Patience and Inflation

Hübner, Malte and Vannoorenberghe, Gonzague

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Malte Hübner*
Gonzague Vannoorenberghe†

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Abstract

Monetary policy makers constantly face an inter-temporal choice problem. By generating surprise inflation they can temporarily increase employment and output. These short-run gains have however to be weighed against the long-run costs associated with higher inflation and a loss of reputation. More patient countries should therefore choose to implement lower inflation. Using cross-country data for up to 88 advanced and emerging economies, we provide empirical evidence that more patient countries had indeed lower average inflation rates over our sample period from 1961 to 2009. To address the possibility that patience may be endogenous to past inflation rates we use information on how the language spoken in a country encodes future time as an instrument for patience. Our results show that patience has a statistically and economically significant impact on inflation.

Keywords: inflation, patience, stability culture
JEL codes: E31, D72, E58, Z13

1 Introduction

In the past decades, inflation has been on a downward trend in most countries of the world. After many governments made their central banks more independent, average inflation rates in the OECD countries declined from roughly 15% in the 1980's to around 2% at the end of the 2000's (Figure 1). However, this decline in average inflation rates masks persistent cross-country differences in inflation. For instance, Germany, Switzerland, Japan and Malta belonged to the five countries with the best inflation performance in our sample in three out of the five decades from 1961 to 2009. On the other end of the spectrum,

*Loreleiring 13, 65197 Wiesbaden, Germany, malte.huebner@web.de
†Department of Economics, Tilburg University, P.O. Box 90153, 5000 LE Tilburg,The Netherlands, G.C.L.Vannoorenberghe@uvt.nl

Israel, Turkey, Iceland and Mexico were among the five countries with the highest average rate of inflation in four out of these five decades. This suggests that explaining cross-country variation in inflation performance by central bank independence alone might leave a residual to be explained by country specific factors that are largely constant over time.

In the present paper, we argue that people's preference are one important candidate for these country specific factors. The preferences that are at the center of our analysis is the average degree of patience in a country. We provide strong empirical evidence that more patient countries have on average lower inflation.

The argument that patience has an impact on inflation dates at least back to Barro and Gordon (1983a). They present a model in which monetary policy makers face a trade-off between the instant rewards of an expansionary monetary policy and a loss in reputation that makes it harder to maintain low inflation in the future. More patient policy makers are therefore better able to maintain low inflation. Another line of argumentation starts from the observation that the adverse consequences of inflation such as an unplanned redistribution of income and wealth, additional uncertainty over future prices, distorted investment decisions arising from a non-inflation neutral tax system and higher cost in identifying changes in relative prices are at least partly felt in the long-run[1]. In weighing these future costs against the short-term gains in inflation, more future oriented countries should therefore, on average, display higher inflation rates[2]. This argument has already been advanced by Bofinger et al. (1998). However, probably due to a lack of good measures of patience, the authors did not rigorously test for this relationship empirically.

To empirically test for a relationship between patience and inflation we use three distinct proxies for patience. Our preferred measure is obtained from Wang et al. (2011) international comparison of time preferences rates. Wang et al. surveyed students in 53 countries to determine variation in time preferences across countries. In their study, participants were given a binary choice between an immediate monetary reward and a higher payment in the future. We use the share of subjects willing to wait as a proxy for patience in a sample up to 88 advanced and developing economies for the years 1961-2009. Using information on the way languages spoken in the countries encode time as an instrument to control for a possible endogeneity bias, we find strong evidence that a higher share of subjects deciding to wait for a higher reward in the future is associated with a better inflation performance. This result is robust to using Hofstede's Index of Long Term Orientation (Minkov and Hofstede, 2010) and Preis et al.'s Future Orientation Index (Preis et al., 2012) as measures for the average degree of patience in a country. The size of the effect is economically significant. The results of our analysis for instance suggests that if Portugal had a similarly high degree of patience as Switzerland, the difference in the infla-

[1]See Briault (1995) for an overview over the costs of inflation.

[2]We are using the terms time preference and impatience synonymously.

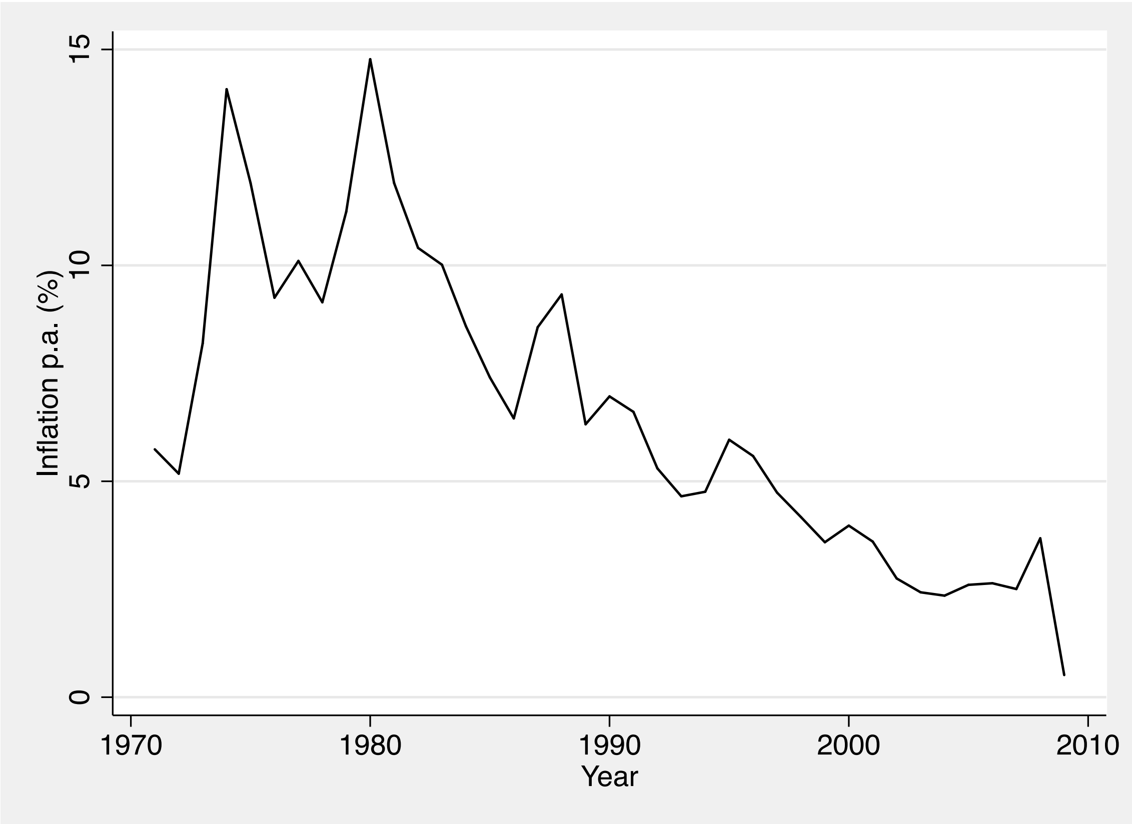

Figure 1: Inflation rates OECD 1971-2009

tion induced rate of depreciation of real money holdings would have been only two thirds of the difference observed in the data between 1961 and 2009. Apart from our measures of patience, per-capita income, a dummy indicating a pegged exchange rate and trade openess turn out to have a robust and negative impact on inflation rates.

The present paper relates to three strands of the economic literature. Firstly, it adds to the growing literature documenting the impact of patience on behavior. There is already a large literature on the impact of patience during childhood or adolescence on individual behavior. It has for instance be shown that patience is a significant predictor of health related behavior, savings decisions, school performance, labor market outcomes, lifetime income, unemployment and welfare dependence (e.g. Golsteyn et al., 2014; Sutter et al., 2013). Other studies have shown that individual time preferences are correlated with the probability to take part in financial education programs and predict the amount of credit card debt taken on by an individual (Meier and Sprenger, 2010, 2013). While the relationship between patience and individual behavior has already been thoroughly analyzed, there is comparably little evidence on the relationship between patience and macroeconomic outcomes. The work closest to ours is Chen (2013) who demonstrates that differences in patience between countries explains variation in aggregate savings rates. Using the same proxy for patience as the present paper, Marcheggiano and Miles (2013) study the relationship between patience and the size of the fiscal multiplier. Hübner and Vannoorenberghe (2015) and Dohmen et al. (2015) study the relationship between patience and growth. Most other existing studies on the impact of patience on macroeconomic outcomes do not go beyond plotting mere correlations between measures of the time preference rate and living standards (e.g. Preis et al., 2012).

Secondly, our analysis contributes to the empirical literature on the determinants of inflation. A large number of studies have tested the relationship between central bank independence and inflation predicted by the positive theories of inflation. These studies typically distinguish between indicators of de-jure central bank independence, which are obtained from an analysis of central bank law, and indicators of de-facto central bank independence such as the average turnover rate of central bank governors. The general picture emerging from these studies is that there is a negative correlation between measures of de-jure central bank independence and inflation in advanced economies while the turnover rate is found to affect monetary policy in developing countries (see e.g. Berger et al., 2000). The results have however found to be sensitive to outliers and the choice of control variables. Other potential determinants of inflation are the degree of openess (Romer, 1993) and the exchange-rate system (Ghosh et al., 1997). Our analysis adds to this literature by establishing the time preference rate as an important additional determinant of medium-and long-term inflation patterns.

Thirdly, we add to a literature trying to identify the impact of differences in a 'stability culture' on economic outcomes. Posen (1995), for instance, has already pointed out that the correlation between central bank independence and inflation could be explained by a third factor, such as the culture and tradition of monetary stability in a country. In a similar vein, Alesina and Summers (1993) argue that central bank independence may be an endogenous variable, determined by the public aversion to inflation. Consistent with this hypothesis, Hayo (1998) shows that survey respondents in low inflation countries react more sensitive to increases in inflation than respondents in countries with higher average inflation. Using the same data, Ehrmann (2009) finds that individuals having lived through a period of hyperinflation during adult lifetime are substantially more concerned about inflation that persists over time. Neuenkirch (2014) shows that the extent to which people are concerned about inflation are reflected in central bank's policy rates. Our paper extends this literature in two aspects. Firstly, our proxies for patience are a more direct measure of people's preferences than the one used by Ehrmann or Hayo and Neuenkirch. We are therefore able to establish a direct link between people's preferences and observed inflation rates. Patience, which is at the center of our analysis, is hence a potential candidate for the 'third factor' explaining the correlation between central bank independence and inflation, which was postulated by Adam Posen and Alesina & Summers.

The remainder of the paper has the following structure. First, we show that the relationship between patience and inflation can be derived in the standard New-Keynesian Model. To do so, we demonstrate that the trade-off between the immediate rewards of an expansionary monetary policy and the long-run costs in form of a loss of reputation and higher inflation in the future, first advanced by Barro and Gordon (1983a), also exists in the New-Keynesian model. In the steady state, more patient monetary policy makers are therefore better able to maintain low inflation (Section 2). Section 3 introduces our data and empirical strategy. Our empirical results are presented in Section 4. Section 5 concludes.

2 Theory

In this section we summarize how the central hypothesis of this paper, that patience and inflation are negatively related can be derived in standard macroeconomic models. In doing so, we will consider different variants of the same argument. It is however not our prime objective to single out one channel as being more realistic than another. Neither do we provide an exclusive list of channels through which patience can affect inflation.

Our starting point is the positive theory of inflation originating from Barro and Gordon (1983a,b). In this theory, monetary policy is set in order to equate the marginal cost and benefits of inflation. In doing so monetary policy makers face a time-inconsistency problem as deviating from an announced policy allows them to temporarily raise output above potential. As price setters adjust their expectations in order to account for this incentive, inflation in a rational expectations equilibrium exceeds the optimal level while output remains unaffected. Failure of the central bank to commit to lower inflation therefore generates an inflationary bias.

One solution to this inflationary bias is to raise the marginal cost of inflation as perceived by the policy maker. If at least some of the cost of loose monetary policy occur in future periods, the marginal cost of inflation automatically depend on the policy makers time preference rate. A lower time preference rate helps central bankers to commit to low inflation.

There are at least three channels through which inflation enters the policy makers objective function with a lag. The first channel originates from incorporating reputation effects into the model as in Barro and Gordon (1983b). The divergence of cost and benefits of inflation over time then arises endogenously as monetary policy makers face a trade-off between enjoying the short-term benefits of inflation and incurring the long-term costs from loosing reputation that would allow them to implement low inflation in future periods. The second channel simply consists in "hard-wiring" the lagged cost of inflation directly into the cost function of the policy maker to account for the fact that some of the cost of inflation, such as distortions of investment decisions arising from a non inflation neutral tax system are partly felt in future periods. The third channel assumes that inflation expectations depend at least partly on past inflation rates. In this scenario, the inter-temporal link between cost and benefits of inflation arises from a hybrid Phillips curve.

2.1 Barro's inflationary bias with a New-Keynesian Phillips curve

In the following, we illustrate all three channels in the setup of Barro and Gordon (1983b,a) but with a New-Keynesian Phillips curve. Most of the exposition is standard and has been summarized elsewhere (see e.g. Clarida et al., 1999). Here, we focus on the impact of patience on the average (steady state) inflation rate.

We assume that the central bank minimizes the standard loss function:

$$L = \frac{1}{2}\sum_{t} \beta^t \left(\alpha(x_t - k)^2 + \pi_t^2\right), \tag{1}$$

where x_t and π_t are respectively the output gap and inflation in period t. In line with Barro and Gordon (1983b) or Clarida et al. (1999), the parameter $k > 0$ captures the idea that central banks may target an output above its natural level, which could be due to the presence of distortions in the economy or to political incentives. In the remainder of the paper, our parameter of interest is the discount factor, β.

We depart from the traditional setup of Barro and Gordon (1983a,b) and assume that the economy faces a New-Keynesian Phillips curve (see e.g. Woodford, 2003):

$$\pi_t = \lambda x_t + E_t \pi_{t+1}. \tag{2}$$

In equation (2) we have abstracted from the fact that the New-Keynesian Phillips curve can in theory depend on the discount factor of price setters. It is however common to assume that price setters do not discount the future as otherwise there would be a long-run trade-off between output and inflation (see for instance Clarida et al., 1999, page 1676). Moreover, empirical estimates of the New-Keynesian Phillips curve have found that the discount factor of price setters is close to one (see for instance Gali and Gertler, 1999).

2.1.1 Commitment

We first characterize the equilibrium inflation rate for the case where the central banker is able to make credible commitments about the future path of inflation. Under the ability to pre-commit, inflation on the optimal path will generally vary over time. The literature has however also characterized time-invariant solutions for the optimal path of inflation under commitment. Woodford (2003), for instance, considers a so called *timeless perspective* by imposing certain requirements on the initial conditions of the policy makers optimization problem. Here, we follow a slightly simpler approach by requiring ex-ante that policy makers commit to a time invariant path of inflation rates.

Assume therefore, that the central bank can commit itself to implementing a time invariant inflation rate π^*. The optimal solution to maximizing (1) with respect to (2) can then be found by inserting (2) into the loss function (1) and making use of the fact that the central bank can credibly commit to future actions; i.e. $E_t \pi_{t+1} = \pi^*$. The discounted loss (1) then becomes a function of π^*:

$$L^C(\pi^*) = \frac{1}{2}\frac{1}{1-\beta}\left[\alpha k^2 + \pi^{*2}\right], \tag{3}$$

which is minimized for $\tilde{\pi}^* = 0$. From (2) we then see that the output gap under commitment (C) is likewise zero; i.e. $x^C = 0$. The minimized loss under commitment is obtained by plugging in $\tilde{\pi}^*$ back into (3) as:

$$L^C_{\tilde{\pi}^*} = \frac{1}{2}\frac{1}{1-\beta}\alpha k^2. \tag{4}$$

2.1.2 Discretion

Absent enforcement, however, central banks have an incentive to deviate from an announced policy π_t, once private agents have formed their expectations. If such deviations from a strict rule are possible, rational private agents would take this incentive into account when forming expectations over the inflation rate implemented by the central bank. As a result, in a rational expectations equilibrium under discretion, there is the famous inflationary bias first pointed out by Barro and Gordon (1983a).

To see this, consider a central bank in period t that chooses π_t and x_t to minimize the loss function (1) subject to (2) and taking private sector expectations as given. The optimal policy of the central bank then follows:

$$x_t = -\frac{\lambda}{\alpha}\pi_t + k. \tag{5}$$

Plugging the above back in the Phillips curve (2) shows that current inflation depends positively on future expected inflation and on the parameter k:

$$\pi_t = \frac{\alpha\lambda}{\alpha+\lambda^2}k + \frac{\alpha}{\alpha+\lambda^2}E_t\pi_{t+1}. \tag{6}$$

Equilibrium inflation and output under discretion can then be obtained by solving recursively for π_t and plugging into (5):

$$\pi_{NC} = \frac{\alpha}{\lambda}k, \qquad x_{NC} = 0, \tag{7}$$

where the superscript NC stands for non-commitment. Comparing π_{NC} with $\tilde{\pi}^*$ and x_{NC} with x_C we immediately see that inflation is higher under discretion than under commitment, but the output gap remains unchanged as price setters anticipate that the central bank has an incentive to deviate from its announced policy. Not surprisingly then, the equilibrium value of the loss function in the absence of commitment (NC)

$$L^{NC} = \frac{1}{2}\frac{1}{1-\beta}\frac{(\alpha+\lambda^2)}{\lambda^2}\alpha k^2 \tag{8}$$

exceeds the one obtained under commitment, L^C.

We have thus replicated the inflationary bias arising in a regime where the central bank is not able to make credible promises over its future behavior in a model with a New-Keynesian Phillips curve. If policy makers cannot commit to implementing an announced inflation rate, price setters will anticipate the incentive to exploit the short-run tradeoff between inflation and output. In a discretionary equilibrium, inflation is therefore higher than optimal but this does not lead to an increase in output that is sufficient to compensate for the welfare loss of higher inflation.

The above analysis shows that, starting in a world were monetary policy is set under discretion, there would be welfare gains if one would introduce institutional mechanisms that help central bankers to implement a policy that more closely resembles the one under perfect commitment. In the following, we summarize three such mechanisms. All three mechanisms raise the perceived future costs of inflation. In setting monetary policy to balance short-term gains and future costs of inflation, policy makers in more patient countries implement lower inflation.

2.2 Reputation effects

Probably one of the most well known mechanism to overcome the time-inconsistency problem of monetary policy is to rely on reputational forces (Barro and Gordon, 1983b). In their original setup, Barro and Gordon (1983b) consider a central banker who can earn a reputation for implementing low inflation. Following a low-inflation rule, the policy maker can guide price setters expectations towards a low inflation equilibrium. When abandoning the rule to increase output in the short-run, the loss of reputation prevents the policy maker to implement low inflation in future periods, raising the perceived future costs of high inflation. Such reputational forces can thus help the central bank to implement an inflation rate that is closer to the one under commitment than the one arising in a discretionary equilibrium. What is most important for our argument is that more patient policy makers, who are more concerned about a loss of reputation in the future will be able to implement lower inflation. In the following, we show that this result of Barro and Gordon (1983b) also holds in a model with a New-Keynesian Phillips curve.

To illustrate this argument we continue to assume that the economy is described by equation (2). Monetary policy makers seek to minimize the loss function (1) in repeated interactions with price setters. We consider the conditions under which a central bank can credibly commit to an inflation rate $\pi^* < \pi^{NC}$ in a trigger strategy equilibrium. For simplicity, we follow Barro and Gordon (1983b) in assuming that price setters expect the central bank to implement π^* as long as it has done so in the past. If, however, the central bank deviates from its commitment in one period and implements a policy $\pi_t > \pi^*$, price setters will punish the central bank by expecting the discretionary output π^{NC} in the next P periods, i.e. from $t+1$ to $t+P$.

We begin in a situation in which the central bank has followed the announced policy π^* in previous periods and study its incentives for abandoning this rule. If the central bank acts in a discretionary manner at time t, it chooses inflation and output according to (5) while price setters expect $E_t\pi_{t+1} = \pi^*$. We thus obtain:

$$x_t = \frac{\alpha}{\alpha+\lambda^2}k - \frac{\lambda}{\alpha+\lambda^2}\pi^*, \tag{9}$$

$$\pi_t = \frac{\alpha}{\alpha+\lambda^2}(\lambda k + \pi^*). \tag{10}$$

The period loss function at t then takes the value:

$$L_t = \frac{1}{2}\frac{\alpha}{\alpha+\lambda^2}(\lambda k+\pi^*)^2 = (1-\beta)L^C(\pi^*) - \frac{1}{2}\frac{\alpha^2k^2}{\alpha+\lambda^2}\left(1-\frac{\pi^*}{\pi_{NC}}\right)^2 \tag{11}$$

where π_{NC} is equilibrium inflation in the case without commitment. The second equality makes use of (3) and $(1-\beta)L^C(\pi^*)$ is the per period loss if the central bank commits to the inflation rate π^*. The last term in (11) is the immediate gain from deviating from a previously announced policy. Equation (11) therefore shows that $L_t < L^C(\pi^*)$. This clearly demonstrates that the central bank gains in period t when it stops following the announced policy π^*, making explicit the time inconsistency problem faced by the central bank.

The immediate gain from abandoning the announced policy has however to weighed against the additional costs in future periods arising from the loss of reputation. Upon deviating from the policy π^* in period t the central bank incurs the additional costs

$$(1-\beta)(L^{NC} - L^C_{\pi^*}) = \frac{1}{2}\left[\frac{\alpha+\lambda^2}{\alpha}\pi^2_{NC} - \pi^{*2} - \alpha k^2\right] \tag{12}$$

in each of the subsequent periods $t+1, \ldots, t+P$.

From the perspective of time t, it is worth cheating if the immediate gain in utility compensates for the P periods of future losses; i.e if

$$\frac{\alpha^2k^2}{\alpha+\lambda^2}\left(1-\frac{\pi^*}{\pi_{NC}}\right)^2 > \beta\frac{1-\beta^P}{1-\beta}\left[\frac{\alpha+\lambda^2}{\alpha}\pi^2_{NC} - \pi^{*2} - \alpha k^2\right] \tag{13}$$

where we denote in the following $f(\beta, P) \equiv \beta \frac{1-\beta^P}{1-\beta}$, with $\partial f(\beta, P)/\partial \beta > 0$ as well as $\partial f(\beta, P)/\partial P < 0$.

A policy $\pi^* < \pi^{NC}$ can be sustained in equilibrium if the policy maker has no incentive to cheat, given that he has implemented π^* in previous periods. Equation (13) therefore implies that there are generally a range of equilibrium inflation rates that can be sustained in a reputational equilibrium. Writing $\pi^* = \eta \pi_{NC}$, condition (13) becomes:

$$\frac{\lambda^2}{\alpha + \lambda^2}(1-\eta)^2 > f(\beta, P)\left(1-\eta^2\right) \Leftrightarrow \frac{\lambda^2}{\alpha + \lambda^2}(1-\eta) > f(\beta, P)\,(1+\eta) \qquad (14)$$

where the inequality on the right hand side assumes that $\eta \neq 1$, i.e. it excludes one (irrelevant) root of the problem. From (14) we then obtain that π^* is sustainable in an equilibrium if

$$\pi^* \geq \frac{\frac{\lambda^2}{\alpha+\lambda^2} - f(\beta, P)}{\frac{\lambda^2}{\alpha+\lambda^2} + f(\beta, P)} \pi_{NC} \qquad (15)$$

If the numerator of the right hand side is smaller or equal zero, a policy of zero inflation is credible and will be implemented. If not, the lowest-inflation policy which is credible (the one the government should implement) is given by imposing equality in (15), i.e. the equilibrium inflation is:

$$\pi^* = \max\left\{\frac{\frac{\lambda^2}{\alpha+\lambda^2} - f(\beta, P)}{\frac{\lambda^2}{\alpha+\lambda^2} + f(\beta, P)}, 0\right\} \qquad (16)$$

From (16) we can directly infer the central result of this section, namely that the minimal sustainable rate of inflation is decreasing in β. More patient policy makers are able to implement a lower inflation rate as their perceived future costs of inflation are higher than for policy makers with a lower discount factor.

2.3 Lagged inflation in the cost function

In the above analysis, the threat to loose reputation which would limit the policy makers ability to implement low inflation in the future created some future costs of inflation. These future costs of inflation can however also be directly incorporated in the loss function. The standard model analyzed above typically assumes that the cost of higher inflation are instantaneous. However, some of the costs of inflation summarized in Hughes (1982) or Briault (1995) are costly even after inflation has returned to its original level. Hughes (1982) even distinguishes explicitly between short-run and long-run costs of inflation. The long-run costs of inflation thereby originate from inflation induced distortions in investment and savings decisions that have adverse effects on potential output. Such distortion may for instance originate from a non-inflation neutral tax system (Briault, 1995) or from the reluctance of savers to buy long-term assets (Hughes, 1982). Moreover, it has been suggested that inflation becomes more uncertain at higher inflation rates and this increased uncertainty again distorts investment decisions (Fischer, 1995).

If we adjust the standard loss function of the positive theory of inflation to account for the fact that some of the costs of inflation are felt in future periods, policy makers perceived cost of inflation depend on the discount factor β. More patient policy makers will thus again be better able to overcome the inflationary bias. The policy maker's discount factor is thus one mechanism to raise the costs of inflation. To see this assume for simplicity that the costs of inflation in period t are completely felt in period $t+1$. This changes the objective function to:

$$L = \frac{1}{2} \sum_t \beta^t \left(\alpha (x_t - k)^2 + \pi_{t-1}^2 \right), \tag{17}$$

Repeating the steps from section 2.1.1 above one easily sees that the time-invariant optimal inflation rate under commitment is still zero. However, equilibrium inflation under discretion, π'_{NC}, now depends on the time preference rate of the policy maker, β:

$$\pi'_{NC} = \frac{\alpha}{\beta \lambda} k \tag{18}$$

Because $\pi'_{NC} > 0$ there is still the inflationary bias that we already identified above. However, as the costs of inflation now occur in the future, we obtain the expected result that more patient policy makers implement lower inflation; i.e. $\partial \pi'_{NC} / \partial \beta < 0$. The inflationary bias, $\pi'_{NC} - \tilde{\pi}^*$, is thus smaller for more patient policy makers.

2.4 Hybrid Phillips Curve

A third channel through which current inflation affects the cost function in future periods is to assume that current inflation also depends on lagged inflation. This for instance holds if one assumes a hybrid Phillips curve of the form:

$$\pi_t = \lambda x_t + (1-a) E_t \pi_{t+1} + a \pi_{t-1}. \tag{19}$$

Such a hybrid Phillips curve can be derived by extending the Calvo model of staggered price setting to account for a fraction of firms that set prices according to a backward-looking rule of thumb (Gali and Gertler, 1999). Despite the fact that the standard New-Keynesian Phillips curve (2) is more appealing from a theoretical perspective due to its purely forward-looking specification, hybrid Phillips curves of the form (19) have sometimes been found to perform better in empirical estimations (see for instance Gali and Gertler, 1999).

The presence of backward-looking price setters introduces some inflation persistence into the model. Higher inflation today therefore also raises inflation and the associated costs in future periods. Again, this increases the marginal costs of inflation for more patient policy makers and establishes the negative relation between patience and inflation.

We can analyze equilibrium inflation rates in the setup of Barro and Gordon (1983a) with the hybrid Phillips curve (19). Our exposition follows Kirsanova et al. (2009). Here, we only summarize those results that are important for the present paper. Readers interested in detailed derivations and a more general setup are referred to the paper by Kirsanova et al.

Turning first to the case where the central bank is able to make credible commitments to implementing an announced policy, by following the same reasoning as in section 2.1.1, it is straightforward to show that the optimal inflation rate is zero if policy makers commit ex-ante to a time-invariant inflation rate [3].

Under discretion, a solution for the optimization problem of the central bank can in general only be obtained numerically. It is however possible to calculate an analytical solution for the two polar cases $a = 0$ and $a = 1$. Turning first to the purely forward looking case, $a = 0$ we know from section 2.1.2 that the equilibrium inflation rate under discretion is $\pi^{NC} = \frac{\alpha}{\lambda} k > 0$. There is thus still an inflationary bias. In the purely backward-looking case, $a = 1$, the solution under discretion is the same as under commitment (Kirsanova et al., 2009).

For the intermediate cases, $a \in (0, 1)$, equilibrium inflation under discretion should be negatively related to the policy maker's discount factor as the backward-looking part of (19) introduces some inflation persistence that causes present inflation to be also costly in future periods. While it is not possible to derive this result analytically, Kirsanova et al. (2009) solve the central banks optimization problem numerically. Their results show, that equilibrium inflation is indeed decreasing in β for all parameters $a \in (0, 1)$.

Overall, we have thus seen that our central hypothesis that patience and inflation should be negatively related can be rationalized in a number of ways in the standard New-Keynesian model. In the exposition above, the link between patience and inflation results from the inflationary bias inherent in monetary policy making. We have seen, that if at least a part of the cost of present inflation rates are also felt in the future, a higher discount factor raises the marginal cost of inflation from the perspective of the policy maker and helps him to overcome the inflationary bias. In the following, we now try to identify the negative relationship between patience and inflation empirically.

3 Data and empirical strategy

We use an unbalanced panel to test the prediction that more patient countries have been more successful in achieving low inflation. Our empirical method consists in regressing

[3] The same holds for the timeless perspective of Woodford (2010) as is for instance shown in Kirsanova et al. (2009).

inflation rates on a proxy for patience for country i, P_i, while controlling for other factors X_{it} that are commonly thought to influence inflation rates. We therefore estimate the following empirical model:

$$\pi_{it} = c + \alpha P_i + \beta X_{it} + \epsilon_{it} \tag{20}$$

In equation (20 the fact that patience, P_i, does not vary over time is solely due to restrictions on the available data. We use three distinct proxies for our variable of interest, the degree of patience that are measured at a single point in time. In estimating equation (20) we therefore cluster errors at the country level in all estimations. Our preferred measure of patience comes from the study of Wang et al. (2011)[4]. To obtain internationally comparable data on average time preferences, Wang et al. surveyed a total of 6912 university students in 53 countries, mostly second-year students of economics, finance or business administration. Each participant was asked to fill out a questionnaire that included a number of decision-making questions. Amongst these questions was a binary choice question (*wait-or-not*) question that had already been used in previous studies to elicit time preferences (Frederick, 2005). The exact wording of the question was:

Which offer would you prefer?
A. a payment of $3400 this month
B. a payment of $3800 next month

To account for the possibility that the answer to this question might be influenced by the living standards of the respondents, Wang et al. (2011) have adjusted the monetary payoffs on the basis of purchasing power indices and the average monthly income of a student in the respective countries.

For each country, Wang et al. report the share of respondents that decided to wait for the higher monetary reward. This share ranges from 8 per cent in Nigeria to 89 per cent in Germany (Figure 3). The average share of respondents deciding to wait was 63 per cent (Figure 3). We use this share, (*Wait*), as the main explanatory variable in the subsequent analysis of the determinants of inflation.

As an alternative measure of patience we use Hofstede's Index of Long Term Orientation (Minkov and Hofstede, 2010; Hofstede and Minkov, 2010). This index is calculated based on a subjectively chosen subset of questions from the World Values Survey that is potentially related to long-term orientation. To obtain a cross-country measure of Long Term Orientation, Minkov and Hofstede (2010) have carried out a factor analysis with the country averages of the answers on the selected question to determine which linear combi-

[4]The experiment is also described in Rieger et al. (2014).

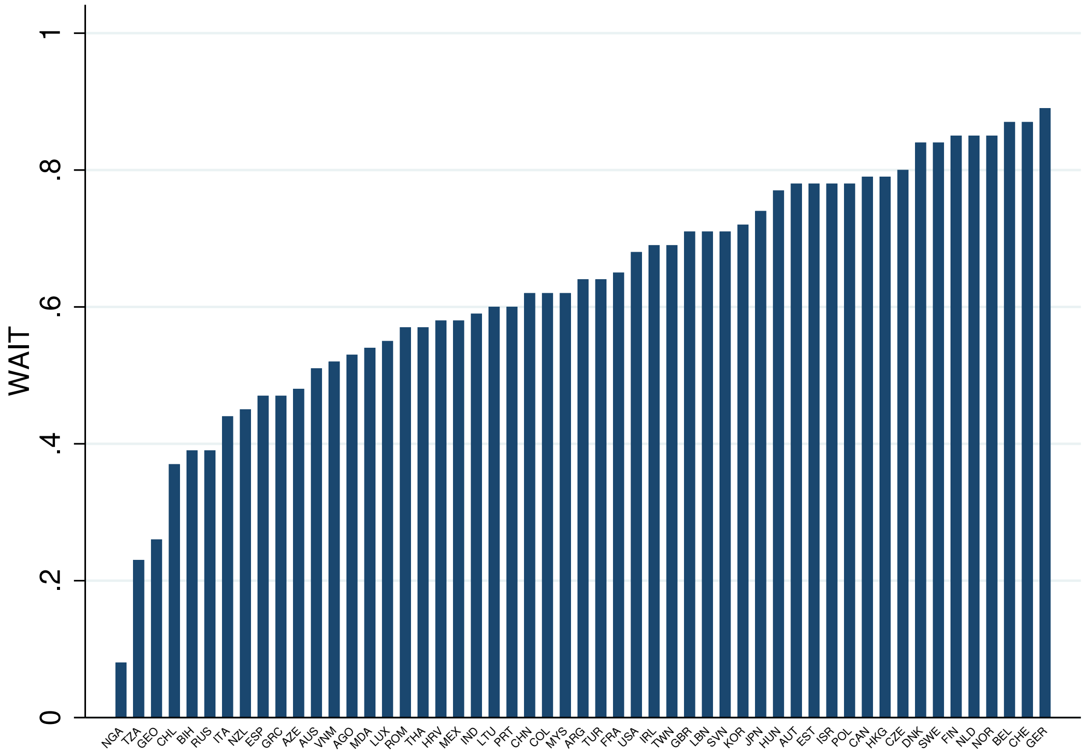

Figure 2: Share of people deciding to wait for higher monetary reward in Wang et. al.'s (2011) binary decision task.

nation of the response vectors best explain the cross country variation of the answers. The resulting factors contained, amongst others, questions asking whether respondents deemed it important to teach children the quality of thrift and how proud they are to be of their nationality. While this is certainly a less direct measure of time preferences than the one of Wang et al. (2011), both measures are at least weakly correlated with a correlation coefficient of r=0.34.

As a third proxy for patience we use the Future Orientation Index of Preis et al. (2012). The index is calculated from a cross-country analysis of internet search engine queries. For each country, the index represents the ratio of searches containing the coming year in Arabic numerals (e.g. "2013" in 2012) to searches containing the previous year (e.g. "2011" in 2012). The Future Orientation Index is also correlated with the variable *Wait* with a correlation coefficient of $r = 0.37$.

The central hypothesis of the present paper is that the coefficient on patience α is negative for all three proxies for patience. Figure 3 plots our preferred measure of patience *Wait* against the sample averages of inflation, providing a first impression that inflation and patience are indeed negatively related.

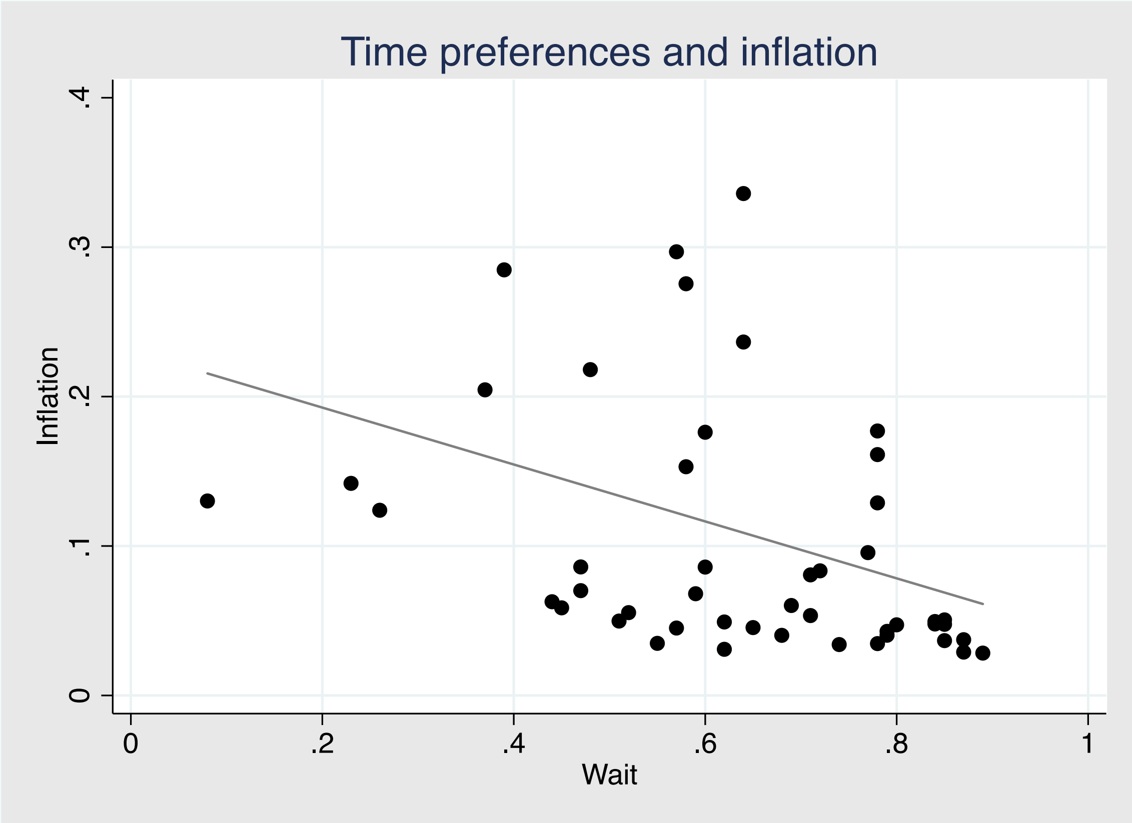

Figure 3: Inflation is measured by rate of depreciation of real money holdings induced by the annual rate of increase in the consumer price index (CPI). Values are averages over 1961-2009 and available data. Data on CPI is from World Bank, AMECO and OECD. Wait is share of people deciding to wait for higher monetary reward in Wang et. al.'s (2011) binary decision task. Values for Angola lie outside axis range.

In equation (1) the vector of control variables X_{it}, includes the measures of actual and legal central bank independence of Cukierman et al. (1992), henceforth CWN index [5]. This measure of legal central bank independence (*CBI*) is based on a coding of the characteristics of central bank law. A higher score indicates a more independent central bank. Actual independence of a central bank is measured by the average turnover rate of the central bank governor. A higher turnover rate is interpreted as indicating a more dependent central bank. In their influential study on the relationship between central bank independence and inflation, Cukierman et al. (1992) found that the index of legal independence is negatively related with inflation in the developed economies, while the predicted positive association between the turnover rate and inflation is significant for the developing economies.

[5]We use Cukierman's weighted index of central bank independence, LVAW.

We also control for other variables that might influence monetary policy makers. The first is the degree of openness of the economy. Romer (1993) has argued that the benefits of unanticipated inflation are decreasing in the degree of openness, reducing policy makers incentives to inflate in more open economies. The second variable is the ratio of public debt to gross domestic product as a higher debt to GDP ratio may increase the need for revenue from an inflation tax. Similarly, a high level of external debt may also increase the incentives to generate inflation in an attempt to reduce the real burden of the external debt. We therefore add the ratio of net foreign assets to GDP to the vector of control variables. Furthermore, we include an exchange rate system dummy indicting a pegged exchange rate which can serve as a nominal anchor helping to overcome the time-inconsistency problem associated with monetary policy making (Ghosh et al., 1997; Arnone et al., 2008). In addition, we also control for real income per capita. On the one hand, this variable is potentially associated with the general level of development of a country and may therefore capture a number of factors that have an impact on average inflation (Romer, 1993). On the other hand, real income may have an effect on individual's behavior in the wait-or-not task used to elicit time preferences. Irvin Fisher has for instance already argued that ... *"the smaller the income, the higher the preference for present over future income, that is the greater the impatience"* ... (cited in Thaler, 1997). We also add the number of coups in a given year. This variable is generally seen as a proxy for political instability which shortens the planning horizon of policy makers and is hence conceived as making countries more inflation-prone (see e.g. Campillo and Miron, 1996, and the references therein).

When deriving the New-Keynesian Phillips curve (2) from microeconomic foundations of firms price setting behavior, one can see that the parameter λ is influenced by the degree of risk aversion (e.g. Menz and Vogel, 2009). We therefore also include a country specific measure of risk-aversion into the vector of control variables. Apart from accounting for the micro foundations of the New-Keynesian Phillips curve, this has the additional advantage that it accounts for the risk that a wait-or-not question such as the one used by Wang et al. (2011) may measure risk-aversion rather than patience. Our risk-aversion measure comes from Rieger et al. (2014) and was determined in the same questionnaire study used to elicit the time preferences of Wang et al. (2011). We use Rieger et al.'s average relative risk premium in gains determined by asking subjects for their willingness to pay for taking part in six different hypothetical lotteries as our measure of risk aversion. All variables are described in more detail in the Data appendix.

Previous studies on the medium- to long-term determinants of inflation have often found to be sensitive to outliers. Following (Cukierman, 1992; Cukierman et al., 1992), most of the literature has therefore used the rate of depreciation of real money holdings $d = \pi/(100 + \pi)$ rather than the actual inflation rate as dependent variable. We also follow this standard approach. To further control for outliers we include a dummy for hyperinflations which equals one if inflation in a given year exceeds 100 per cent and is zero otherwise.

Our observation period comprises the years 1961 to 2009, which we partition into five sub-periods: The first three sub-periods are those for which Cukierman et al. (1992) calculated their indices of actual and legal central bank independence. They correspond to the period of convertibility with the dollar (1961-1971), the period of the two oil shocks after the end of the Bretton Woods system (1972-1979) and the period of disinflation (1980-1989). We split the remaining years of our sample period into two sub-periods covering the decades from 1990-1999 and 2000-2009.

All variables used in our estimation are period-averages, apart from the public and external debt to GDP ratios, for which we use beginning of period values. Data on net foreign assets is only available from 1970 onwards. As inclusion of this variable in our estimations would mean that we would loose the first period between 1961 and 1971, we exclude net foreign assets from our baseline specification. All together, and depending on the measure of patience used, this leaves us with an unbalanced panel of up to 88 countries for which we have at least one of the three measures of patience and inflation data for at least one period. This corresponds to up to 213 country-period observations in our sample. Summary statistics of our data are provided in Table 1.

Table 1: Summary Statistics

variable	**mean**	**min**	**max**	**N**	**sum**[1]
CBI	0.44	0.09	0.98	285	
Turnover	0.18	0.00	1.08	216	
Wait	0.63	0.08	0.89	253	
Future Orientation Index	0.78	0.24	1.32	201	
Hofstede's Long term	0.47	0.04	1.00	347	
NFA/GDP	-0.20	-2.78	3.15	322	
Fixed exch. rate	0.44	0.00	1.00	334	
Trade open.	0.63	0.04	3.89	337	
Income per capita	12533	297	72000	337	
Depreciation real money (CPI)	0.09	-0.00	0.69	215	
Dummy Hyperinfl. (CPI)	0.01	0.00	0.90	374	5.22
Coups	0.03	0.00	0.82	374	10.77
Public Debt/GDP	0.45	0.01	2.29	288	

[1] Sums of period averages

4 Results

We begin by estimating equation (1) by ordinary least squares (OLS). As the time preferences measured by Wang et al. (2011) may themselves be dependent on inflation rates, we then estimate equation (1) by instrumental variables (IV) to address a potential endogeneity bias.

4.1 Results from Ordinary Least Squares estimation

To become familiar with the data, we first replicate the results from earlier studies (e.g. Cukierman, 1992) that legal central bank independence is a good predictor for inflation for advanced economies while the turnover rate of the central bank governor affects inflation in developing economies (see section A of the appendix).

We then turn to the center of our analysis, the relationship between patience and inflation. As a first test of whether the data is consistent with our hypothesis that more patient countries have lower inflation rates, we regress inflation on our preferred measure of patience (*Wait*) and a period dummy. Consistent with our hypothesis, we find that more patient countries have on average lower inflation (column 1 of Table 2). Upon including a hyperinflation dummy to control for periods in which the annual inflation rate exceeds 100 per cent and a measure for risk aversion, the absolute size of the coefficient on patience decreases slightly but remains highly significant (column 2 of Table 2). Adding the measures of actual and legal central bank independence to the equation does not affect the coefficient on our variable of interest (column 3 of Table 2).

After controlling for per-capita income and two variables related to the external side of the economy, trade openness and the fixed exchange rate dummy, our coefficient of interest becomes smaller in absolute value but remains negative and highly significant. Consistent with expectations, it turns out that a higher per-capita income and a pegged exchange rate have a significantly negative impact on inflation. The coefficient on trade openness also has the expected negative sign but is insignificant (column 4 of Table 2). Inclusion of the public debt to GDP-ratio and average number of coups per year results in our complete baseline specification. In the full specification, the coefficient on the measure of patience continues to be negative and significantly different from zero (column 5 of Table 2). Finally, we also include the ratio of net-foreign assets to GDP. As data on this variable is only available from the year 1970 onwards, including net foreign assets effectively removes the period from 1961-1971 from the analysis. This however hardly affects the coefficient on our variable of interest, *Wait*, which remains significantly negative (column 6 of Table 2). When removing the period dummies from the analysis, the coefficient on the degree of patience remains negative but is no longer significantly different from zero. This is however not very surprising, given the large variations of average inflation rates over the different periods (Figure 1).

So far, our results are therefore in line with our hypothesis that more patient countries are more successful in maintaining low inflation. Other variables that are found to be consistently related to inflation are the level per-capita income and the exchange-rate system. This result is robust to using the two alternative measures of patience (Tables B.2 and B.3).

As the results of earlier studies on the determinants of inflation are sometimes sensitive to the exact choice of the sample, we repeat the above analysis for various subsamples of our data. First, we restrict the sample to advanced economies. This leaves the coefficient on patience *Wait* unaffected (Table 3, columns 1-2). Also, per-capita income and a pegged exchange-rate remain to have a negative impact on inflation rates. In addition, the coefficient on legal central bank independence now has the expected significant negative impact on inflation. Interestingly, the size of this coefficient is almost similar to the one estimated in the landmark study of Cukierman (1992). Similarly to the results reported in Table 5, the effect of legal central bank independence on inflation is however not robust to the inclusion of period dummies, but the degree of openness now emerges as an additional significant variable and has the expected negative sign (columns 1-2 of Table 3). The expected negative impact of patience on inflation is also confirmed in the subsample comprising only developing economies (columns 3-4 of Table 3). The hypothesis that inflation is negatively related to patience is also robust to splitting our sample in OECD and non-OECD countries.

The coefficient on our preferred measure of patience remains significantly negative in both subsamples, while the size of the effect is somewhat larger in the non-OECD countries (columns 5-6 of Table 3). The impact of patience on inflation remains significantly negative when restricting the sample to the period from 2000 to 2009 (column 7 of Table 3). As for some countries, some data for previous periods are not available, this latter specification gives us the broadest possible coverage of countries.

As a further robustness check, we use the GDP deflator instead of the consumer price index for calculating inflation rates. The relationship between inflation calculated from the GDP deflator and patience is negative for all three proxies for patience (Table B.1, column 1-3). In addition, we have experimented with alternative measures of central bank independence. Columns 4 to 6 of Table B.1 show the results from using the measures of economic (ECON), political (POL) and overall central bank independence (TOTAL) from Grilli et al. (1991). These variables are only available for the late eighties and the 2000's[6].

[6] We have interpolated the values for the period 1990-1999 by taking averages over the previous and subsequent period.

Table 2: OLS Estimates / Time preferences from Wang et al. (2011)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Wait	-0.137***	-0.111***	-0.102***	-0.0572**	-0.0553**	-0.0501*	-0.0385	-0.0325
	(0.0356)	(0.0172)	(0.0148)	(0.0215)	(0.0233)	(0.0251)	(0.0239)	(0.0249)
Rel. Risk Premium		0.00728	-0.0112	-0.00676	-0.00331	-0.00210	-0.0109	-0.0115
		(0.0313)	(0.0279)	(0.0186)	(0.0193)	(0.0192)	(0.0209)	(0.0209)
CBI			0.0294	0.0499	0.0458	0.0479	0.0146	0.0182
			(0.0268)	(0.0320)	(0.0329)	(0.0330)	(0.0297)	(0.0308)
Turnover rate			0.0539	0.0134	0.0133	0.0137	0.0130	0.0129
			(0.0333)	(0.0274)	(0.0290)	(0.0295)	(0.0285)	(0.0294)
Income per capita				-0.00162**	-0.00169**	-0.00154**	-0.00176***	-0.00174**
				(0.000613)	(0.000646)	(0.000687)	(0.000648)	(0.000660)
Trade open.				-0.00508	-0.00564	-0.00652	-0.0135	-0.0177
				(0.0170)	(0.0181)	(0.0196)	(0.0171)	(0.0174)
Fixed. Exch. Rate				-0.0315**	-0.0301**	-0.0311**	-0.0425***	-0.0429***
				(0.0123)	(0.0128)	(0.0125)	(0.0112)	(0.0115)
Public Debt/GDP					0.00571	0.00415	-9.70e-06	0.000542
					(0.0145)	(0.0137)	(0.0152)	(0.0145)
Coups					-0.00757	-0.00447	0.0495	0.0557
					(0.0507)	(0.0498)	(0.0571)	(0.0573)
NFA/GDP						-0.0130		-0.00548
						(0.00846)		(0.00947)
Period dummies	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Observations	200	200	179	177	174	173	174	173
R-squared	0.170	0.788	0.802	0.833	0.835	0.837	0.806	0.807

Dependent variable is rate of depreciation of real money holdings calculated from CPI. Standard errors clustered at country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All estimations include a constant. A dummy for hyper-inflations in which the annual inflation rate exceeds 100 per cent is included in all but the first estimation.

Table 3: OLS Estimates: Subsamples

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Adv. Econ	Adv. Econ	Dev. Econ.	Dev. Econ.	OECD	Non-OECD	2000-2009
Wait	-0.0363**	-0.0515***	-0.0628*	-0.0847**	-0.0466*	-0.117***	-0.0513*
	(0.0165)	(0.0162)	(0.0338)	(0.0329)	(0.0231)	(0.0243)	(0.0291)
Rel. risk premium	0.0120	0.0199	-0.0506	-0.0572	0.000106	-0.0212	0.00247
	(0.0363)	(0.0297)	(0.0421)	(0.0413)	(0.0459)	(0.0208)	(0.0336)
CBI	-0.0359**	-0.0102	0.0706	0.136	0.0185	-0.0278	0.0311
	(0.0136)	(0.0177)	(0.0597)	(0.0896)	(0.0318)	(0.0527)	(0.0262)
Turnover rate	0.0483	0.0598***	-0.0515	-0.0508	0.0534**	-0.0971*	-0.00134
	(0.0345)	(0.0206)	(0.0597)	(0.0374)	(0.0223)	(0.0508)	(0.0492)
Income per capita	-0.00219***	-0.00178***	0.00560	0.00640*	-0.00275***	0.00756**	-0.000868**
	(0.000462)	(0.000463)	(0.00348)	(0.00338)	(0.000943)	(0.00294)	(0.000405)
Trade openness	0.0226**	0.0229***	-0.0856***	-0.0690***	0.0192	-0.0742***	0.00552
	(0.00844)	(0.00745)	(0.0191)	(0.0105)	(0.0121)	(0.0151)	(0.0126)
Fixed exch. rate	-0.0264***	-0.0135*	-0.0773*	-0.0713	-0.0193	-0.0257	-0.0266**
	(0.00870)	(0.00768)	(0.0394)	(0.0520)	(0.0128)	(0.0326)	(0.0118)
Public debt / GDP	-0.00904	0.00435	-0.000142	-0.0294	-0.00946	0.0296	-0.00282
	(0.00970)	(0.00981)	(0.0478)	(0.0533)	(0.0165)	(0.0273)	(0.0177)
Coups	0.157*	0.0921	0.150**	0.127**	0.00608	0.0801	-0.336
	(0.0813)	(0.0690)	(0.0636)	(0.0463)	(0.0931)	(0.0598)	(0.358)
Period dummies	No	Yes	No	Yes	Yes	Yes	No
Observations	126	126	48	48	134	40	43
R-squared	0.805	0.867	0.862	0.903	0.800	0.955	0.420

Dependent variable is rate of depreciation of real money holdings calculated from CPI. Standard errors clustered at country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All estimations include a constant and period averages of a dummy for hyper-inflations in which the annual inflation rate exceeds 100 per cent.

Using these alternative measures of central bank independence does not alter our central result: The coefficient on the proxy for patience remains negative and highly significant.

Overall, the results presented so far have provided robust evidence for our hypothesis that more patient countries have on average lower inflation rate. The estimated coefficients on patience are not only statistically, but also economically significant. A coefficient between -0.05 and -0.07 on the variable *Wait* implies that an increase of the share of the population who decides to wait in the wait-or-not question from 39 per cent (as in Russia and Bosnia and Herzegovina) to 89 per cent (as in Germany) has a similar negative impact on inflation as what can be achieved by moving from a flexible exchange-rate to a peg to the US dollar. Similarly, the results of our analysis for instance suggests that if Portugal had a similarly high degree of patience as Switzerland, the difference in the inflation induced rate of depreciation of real money holdings would have been only two thirds of the value observed in the data between 1961 and 2009.

4.2 Results from Instrumental Variable Estimation

The main threat to our empirical analysis is that patience may be endogenous to inflation rates, giving rise to reverse causality. It is possible, for instance, that people in countries with high inflation rates have become used to learn over time that inflation erodes the value of monetary assets. They may then be less willing to wait for higher monetary rewards in the future, creating an upward bias in estimates of the discount rate (e.g. Frederick et al., 2002). To address this concern we use differences in how the languages spoken in the countries of our sample encode time to obtain exogenous variation in patience in an instrumental variables regression.

The idea that the representation of abstract concepts such as time in the human brain may be influenced by language has recently attracted renewed attention amongst psychologists (see Boroditsky, 2011, for an overview). In the field of economics, Chen (2013) has introduced a linguistic savings hypothesis. It is based on the observation that languages differ in how they require speakers to mark future events. Chen argues that a German speaker could speak about the future in the present tense as in "I go to the cinema tomorrow" while an English speaker would be required to use a future marker as in "I will go to the cinema" tomorrow. The hypothesis put forward by Chen states that languages that do not require the speaker to separate the present and future (weak future-time reference) induce a more future oriented behavior than languages that do require this distinction (strong future-time reference). It is based on the argument that languages with strong future-time reference (strong FTR) make future events to be perceived as more distant. Chen (2013) explicitly notes that this could be represented by a larger discount rate for speakers of strong FTR languages. Consistent with this hypothesis it has indeed been found that speakers of weak FTR languages save more, posses more wealth at the time of retirement (Chen, 2013) and are more likely to wait for a larger reward in the future (Sutter et al., 2013).

We use the variation on how languages require speakers to mark future events provided by Chen (2013) as an instrument for patience. For each country, we use the population-weighted average of Chen's strong FTR dummy for the languages spoken in the country as an instrument for our proxies for patience. The exclusion restriction for our IV strategy is that the grammatical structure of a country's language(s) is correlated with the time preference of its inhabitants but not directly with inflation.

Table 4 shows that our central hypothesis is consistent with the results obtained from instrumenting our preferred measure of patience in various subsamples of the data. Turning first to the estimation results for the full sample, our first stage regression documents that there is a strong impact of the way the language spoken in a country requires a speaker to encode time on patience. On average, moving from a country in which the language does not require speakers to use a future marker ($strong\ FTR = 0$) to a country in which this marker is required ($strong\ FTR = 1$) reduces the share of persons who decide to wait in the wait-or-not question by 18.8 percentage points. The F-statistics on the excluded instruments in the first-stage regression is 19.9, indicating that the strong FTR variable is not a weak instrument. The results of the second stage confirm our findings from the OLS estimates reported above. The coefficient on our variable of interest is even higher than in the OLS estimates and remains highly significant (columns 1-2).

We continue to estimate a significantly negative coefficient in various subsamples of the data. If at all, the coefficient on patience is now closer to the coefficients estimated with OLS which we have reported above (columns 5-10). The coefficient on the variable *Wait* remains negative after removing the period dummies but becomes marginally insignificant (columns 3-4).

The results from the instrumental variable regression are generally robust to using inflation rates calculated from the GDP deflator rather than the consumer price index and to using alternative measures of patience (Table B.4). Columns 1 and 2 show that we continue to estimate a negative effect of patience on inflation when we use different proxies for patience. The second stage coefficient on patience is negative for both Hofstede's Index of Long Term Orientation and the Future Orientation Index. However, only the coefficient on the former is also significant. We obtain a similar result when using the GDP deflator to calculate inflation rates (columns 3-5). Again, the coefficient on patience is negative in all three second stage regressions, but only the coefficients on the variable *Wait* and Hofstede's Index of Long Term Orientation are significant. In all estimations, the F-Test on the excluded instruments becomes significantly smaller when using the two alternative measures of patience. But with only a single instrument which is highly significant in the first-stage regression, this not necessarily points to a problem of weak instruments.

5 Conclusion

Monetary policy makers constantly face an inter temporal choice problem. By easing monetary policy they can temporarily increase output and employment. These short-run gains have however to be weighed against the long-run cost of inflation. Monetary policy makers in more patient countries should therefore be better able to maintain lower inflation. In this paper we have provide empirical evidence for this hypothesis. Based on a panel of up to 88 countries covering the years from 1961 to 2009 we found that patience is negatively related to observed inflation rates. We demonstrated that this result holds for a range of sub-samples and is robust to changes in the sample period as well as to using alternative measures of patience.

Our paper therefore establishes a new determinant of inflation. So far, the most widely accepted determinants of inflation included the degree of independence of the central bank, the openness of an economy, the exchange-rate system and the financial sector's opposition to inflation. The results of the present paper show that central bank independence might not be sufficient to ensure stable prices. It has already been pointed out by Neumann (1998) that central bank independence is only a necessary, but no sufficient condition for price stability. Rather, central bank independence would need to be accommodated in a stability culture that facilitates implementation of a policy of stable prices by the central bank. In this paper, we have identified one possible instance of such a stability culture, the time preference rate of the population.

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Table 4: Instrumental Variable Regression / Wang et al. (2011) measure of patience

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Full Sample			Adv. Economies		OECD		Dev. Economies	
	1^{st} stage	2^{nd} stage	1^{st} stage	2^{nd} stage	1^{st} stage	2^{nd} stage	1^{st} stage	2^{nd} stage	1^{st} stage	2^{nd} stage
strong FTR	-0.188***		-0.198***		-0.223***		-0.225***		-0.0752***	
	(0.0422)		(0.0406)		(0.0457)		(0.0456)		(0.0215)	
Wait		-0.139**		-0.0918		-0.0719***		-0.0775**		-0.739***
		(0.0582)		(0.0571)		(0.0278)		(0.0319)		(0.182)
Rel. risk premium	0.0374	0.00309	0.0738	0.00552	-0.0373	0.0167	-0.0251	-0.00447	-0.508***	-0.681***
	(0.142)	(0.0475)	(0.143)	(0.0500)	(0.183)	(0.0278)	(0.147)	(0.0442)	(0.0820)	(0.174)
CBI	0.0576	0.0455	0.000182	0.00859	0.0450	-0.00849	0.0474	0.0213	-0.0503	0.129***
	(0.0847)	(0.0343)	(0.0731)	(0.0291)	(0.0957)	(0.0157)	(0.0951)	(0.0294)	(0.0646)	(0.0494)
Turnover	0.0619	0.0318	0.0399	0.0253	-0.0199	0.0586***	-0.0376	0.0510***	0.0217	-0.0419
	(0.0830)	(0.0279)	(0.0830)	(0.0284)	(0.121)	(0.0182)	(0.110)	(0.0194)	(0.0278)	(0.0351)
Income per capita	0.00259	-0.00132*	0.00202	-0.00162**	-0.000263	-0.00169***	-0.000757	-0.00263***	0.0307***	0.0350***
	(0.00205)	(0.000706)	(0.00185)	(0.000696)	(0.00294)	(0.000394)	(0.00252)	(0.000838)	(0.00503)	(0.0102)
Trade openess	-0.00510	-0.000485	-0.0361	-0.0122	0.0348	0.0247***	0.0401	0.0221**	-0.0855**	-0.108***
	(0.0693)	(0.0148)	(0.0520)	(0.0156)	(0.0907)	(0.00811)	(0.0830)	(0.0102)	(0.0313)	(0.0136)
Fixed exch. rate	-0.0447	-0.0312**	-0.0130	-0.0398***	-0.0631	-0.0145**	-0.0684	-0.0211*	-0.00289	-0.0724*
	(0.0393)	(0.0148)	(0.0293)	(0.0125)	(0.0473)	(0.00710)	(0.0406)	(0.0121)	(0.0161)	(0.0381)
Public debt/ GDP	0.0864	0.00155	0.0760	-0.00774	0.0882	0.00508	0.108*	-0.00765	0.0708**	-0.0551
	(0.0571)	(0.0131)	(0.0560)	(0.0140)	(0.0624)	(0.00938)	(0.0576)	(0.0151)	(0.0219)	(0.0578)
Coups	-0.125	-0.0780	-0.0730	-0.00634	-0.472	0.0769	-0.261	-0.00914	0.0148	-0.0243
	(0.145)	(0.0538)	(0.124)	(0.0694)	(0.292)	(0.0675)	(0.192)	(0.0894)	(0.0772)	(0.0552)
Period dummies	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
F-Test excl. instr.	19.90		23.71		23.88		24.35		12.29	
Observations	159	159	159	159	126	126	134	134	33	33
R-squared	0.443	0.835	0.424	0.814	0.492	0.865	0.514	0.797	0.868	0.946

Dependent variable is rate of depreciation of real money holdings calculated from CPI. Standard errors clustered at country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All estimations include period dummies, a constant and period averages for a dummy indicating years in which the annual inflation rate exceeds 100 per cent. .

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Table 5: Cukierman regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Full Sample	Adv. Econ	Dev. Econ.	Full Sample	Adv. Econ.	Dev. Econ.
CBI	-0.0265	-0.0536*	0.0685	0.0408	0.00932	0.227*
	(0.0330)	(0.0282)	(0.105)	(0.0393)	(0.0322)	(0.125)
Turnover	0.350***	0.225***	0.419***	0.315***	0.202***	0.349***
	(0.0432)	(0.0471)	(0.0890)	(0.0421)	(0.0440)	(0.0850)
Constant	0.0323*	0.0536***	0.00363	-0.0209	0.0108	-0.109*
	(0.0189)	(0.0170)	(0.0539)	(0.0220)	(0.0187)	(0.0621)
Period dum.	Yes	Yes	Yes	No	No	No
Obsrv.	179	130	49	179	130	49
R-squared	0.279	0.189	0.330	0.358	0.339	0.484

Standard errors clustered at the country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Dependent variable: rate of depreciation of real money holdings (CPI inflation).

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A Cukierman et al. (1992) regressions

In this section, we repeat the classic analysis of Cukierman (1992) on the impact of central bank independence on inflation. We therefore regress the rate of depreciation of real money holdings, d, on the degree of legal and actual central bank independence from Cukierman (1992). We find that both coefficients have the expected sign, but only the coefficient on the turnover rate is statistically significant (Table 5, column 1). Upon restricting the sample to developed economies, the coefficient on the degree of legal central bank independence becomes significantly negative and has the same size as in Cukierman (1992). For developing economies, we continue to find that only the degree of actual central bank independence is significantly related with inflation (Table 5 columns 2-3). The only slight deviation from these results is that in the present sample, the turnover rate also affects inflation in advanced economies. However, these first results are not robust to the inclusion of period dummies (columns 4-6 of Table 5).

B Data Appendix

Inflation: Consumer Price Index, percentages change to previous year, using rate of depreciation of real money holdings transformation, $\pi/(100+\pi)$. Data is taken from AMECO wherever possible, data for remaining countries is from World Bank Development Indicators or OECD. Period averages.

Hyperinflation: Dummy indicating period of hyperinflation. Equals 1 if period contains year in which consumer price index rises by more than 100 per cent.

Wait: Share of respondents in a given country that decided to wait for a better option in a survey designed to elicit time preferences. The question asked was the following: *Which offer would you prefer? A. a payment of $3400 this month B. a payment of $3800 next month.* Data are taken from Wang et al. (2011).

Fixed exchange rate: Exchange rate system dummy taken from Shambaugh (2004). Dummy equals 1 if exchange rate is pegged and 0 otherwise. Period averages.

Public debt: Public debt in per cent of GDP. Data are taken from IMF's Historical Debt Database (Vintage 2012), AMECO and OECD. Beginning of period data.

Net foreign assets: Net foreign assets as a share of GDP. Period averages. Data taken from Philip Lane's External Wealth of Nations Dataset 1970-2011. Beginning of period levels.

Income per capita: PPP Converted GDP Per Capita (Chain Series), at 2005 constant prices. Data taken from Penn World Tables. Period averages.

Trade openness: Openess at constant prices. Data taken from Penn World Tables. Period averages.

Turnover: Average turnover of central bank governor. Data for periods 1960-1971, 1972-1979 and 1980-1989 is taken from Alex Cukiermans webpage. Data for periods 1990-1999 and 2000-2009 are own calculation based on Dreher et al. (2010). Period averages. Index for 1990-1999 is average over periods 1980-1989 and 2000-2009.

Central bank independence: Index of central bank independence. Data for periods 1960-1971, 1972-1979 and 1980-1989 is taken from Alex Cukiermans webpage. Data for 2000-2009 is from the update of Cukierman's data from Crowe and Meade (2007). Index for 1990-1999 is average over periods 1980-1989 and 2000-2009.

Coups: Number of coups in the respective period. Data is taken from Powell and Thyne (2011).

Political autonomy (POL): Indicator for political autonomy of central banks from Grilli et al. (1991), updated by Arnone et al. (2007). Data is taken from Arnone et al. (2007) who publish this indicator for the late eighties' and the early 2000's.

Economic autonomy (ECON): Index for economic autonomy of central banks from Grilli et al. (1991), updated by Arnone et al. (2007). Data is taken from Arnone et al. (2007) who publish this indicator for the late eighties' and the early 2000's.

Overall autonomy (TOTAL): Overall central bank autonomy from Grilli et al. (1991), updated by Arnone et al. (2007). Data is taken from Arnone et al. (2007) who publish this indicator for the late eighties' and the early 2000's.

Hofstede's Long Term: Hofstede's index of long-term orientation. Data downloaded from Hofstede's webpage.

Ambiguity Aversion: Rieger et al. (2014) measure of ambiguity aversion.

Relative risk premium: Country specific relative risk premium calculated by Rieger et al. (2014), calculated from participant's willingness-to-pay for theoretical lotteries comprising only gains.

Future Orientation Index: Country specific ratio of internet search engine queries for next year relative to previous year (Preis et al., 2012).

C Further Tables

Table B.1: Robustness Checks: OLS

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES		GDP deflator			Alternative measure of CBI	
Wait	-0.0628**			-0.0837***	-0.0719**	-0.0780**
	(0.0258)			(0.0311)	(0.0334)	(0.0329)
Hofstede's Long Term		-4.070**				
		(1.813)				
Future Orientation Index			-0.0737***			
			(0.0265)			
Rel. risk premium	0.0237	0.00828	-0.0130	-0.0102	-0.00815	-0.0188
	(0.0365)	(0.0366)	(0.0794)	(0.0308)	(0.0289)	(0.0329)
CBI	0.0435	0.0418	0.0547			
	(0.0352)	(0.0350)	(0.0459)			
Turnover	0.0438	0.0402	0.0203	0.0140	0.00694	0.0139
	(0.0311)	(0.0335)	(0.0358)	(0.0388)	(0.0381)	(0.0366)
Income per capita	-0.00169**	-0.00206***	-0.00153*	-0.00181**	-0.00162**	-0.00178***
	(0.000659)	(0.000605)	(0.000776)	(0.000699)	(0.000680)	(0.000630)
Trade open.	-0.00421	-0.00638	-0.0336*	0.00436	-0.000270	0.00328
	(0.0181)	(0.0217)	(0.0189)	(0.0126)	(0.0128)	(0.0113)
Fixed exch. rate	-0.0298**	-0.0284**	-0.0353*	-0.0327**	-0.0271**	-0.0367**
	(0.0129)	(0.0135)	(0.0205)	(0.0144)	(0.0104)	(0.0146)
Public debt / GDP	-0.00179	-0.00201	0.0188	0.00291	0.000442	0.00334
	(0.0127)	(0.0143)	(0.0171)	(0.0157)	(0.0176)	(0.0161)
Coups	-0.0725	-0.0571	-0.0105	-0.0167	0.00346	-0.00337
	(0.0434)	(0.0480)	(0.0575)	(0.185)	(0.199)	(0.200)
total				0.0471		
				(0.0508)		
econ					0.00116	
					(0.0360)	
pol						0.0396
						(0.0257)
Observations	171	169	127	119	119	119
R-squared	0.809	0.806	0.834	0.818	0.814	0.820

Standard errors clustered at country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All estimations include a constant, a dummy indicating hyper-inflations and period dummies.
Dependent variable is depreciation of real money holdings calculated from GDP deflator (columns 1-3 and CPI (columns 4-6).

Table B.2: OLS Estimates (Hofstede's Index of Long Term Orientation)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hofstede's Long Term	-9.281*	-3.596	-5.046**	-3.394**	-3.195**	-2.746	-2.903*	-3.012
	(4.843)	(2.501)	(1.971)	(1.482)	(1.471)	(1.802)	(1.535)	(1.851)
Rel. Risk Premium		-0.0356	-0.0524	-0.0237	-0.0185	-0.0171	-0.0230	-0.0241
		(0.0393)	(0.0348)	(0.0175)	(0.0190)	(0.0193)	(0.0190)	(0.0195)
CBI			0.0281	0.0505	0.0455	0.0477	0.0186	0.0237
			(0.0282)	(0.0307)	(0.0320)	(0.0324)	(0.0286)	(0.0294)
Turnover			0.0703*	0.0141	0.0116	0.0120	0.0140	0.0152
			(0.0353)	(0.0301)	(0.0314)	(0.0320)	(0.0293)	(0.0306)
Income per capita				-0.00198***	-0.00202***	-0.00194***	-0.00196***	-0.00197***
				(0.000545)	(0.000577)	(0.000641)	(0.000560)	(0.000597)
Trade open.				-0.00641	-0.00752	-0.0103	-0.0127	-0.0172
				(0.0205)	(0.0212)	(0.0212)	(0.0193)	(0.0189)
Fixed exch. rate				-0.0310**	-0.0292**	-0.0304**	-0.0433***	-0.0441***
				(0.0119)	(0.0124)	(0.0123)	(0.0104)	(0.0108)
Public debt / GDP					0.00548	0.00556	0.000179	0.00231
					(0.0151)	(0.0141)	(0.0156)	(0.0143)
Coups					0.00895	0.0129	0.0540	0.0554
					(0.0606)	(0.0612)	(0.0635)	(0.0660)
NFA / GDP						-0.00694		0.000775
						(0.0112)		(0.0111)
Period dummies	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Observations	212	199	179	177	174	173	174	173
R-squared	0.168	0.755	0.783	0.830	0.833	0.834	0.806	0.808

Dependent variable is rate of depreciation of real money holdings calculated from CPI. Standard errors clustered at country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All estimations include a constant. A dummy for hyper-inflations in which the annual inflation rate exceeds 100 per cent is included in all but the first estimation.

Table B.3: OLS Estimates (Future Orientation Index)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Future Orientation Index	-0.130***	-0.0819***	-0.0924***	-0.0381	-0.0543**	-0.0510**	-0.0358*	-0.0336
	(0.0394)	(0.0232)	(0.0252)	(0.0261)	(0.0209)	(0.0229)	(0.0211)	(0.0239)
Rel. Risk Premium		0.0298	-0.00127	-0.0489	-0.0600	-0.0597	-0.0713	-0.0708
		(0.0497)	(0.0432)	(0.0570)	(0.0592)	(0.0597)	(0.0615)	(0.0623)
CBI			0.0415	0.0657	0.0624	0.0630	0.0404	0.0401
			(0.0365)	(0.0403)	(0.0413)	(0.0415)	(0.0383)	(0.0386)
Turnover			0.0386	-0.0106	-0.0178	-0.0193	-0.0162	-0.0170
			(0.0287)	(0.0305)	(0.0335)	(0.0337)	(0.0333)	(0.0338)
Income per capita				-0.00209**	-0.00190**	-0.00183**	-0.00215***	-0.00213***
				(0.000876)	(0.000805)	(0.000826)	(0.000733)	(0.000745)
Trade open.				-0.0341*	-0.0399**	-0.0395**	-0.0484***	-0.0485***
				(0.0192)	(0.0169)	(0.0171)	(0.0172)	(0.0173)
Fixed exch. rate				-0.0383**	-0.0395**	-0.0393**	-0.0509***	-0.0505***
				(0.0172)	(0.0185)	(0.0184)	(0.0159)	(0.0160)
Public debt / GDP					0.0315*	0.0296*	0.0273	0.0261
					(0.0170)	(0.0166)	(0.0190)	(0.0197)
Coups					0.0518	0.0482	0.0909	0.0895
					(0.0697)	(0.0661)	(0.0704)	(0.0682)
NFA / GDP						-0.00920		-0.00436
						(0.0146)		(0.0126)
Period dummies	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Observations	140	140	133	131	129	129	129	129
R-squared	0.198	0.807	0.828	0.862	0.872	0.872	0.853	0.853

Dependent variable is rate of depreciation of real money holdings calculated from CPI. Standard errors clustered at country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All estimations include a constant. A dummy for hyper-inflations in which the annual inflation rate exceeds 100 per cent is included in all but the first estimation.

Table B.4: Robustness Checks: IV

VARIABLES	(1) cpiinf_drm	(2) cpiinf_drm	(3) gdpinf_drm	(4) gdpinf_drm	(5) gdpinf_drm
Hofstede's Long Termn	-15.39*			-16.63*	
	(8.501)			(8.658)	
Future Orientation Index		-0.260			-0.311
		(0.236)			(0.269)
Wait			-0.150**		
			(0.0635)		
Rel. risk premium	-0.0571	-0.123	0.0364	-0.0299	-0.0833
	(0.0704)	(0.0905)	(0.0550)	(0.0719)	(0.0969)
CBI	0.0476	0.0629	0.0429	0.0436	0.0473
	(0.0340)	(0.0447)	(0.0364)	(0.0359)	(0.0491)
Turnover	0.0430	0.0458	0.0554**	0.0538	0.0920
	(0.0460)	(0.0541)	(0.0267)	(0.0372)	(0.0629)
Income per capita	-0.00196**	0.00251	-0.00141*	-0.00211**	0.00327
	(0.000817)	(0.00545)	(0.000727)	(0.000856)	(0.00612)
Trade openss	-0.00288	-0.0246	-0.00109	-0.00424	-0.0214
	(0.0255)	(0.0368)	(0.0156)	(0.0263)	(0.0401)
Fixed exch. rate	-0.0276*	-0.0439*	-0.0281**	-0.0234	-0.0397
	(0.0147)	(0.0238)	(0.0142)	(0.0158)	(0.0261)
Public debt / GDP	-0.00177	0.0358*	-0.00254	-0.00639	0.0389
	(0.0187)	(0.0211)	(0.0123)	(0.0189)	(0.0284)
Coups	-0.122	-0.0633	-0.114***	-0.169**	-0.124**
	(0.0781)	(0.0572)	(0.0377)	(0.0673)	(0.0567)
Period dummies	Yes	Yes	Yes	Yes	Yes
F-Test excl. instruments	3.37	0.97	21.58	3.51	1.01
Observations	159	119	159	157	117
R-squared	0.789	0.825	0.804	0.756	0.766

Standard errors clustered at country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All estimations include a constant, period dummies and a dummy controlling for hyperinflations.
Dependent variable is depreciation of real money holdings calculated from CPI.