are the average of monthly values.

Chart 1 shows that there is a positive correlation between the measure for aggregate inflation uncertainty (y-axis) discussed below and the measure for relative price variability (x-axis) for the twelve European countries in the study between 1996 and 2001. In other words, high aggregate inflation volatility tends to coincide with high relative price variability, suggesting that a rise in the former might have additional negative effects through the latter.

Chart 1: Volatility of relative prices and of aggregate inflation



3.2. Key variables

This paper will try to establish the links between a measure for higher frequency aggregate inflation volatility and a measure of fiscal policy volatility for a panel of OECD countries, controlling for a set of possible additional explanatory factors. Essentially, the aim is to explain inflation volatility as a function of the volatility of activist fiscal policies and a set of additional variables

[3] The classes are those carrying three digits in the COICOP classification.

$$s_t^p = a_0 + a_1 s_t^d + a_2' X_t + u_t, \quad (1)$$

where s^p denotes inflation volatility, s^d the volatility of discretionary fiscal policies and X_t a vector of additional explanatory variables.

The results from this empirical specification are open to different ways of interpretation. The view adopted here, that activist fiscal policies may have an important impact on inflation volatility, is broadly consistent with the findings in the literature reviewed above. By contrast, a positive correlation between the two variables of interest could also be the result of reverse causality, i.e., higher inflation volatility causing more activist fiscal policies. In addition, the results could be driven by a third, omitted variable that affects inflation volatility and the volatility of discretionary fiscal policies simultaneously. However, these latter two interpretations would be more difficult to reconcile with the evidence in literature.

Two alternative measures for inflation volatility are employed, namely the unconditional and the conditional variability of the inflation rate. The former is defined as the standard deviation over a calendar year of month-on-month inflation rates, based on the CPI basket. Thus, the unconditional inflation volatility measure captures the extent of short-term fluctuations in inflation. The idea underlying this approach is that changes in discretionary fiscal policies either directly or indirectly induce reactions in inflation, making it more volatile in the short run. By contrast, conditional inflation variability is measured by the standard deviation of one-step-ahead forecast errors derived from a time-series based inflation forecast model (presented formally below). Thus, the implicit assumption is that changes in discretionary fiscal policies make inflation forecasting more difficult which is reflected in larger forecast errors.

While the use of conditional variances may appear better suited to capture the effects of inflation uncertainty, there are good reasons to take both forms of inflation volatility into account. As inflation expectations are not observable a general caveat to using conditional variances is that the results will only hold for the specific underlying model used to generate the aggregate inflation expectations. A change in the expectation model may result in different conclusions. In addition, from a practical point of view conditional and unconditional inflation volatilities tend to be highly positively correlated. Thus, using unconditional variances could be expected to yield results broadly representative also for inflation expectations, while eschewing the problems related to forecast modeling.

To measure the volatility of discretionary fiscal policies, the analysis below looks at variations in the fiscal policy stance. The fiscal policy stance is defined as the year-on-year change in the cyclically adjusted primary balance relative to GDP. Thus, taking out from the overall budget balance the effects

of changes in interest payments and in the economic cycle, it reflects the net budgetary impact of activist fiscal policy measures. Regarding the method to compute cyclically adjusted balances, this paper uses OECD estimates which are based on the production function approach.[4]

The link between inflation volatility and discretionary fiscal policies is tested empirically at two frequencies, reflecting the trade-off between the advantages of higher data availability at the annual level and the dis-advantage that volatility of discretionary fiscal policies can be modeled strictly only at a multi-annual frequency. In particular, using five-year non-overlapping intervals, the variability of activist fiscal policies is measured by the standard deviation over this period of the annual changes in the fiscal policy stance. By contrast, with annual data frequency, the variability of activist fiscal policies is captured by the absolute change in the fiscal stance between two years.

3.3. Other variables

In addition to the variability of discretionary fiscal policies, other variables are expected to have an impact on inflation volatility. First, it has been observed empirically that inflation volatility is highly correlated with the level of inflation. To account for this relationship, the regression includes the level of inflation as an additional explanatory variable. In addition, according to theory inflation is linked to the size of the output gap, reflecting the impact of aggregate demand. Thus, the variability of the output gap could be expected to affect the volatility of inflation. Moreover, in practice the size of the government may have an impact on price dynamics. Large governments tend to reduce the volatility of output and inflation in response to demand shocks through the operation of automatic fiscal stabilisers.[5] Therefore, if such shocks are an important source of volatility in the economy, the size of the government would be expected to have a negative impact on inflation volatility.

Turning to monetary policies, given the reasoning above, the effect of monetary policies offsetting inflationary fiscal policies will itself induce inflation volatility. In addition, independent variations in monetary policies may add to inflation volatility. As a consequence, a variable reflecting the volatility of monetary policies is also included in the model.

Finally, in an open economy, CPI inflation will in part be determined by price movements of foreign goods. This could occur due to the direct inclusion of such goods in the consumption basket or through their use as intermediate inputs. According to this reasoning, inflation volatility would be expected to

[4] See van den Noord (2002) for a description and Bouthevillain et al. (2001) for a general discussion of cyclical adjustment. Using fiscal stance data based on the IMF World Economic Outlook in the major regressions does not change the results materially.

[5] See Martinez-Mongay (2001) for empirical evidence regarding this relationship.

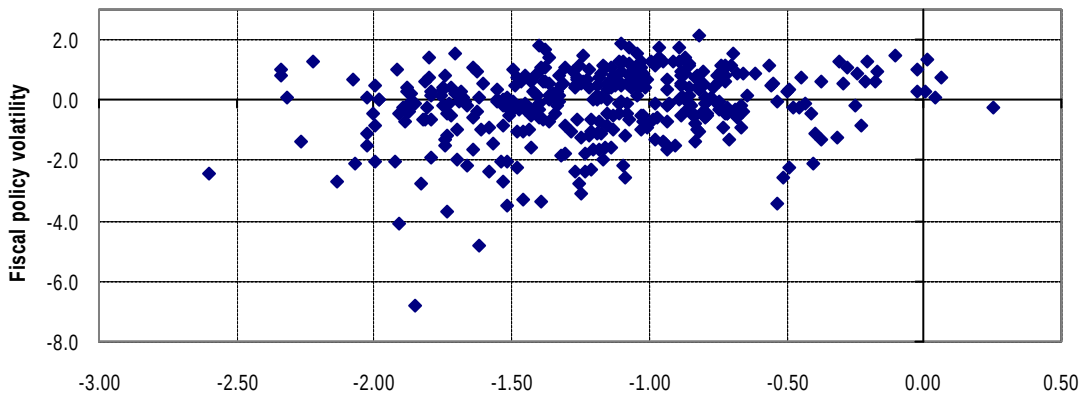
increase with the volatility of the nominal exchange rate, foreign price volatility and the openness of the economy. However, another effect might offset this impact. With sticky domestic wages and prices, adjustments to shocks to the economy will occur to some extent through the exchange rate. In this situation, movements in the nominal exchange rate would substitute for changes in prices, implying a negative relationship between variations in the two variables. Thus, the overall effect is not clear from the outset.

4. Results

4.1. Visual analysis

Chart 2 presents a scatterplot of the two key variables in this study, using annual data. Inflation volatility, measured by the (log of the) standard deviation of monthly inflation rates, is presented along the x-axis, while fiscal policy volatility, measured by the (log of) absolute changes in the cyclically adjusted primary balance, is presented along the y-axis. Although the graph does not allow any firm inference, there appears to be some positive relationship between the two variables when other explanatory factors are excluded.

Chart 2: Volatility of inflation and discretionary fiscal policies



4.2. Annual data

As discussed above, the empirical analysis involves the fixed effects panel estimation of a single equation explaining inflation variability for 15 industrialised countries.[6] To account for possible cross-

[6] The countries are Austria, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Ireland, Italy, Japan, the Netherlands, Spain, Sweden and the United States. Data are from the OECD. Tables describing the data can be found in the Appendix.

sectional heteroskedasticity, the estimation method is Generalised Least Squares using estimated cross-section residual variances as weights. The estimation period is 1967 through 2001.

The following equation is estimated for annual data:

$$SD\_INFL_{i,t} = b_{i,0} + b_1\ INFL_{i,t} + b_2\ D\_STNC_{i,t} + b_3\ D\_YGP_{i,t} + b_4\ GX_{i,t} + b_5\ SD\_MY_{i,t} + b_6\ SD\_ER_{i,t} + b_7\ IMP_{i,t} + e_{i,t} \quad (2)$$

where *i* denotes the country and *t* the time indicator. At the level of annual frequency, variations in activist fiscal policies and in the output gap can only be measured by single observations. Therefore, the empirical specification tests whether absolute changes in the fiscal policy stance (D_STNC) and in the output gap (D_YGP) are positively related to changes in the volatility of inflation (SD_INFL). The share of government expenditure in GDP (GX) reflects the smoothing impact of large governments on inflation. In line with the reasoning above, the impact of monetary policies is reflected by the volatility of the ratio of broad money to GDP (SD_MY). To reflect the impact of foreign prices on domestic inflation, the volatility of nominal exchange rates (SD_ER) and the share of imports relative to GDP (IMP) are included. The method to generate a measure for inflation volatility explained above, namely using the standard deviation (SD_) of monthly observations, is also used to derive the volatilities regarding monetary policies and the exchange rate. Finally, the level of inflation (INFL) is included to reflect the observation that empirically high inflation volatility is associated with high levels of inflation.[7]

The regression results support the reasoning presented above. Looking at the basic specification presented in column (1) in Table 1, almost all variables are found significant with the expected signs in the estimation, where lags for inflation volatility and for the level of inflation are included to account for serial correlation and the prefix "L" indicates natural logarithms of the respective variable. Inflation volatility responds positively to its own lags and the level of inflation. Lagged inflation is found to have a smaller negative impact on volatility. The coefficient on the absolute change in the fiscal stance has the expected positive sign and is highly significant, suggesting that a change in the fiscal stance between years *t*-1 and *t* drives up the volatility of the inflation process in *t*. The size of the government in the previous period has the expected moderating impact.

[7] The impact of oil price volatility and short-term interest rate volatility were tested but did not yield significant results.

Table 1: Dependent variable: LSD_INFL; annual observations

	CPI inflation				Core inflation			
		time dummies	sample 80-2001	sample 80-2001; time dummies		time dummies	sample 80-2001	sample 80-2001; time dummies
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LSD_INFL(-1)	0.216** 4.27	0.212** 3.83	0.284** 5.31	0.278** 4.87	0.348** 6.17	0.343** 5.24	0.414** 7.00	0.401** 6.04
LSD_INFL(-2)	0.091* 1.93	0.105** 2.02			0.114** 2.05	0.079 1.27		
INFL	0.069** 7.60	0.082** 5.60	0.087** 8.41	0.100** 6.04	0.078** 8.07	0.089** 6.33	0.099** 8.16	0.108** 6.41
INFL(-1)	–0.029** –3.46	–0.026** –2.15	–0.040** –3.60	–0.037** –2.19	–0.044** –4.23	–0.042** –2.77	–0.059** –4.96	–0.058** –3.24
LD_STNC	0.033** 2.77	0.037** 2.92	0.022* 1.90	0.026** 2.00	0.027** 2.40	0.023* 1.77	0.023** 1.97	0.019 1.40
LD_YGP(-1)	0.027** 2.19	0.021 1.53	0.025* 1.89	0.015 1.06	0.002 0.19	0.001 0.07	–0.002 –0.14	–0.005 –0.34
GX(-1)	–0.014** –3.25	–0.011* –1.87	–0.017** –3.89	–0.012** –2.40	–0.006 –1.52	–0.010 –1.63	–0.004 –0.81	–0.009 –1.52
SD_ER(-2)	0.011** 2.60	0.014* 1.86	0.014** 3.21	0.017** 2.10	–0.005 –1.26	0.002 0.29	–0.003 –0.51	0.009 1.17
SD_MY(-1)	0.071* 1.80	0.055 1.16	0.061 1.53	0.054 1.20	0.025 0.52	0.007 0.11	0.020 0.37	0.001 0.01
IMP	–0.0004 –0.14	0.002 0.58	–0.002 –0.93	0.001 0.32	0.004** 2.13	0.005* 1.86	0.004** 1.99	0.004 1.60
adj. R^2	0.62	0.63	0.65	0.69	0.63	0.62	0.65	0.68
No. of obs	342	342	285	285	313	313	266	266

t-statistics using White heteroskedasticity consistent standard errors are reported below the coefficient estimates. Estimation uses GLS with cross section weights. **, * denote significance at the 5% and 10% level, respectively.

Also the results for the remaining explanatory variables are in line with the expectations. First, inflation volatility rises one period after a change in the output gap. Similarly, it rises with a one-period lag to volatile monetary policies. The results for the variables reflecting the external sector developments need to be interpreted cautiously. While exchange rate variability is found to be positively related with inflation variability, the two year lag appears rather long. In addition, the coefficient on the level of imports is far from significant, suggesting that the exchange rate effect may work through other channels than the inflation rate for imported goods in the CPI basket.

4.3. Robustness of results from annual data

To check for the possible impact of sample wide economic developments, time dummies were added to the basic specification. This leaves the major results from the basic specification unaffected (see column (2)). The signs of the significant coefficients from the basic specification remain unchanged. The significance levels of the variables reflecting the output gap, the size of government, the exchange rate volatility and monetary volatility are reduced somewhat, and the output gap and the monetary measures are no longer significant at conventional levels. By contrast, the impact of changes in the fiscal policy stance comes out even more strongly.

The reduction in the significance level of the output gap variable may be due to the impact of a global business cycle. To the extent that business cycles and, thus, output gaps are positively correlated across the countries in the sample, contemporaneous variations would be picked up by the dummy variable. If as a result the coefficient on the output gap variable itself turns insignificant, this should not be interpreted as a loss of explanatory power of this variable, as the underlying economic relationship remains intact. A similar reasoning may hold for the reduced significance level regarding the impact of the size of the government. Overall, including time dummies results in only a marginal increase in explanatory power.

To assess the robustness of the results, the estimations were also run for a shorter sample period. The literature on monetary policies and their impact on inflation has pointed to a possible a structural break in the relationships towards the end of the 1970s. Favero (2002) shows that the behaviour of monetary policies and inflation in Europe changed significantly at that time. He links this change to a shift in central banks' policy focus which has also been observed for the U.S. To reflect a possible change in the inflationary process, the regressions have been re-estimated for the sample 1980-2001.

The results in columns (3) and (4) show that the major effects also work in the short sample. In particular, the coefficients that are significant in the full sample remain so in the shorter sample, except for the coefficient on the monetary policy, whose significance drops marginally below the 10%-level.[8] The regressions over the shorter sample point to a slight change in the behaviour of inflation volatility. This is evidenced by loss in significance of the second lag of the endogenous variable and by the slight decrease in value and significance level of the coefficient on fiscal activism, providing support for the findings in the literature regarding a possible structural break. The overall explanatory power of the regression increases somewhat in the shorter sample.

[8] Varying the starting date of the subsample period does not alter the results significantly.

As a final robustness test, the coefficient on fiscal policy volatility was checked for stability across countries. Essentially, the panel estimation approach employed here can deliver meaningful results only if the slope coefficients are not significantly different across countries. In principle, this test should be applied to all coefficients in the estimation. However, this would require sufficient data to estimate individual time series models for each country separately. Because of the scarcity of observations, the test focuses on the fiscal stance variable. In particular, the estimated equation is augmented by interactive dummies for each country for 14 countries in total.[9] The interactive dummies (*ID*) are equal to the product of country dummies (*D*, equal to one for each specific country and zero otherwise) and the respective value of the fiscal policy variable.

$$ID_{j,i,t} = D_{j,i,t} * D\_STNC_{i,t} \quad \text{with} \quad D_{j,i,t} = 1 \quad for \quad j = i \quad \text{and} \; D_{j,i,t} = 0 \quad for \quad j \neq i$$

Thus the estimation equation is now

$$\begin{aligned} SD\_INFL_{i,t} = {} & b_{i,0} + b_1 \, INFL_{i,t} + b_2 \, D\_STNC_{i,t} + b_3 \, D\_YGP_{i,t} + b_4 \, GX_{i,t} \\ & + b_5 \, SD\_MY_{i,t} + b_6 \, SD\_ER_{i,t} + b_7 \, IMP_{i,t} + \sum_{j=1}^{13} g_j \, ID_{j,i,t} + e_{i,t} \end{aligned} \tag{3}$$

where the second to last term on the right hand side represents the 13 interactive slope dummies in the regression. In this regression, estimated values for g_j which are significantly different from zero indicate that for a specific country j the impact of fiscal policy volatility on inflation volatility is different from the impact for the base country, holding the remaining coefficients constant. As the results depend on the choice of the base country, the estimation was repeated using each country in the sample as base country.

The results are summarised in Table 2. For eleven out of the fourteen countries, the estimated slope coefficients on fiscal policy volatility are in no case significantly different from the base country, independent of the choice of the latter. Thus, the overall results from the panel approach appear to be representative for the individual countries. Only France may pose an exception. In ten out of the fourteen estimations, France is found to have a coefficient significantly smaller at the 5% level than the respective base country. In other words, the presence of France in the sample is leading to lower estimates for the coefficient on fiscal policy volatility than otherwise. Finally, in four cases each the Netherlands and Finland are found to have slope coefficients significantly larger than the respective base country, albeit in some instances only at a 10% significance level.

[9] Ireland was excluded from the exercise due insufficient degrees of freedom.

Table 2: Number of regressions with slope coefficients significantly different from base country

	AUT	BEL	CAN	DEU	DNK	ESP	FIN	FRA	GBR	ITA	JPN	NLD	SWE	USA
$g_j < 0$	–	–	–	–	–	–	–	10	–	–	–	–	–	–
$g_j > 0$	–	–	–	–	–	–	4	–	–	–	–	4	–	–

Total 14 regressions per country.

4.4. Core inflation

The specifications were also tested restricting the measure of inflation to exclude food and energy. This approach is useful to detect if the empirical relationship established above is due to particularly strong effects regarding certain goods classes. Empirically, food and energy prices have been found to be particularly volatile, and it has been argued that these components should be excluded from the inflation analysis, leaving the so-called core inflation as the variable of interest.

Switching to the volatility of core inflation (table 1, column (5)) leaves the estimated impact of the fiscal variables broadly unaffected but changes the above pattern regarding the external, real sector and monetary variables. In particular, the impact of the changes in the fiscal policy stance remains significantly positive while a larger size of the government tends to smooth inflation, albeit with a level of significance just outside the 10% band. The output gap, exchange rate and monetary variables turn insignificant. This suggests that the impact of these variables on overall inflation volatility derives mainly from their effect on the volatility of food and energy prices. By contrast, the coefficient on the level of imports turns significantly positive upon removing food and energy from the inflation measure. Thus, the degree of openness tends to raise in particular the volatility of non-food and non-energy prices, while it appears to matter less for food and energy.

Including time dummies (column (6)) in the specification for core inflation has almost no impact on the results. Except for the significance of the lag structure of the endogenous variable, the results remain very close to the specification without time dummies. Restricting the sample period to the more recent past has similar effects in the specification for core inflation as in the full inflation measure (columns (7) and (8)). Coefficients that are significant in the full sample generally maintain this characteristic in the shorter sample. The size and significance of the coefficient on changes in the fiscal stance decrease in the shorter sample, resulting in a significance level below conventional limits in the specification including time dummies.

4.5. Five-year data

The empirical specification using five-year data is very similar to that for annual data. Regarding the fiscal policy stance and output gap, the use of five-year data allows to specify variability in terms of the standard deviation of the specific variable. Thus, SD_STNC and SD_YGP stand for the standard

deviation over the five-year periods of annual observations of the fiscal stance and the output gap, respectively. The other data have been taken as five-year averages, as indicated by the suffix "a". The time indicator τ denotes the non-overlapping five-year periods from 1967–1971 through 1997–2001. The output volatility and the import level are in logs.

$$SD\_INFLa_{i,t} = b'_{i,0} + b'_1\, INFLa_{i,t} + b'_2\, SD\_STNC_{i,t} + b'_3\, SD\_YGP_{i,t} + b'_4\, GXa_{i,t} + b'_5\, SD\_MYa_{i,t} + b'_6\, SD\_ERa_{i,t} + b'_7\, IMPa_{i,t} + e'_{i,t} \quad (4)$$

The results from the specification based on five-year intervals closely resemble those based on annual data (see Table 3). In the basic specification (column (1)), i.e., without time dummies and including food and energy prices, the same variables are found to be significantly correlated with inflation volatility as in the annual set-up. The only exception is the coefficient on exchange rate volatility, which switches to a negative sign but remains insignificant. Regarding the fiscal variables, the data show that a higher volatility of activist fiscal policies coincides with higher inflation volatility, while the size of governments tends to reduce it. Volatility in the output gap and in monetary policies correlate positively with inflation volatility, while the level of imports is insignificant as in the annual specification. Including time dummies (column (2)) does little to the results except for turning the coefficient on government size insignificant, possibly a reaction similar to the annual specification.

Table 3: Dependent variable: LSD_INFLa; five-year observations

	CPI inflation		Core inflation		2SLS estimate
		time dummies		time dummies	
	(1)	(2)	(3)	(4)	(5)
INFLa	0.053**	0.070**	0.076**	0.082**	0.063**
	13.37	7.02	10.91	5.77	8.43
SD_STNC	0.038**	0.057**	–0.009	0.0005	0.048**
	2.85	2.74	–0.23	0.009	2.27
LSD_YGP	0.044**	0.057*	0.023	0.025	0.125**
	2.06	1.79	0.77	0.64	3.54
GXa	–0.005*	–0.004	0.002	0.008	–0.001
	–1.99	–0.60	0.41	0.75	–0.316
SD_Era	–0.003	–0.013	–0.032**	–0.039**	–0.009
	–0.62	–0.89	–4.36	–2.40	–1.37
SD_Mya	0.133**	0.118*	0.167*	0.087	–0.018
	3.99	1.78	2.01	0.89	–0.18
LIMPa	0.032	0.091	0.420**	0.767**	0.248*
	0.30	0.53	3.02	3.37	1.69
adj. R^2	0.78	0.78	0.74	0.71	
No. of obs	75	75	68	68	46

Footnote as in Table 1.

The equality of slope coefficients across countries may be problematic also in the five-year specification. While estimation of country specific coefficients is not possible given the scarcity of data, a test can be performed to ascertain that the results are not driven by the behaviour of an individual country. Specifically, the model was estimated recursively excluding one country at a time. This left the overall results unchanged, in particular regarding the impact of the volatility of discretionary fiscal policies.

Results based on five-year intervals using core inflation differ markedly from those for the comprehensive definition (columns (3) and (4)). Except for the level of inflation, only the coefficients for exchange rate volatility and the level of imports enter significantly. Monetary volatility is significant in the specification without time dummies. The negative sign on the exchange rate volatility coefficient indicates that high exchange rate volatility may substitute inflation variability in the medium term.

Comparing the annual results on core inflation to those from five-year data, suggests that the effects of systematic volatility of discretionary fiscal policies over the medium term tend to affect mainly the more volatile food and energy prices. If fiscal policies are continuously variable, as reflected by a high standard deviation of the fiscal stance over five-year periods, their impact appears to drive up primarily the volatility of those goods classes where price changes occur frequently, namely food and energy. A possible explanation is that in those classes the economic costs of price changes may be lower than in other classes. For example, demand may be less price elastic due to low substitutability or because consumers are more used to price changes in these categories. By contrast, one-off changes in the fiscal stance, captured by the annual data, affect all goods categories broadly symmetrically.

Endogeneity may be a problem for the five-year specification. It could be argued that over the medium term high output volatility induces more activist fiscal policies or may result in larger overall governments. In addition, a high degree of openness could drive up output volatility and there may be a close two-way relationship between monetary and exchange rate volatility. To account for these issues, the five-year model has been re-estimated using a weighted 2SLS procedure of Anderson and Hsiao. In particular, equation (4) was differenced to eliminate country fixed effects and the second lags of the explanatory variables were used as instruments.

As can be seen from the last column in Table 3, the results strongly support the findings for the basic specification (column (1)). All signs of the level estimation are confirmed except for the monetary variable which loses significance. The coefficients on the inflation level, the volatility of activist fiscal policies and the volatility of the output gap remain highly significant. The coefficient on output variability increases while the other two coefficients remain broadly similar in size. Government size

and exchange rate volatility turn out insignificant, although the precision for the latter rises. In contrast, the coefficient on the level of imports is now significant and closer to the values found for the specification using core inflation.

Some degree of caution is required in interpreting the weighted 2SLS estimation results, as their value rests on the appropriateness of the instruments. The instruments need to be sufficiently highly correlated with the explanatory variables but uncorrelated with the error term. However, if the explanatory variables are autocorrelated over time, first differencing removes most of the signal from the variable and it is difficult to find a good instrument. In addition, IV-estimators can have a large bias in small samples if the lagged explanatory variables are correlated with the first differences.

4.6. Conditional variances

Turning to the impact of discretionary fiscal policies on the uncertainty of expected inflation, the first issue is to set up an appropriate inflation forecast model. In a panel framework there is a trade-off between forecast accuracy and structural homogeneity across countries when generating a measure of expected inflation. While sophisticated models would be capable of producing fairly precise inflation forecasts for individual countries, these country models would probably differ widely across countries, making any inference for the sample of countries questionable. As a consequence, a common time series approach was used to generate a measure of inflation expectations for all countries. In particular, AR(1) models with GARCH(1,1) structure for residual variances were estimated at annual frequency, with the forecast error variance representing conditional inflation uncertainty.[10]

The conditional variances are corrected for a further potentially distorting effect. To the extent that the level of the fiscal stance should have a systematic impact on the level of inflation, the unconditional variances of the two variables would be positively related. Thus, the results from a regression involving the variances could suggest a strong relationship, solely reflecting the interaction of the levels. While casual empirical analysis does not point to a significant relationship between the level of inflation and the fiscal stance in the sample, conditional inflation variances take the possible interaction into account. This is achieved through including the level of the fiscal stance in the level equation for inflation. Thus, the time series model for the inflation forecast looks as follows:

$$p_t = c + g_1 p_{t-1} + g_2 STNC_t + h_t \qquad (5)$$

[10] AR(2) models were also employed, but average RMSEs were smaller for the specification with a single lag. Similarly, including the oil price in the estimation did not improve forecast performance.

$$s_t^2 = w + d_1 h_{t-1}^2 + d_2 s_{t-1}^2 \quad (6)$$

where π is the year-on-year inflation rate and *STNC* is the fiscal stance. The conditional inflation volatility is then given by the one-step-ahead standard deviation s_t for each forecast of the inflation rate.

The results for the explanation of conditional inflation uncertainty (LSD_FCER) closely match those for unconditional inflation volatility (see Table 4). The evidence suggests that changes in the fiscal stance tend to increase aggregate inflation uncertainty significantly. Of the remaining variables in the basic specification, changes in the output gap and monetary volatility come out with the expected positive and statistically significant sign. In contrast to the results for unconditional variances, the size of the government no longer has a significant impact on inflation volatility, once inflation expectations are accounted for. In building inflation expectations on the basis of past inflation experience, agents may automatically take the dampening impact of a large government into account. In addition, the coefficient on exchange rate volatility (now at lag 1) is significantly negative, while that on the import level is significantly positive. Introducing time dummies affects the results in a similar way as in the specification of unconditional variances. The time dummies reduce the precision of the coefficient

Table 4: Conditional variances; dependent variable: LSD_FCER; annual data

		time dummies
LSD_FCER(-1)	0.404**	0.382**
	4.87	3.97
LSD_FCER(-2)	0.195**	0.174**
	2.99	2.34
LINFL(-2)	0.143**	0.108**
	5.60	2.83
LD_STNC	0.044**	0.040*
	2.51	1.83
LD_YGP(-1)	0.034**	0.009
	2.72	0.59
GX(-1)	0.003	0.004
	0.77	0.69
SD_ER(-1)	–0.015**	–0.028*
	–2.32	–1.73
SD_MY(-1)	0.121*	0.114
	1.74	1.39
IMP	0.040**	0.037**
	8.03	5.56
adj. R^2	0.50	0.56
No. of obs	329	329

Footnote as in Table 1.

estimates for the variables regarding output gap changes, exchange rate and monetary volatility, but the core results of the estimation are confirmed. As above, the time dummies absorb the information affecting all countries simultaneously.

The results using five-year data exhibit an interesting impact of introducing time dummies into the analysis of inflation uncertainty in the medium term. Without the dummies, the results are similar to those for unconditional inflation volatility, pointing to a positive and significant impact of the inflation level and the volatility of activist fiscal policies and the output gap (Table 5). Of the other variables, only exchange rate volatility shows a significant positive correlation. By contrast, the introduction of time dummies renders all coefficients insignificant, except the one for the import level (not reported). This implies that over the medium term inflation uncertainty in the individual countries is driven entirely by global developments which are captured by the time dummies, while national variables representing fiscal and monetary policies as well as output and exchange rate developments have no additional explanatory power. Global developments could include uncertainty over oil prices, exchange rate and output gap volatility as well as synchronized changes in the approach to monetary and fiscal policy.

Table 5: Conditional variances; dependent variable: LSD_FCER5; five-year data

INFLa	0.091** 7.27
SD_STNC	0.091** 2.06
LSD_YGP	0.139** 2.44
GXa	–0.007 –1.11
SD_Era	0.035** 2.10
SD_MYa	0.024 0.27
LIMPa	0.252 1.09
adj. R^2	0.73
No. of obs	75

Footnote as in Table 1.

4.7. Size of impact

The size of the impact of the volatility of activist fiscal policies on inflation variability can be important. Starting with the results for unconditional inflation volatility, for five-year data the estimated coefficient from the direct and the instrumented estimations is around 0.05. With a cross country average of standard deviations of discretionary fiscal policies of 1.23 percentage points of GDP (see Appendix), this suggests that an increase in the volatility of activist fiscal policies by one standard deviation raises inflation volatility by about 6%.

For annual data, the long run coefficient from the basic specification (table 1, column (1)) is close to 0.05. Thus, computed at the mean across countries and time periods, an increase in the (log of the) fiscal variable by one unit, coinciding with roughly one standard deviation, would raise inflation volatility by 5%. To this direct impact, the indirect impact of the volatility of discretionary fiscal policies through their impact on output gap variability needs to be added. Based on a comprehensive survey of the literature, Hemming et al. (2002) report a likely size of the short run fiscal multiplier between one half and one. Combining the average of these values (3/4) with the coefficient on output gap variability yields a potential additional impact of some 2½%, resulting in a total impact of around 7½% for the average across the sample. Feedback effects through the interaction of fiscal discretion with the other explanatory variables would increase the impact further.

Regarding the uncertainty of expected inflation, the results appear even stronger. The long-run coefficient estimates lie around 10% for the specification with annual data, not counting the impact of feedback effects. For the specification with five-year data, the estimated impact of an increase in the volatility of activist fiscal policies by one standard deviation comes out at around 17%, given an estimated coefficient of around 0.14 and the standard deviation of 1.23.

Large differences across countries in the volatility of activist fiscal policies imply that also the impact on inflation volatility differs substantially. If the estimated five-year coefficients for the unconditional inflation variance apply to individual countries, countries with systematically large annual variations in the fiscal stance, such as Sweden, Ireland or Italy, will experience a much larger impact on inflation volatility, with the estimated impacts nearly doubling relative to the average for the extreme case of Sweden.

5. Conclusion

This study has looked at the impact of discretionary fiscal policies on inflation volatility. While from a theoretical point of view fiscal policies may affect inflation through a number of channels, empirical evidence outside high inflation periods has remained relatively weak.

The paper presents evidence suggesting that volatility in discretionary fiscal policies has contributed to inflation volatility in a range of OECD countries between 1967 and 2001. Significantly positive coefficients are found for annual and five year average data as well as for a short sample starting in 1980 and apply for alternative measures of inflation. Similar results obtain for inflation uncertainty as measured by conditional variances derived from country-specific GARCH models. Regarding the size of the impact, an increase in discretionary fiscal policy volatility by one standard deviation is estimated to raise unconditional inflation volatility by some 10% and conditional inflation uncertainty by up to 17%. These values are computed at the mean values across countries, suggesting that individual country effects could be even larger.

From a policy perspective, these results provide further evidence that discretionary fiscal policies may have de-stabilising rather than stabilising effects on the economy. Previous results have shown that discretionary fiscal policies can increase output volatility (e.g., Fatas and Mihov (2003)). Possible reasons for these findings include the fact that such measures tend to take time to decide and implement, making them effective only when the business cycle has turned. In addition, as discretionary measures are usually not reversed automatically with a changing economic environment, further discretionary acts are necessary to revert to the long-term fiscal balance. The present study suggests that such effects are not limited to output volatility but extend to inflation.

Further research in this area should uncover details of this relationship. In particular, it would be of interest to what extent different components of fiscal policies have differential effects on inflation volatility. On the revenue side, direct and indirect taxes could be distinguished and government consumption could be separated from transfers and from investment on the expenditure side. Moreover, the analysis of cross country differences could yield important additional insights.

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Appendix

Description of variables

SD_INFL	inflation volatility	annual standard deviation of month-on-month CPI inflation rates (not seasonally adjusted)
INFL	inflation level	average annual CPI inflation
LSD_FCER	conditional inflation uncertainty	log of standard deviation of forecast error from GARCH model for inflation
D_STNC	fiscal policy volatility	absolute value of first difference of year-on-year change in cyclically adjusted primary balance (in % of GDP), i.e., absolute change in fiscal stance (annual specification)
SD_STNC	fiscal policy volatility	5-year standard deviation of year-on-year change in CAPB (5-yr specification only)
D_YGP	output volatility	absolute year-on-year change in output gap (in % of GDP, annual specification)
SD_YGP	output volatility	5-year standard deviation of year-on-year changes in output gap (5-yr specification only)
GX	size of government	government expenditure relative to GDP
SD_ER	exchange rate volatility	annual standard deviation of m-o-m percent changes in the nominal exchange rate to the USD (to SDR for the U.S.)
SD_MY	volatility of broad money/GDP	annual standard deviation of month-on-month changes in the ratio of broad money to real output (output data splined)
IMP	import ratio	imports in percent of GDP

Descriptive statistics

	annual data			five-year data	
	mean	standard deviation (cross country mean of standard deviations)		mean	standard deviation (cross country mean of standard deviations)
LSD_INFL	-1.046	0.421	LSD_INFLa	-0.998	0.310
LSD_FCER	-0.059	0.719	LSD_FCERa	0.072	0.445
INFL	5.448	3.893	INFLa	5.495	3.560
LD_STNC	-0.116	1.075	SD_STNC	1.233	0.461
LD_YGP	-0.084	1.101	SD_YGP	0.381	0.505
GX	42.060	6.163	GXa	42.021	6.277
SD_ER	3.773	3.227	SD_ERa	3.932	2.649
SD_MY	0.612	0.302	SD_MYa	0.608	0.189
IMP	20.002	3.884	LIMPa	2.859	0.184

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