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Permanent and Transitory Monetary Shocks Around the World^{*}

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Abstract

The effects of monetary policy on output and inflation have been at the center of macroeconomic debate for decades. Uribe (2022) argues, by examining the US, that a better characterization of these effects can be obtained by splitting monetary policy into transitory and permanent shocks. He finds that transitory monetary contractions reduce inflation and output, as predicted by traditional New Keynesian models, whereas long-term increases in the inflation rate boost output in the short run. We propose a simplified method to estimate the impact of these shocks, and expand the analysis to include a sample of 80 countries. Our findings suggest that conclusions drawn from US data generally hold on average for this broader group, although notable variations across countries emerge. We also broaden the analysis by lifting the over-identifying assumption of superneutrality imposed by Uribe. We find that although superneutrality does not strictly hold, deviations from it are on average small. When examining crosscountry differences, the potential positive impact on output of a permanent inflation increase seems to diminish, and may even become negative, for countries with higher average and more volatile inflation rates. Our results provide new evidence supporting the standard tenets of monetary policy: it cannot persistently increase output and has negative side effects if inflation is allowed to rise beyond the range typically defended by central banks.

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1 Introduction

The study of the effects of monetary policy on output and inflation has been at the center of macroeconomic debate for decades. The neutrality of money is one of the fundamental tenets of modern macroeconomics, dating back to David Hume and early versions of the quantity theory of money (e.g., Patinkin (2017)). Monetary superneutrality (by which the long-run level of output is independent of money supply growth) has also been a focus of debates at least since Sidrauski (1967).

Uribe (2022) argues, by examining the US, that a better characterization of the effects of monetary policy can be obtained by differentiating between transitory and permanent monetary shocks. In this framework, monetary policy can operate through transitory shocks without changing long-run inflation, which coexist with permanent shocks that do increase the long-run inflation rate. When implementing such a split, he finds that transitory monetary contractions reduce inflation and output, as suggested by traditional New Keynesian models, but changes in the long-run inflation rate lead to transitory output increases.

In this paper, we extend this decomposition to a larger set of eighty countries. We do this not through a state-space model under a Bayesian approach, but by implementing a two-step, three-variable structural VAR. This approach has four benefits. First, it makes estimates less reliant on prior assumptions. Second, it leads to an easier interpretation of the results. Third, it avoids the use of sign restrictions for the estimation, which can constrain the results. Fourth, is much faster to implement. We show that this methodology replicates Uribe's results for the US and can easily be extended to a larger set of countries.

We find that while the results broadly follow the same pattern as in the US, there is significant cross-country variation, and they are not independent of the monetary policy framework in place. In particular, countries with a historically higher average inflation rate display a more muted effect on output from changes in the long-run inflation rate. For instance, this implies that disinflations may be costly when transitioning from, say, 6% to 2%, but not when bringing inflation down from 20%. For this second group of countries, disinflation may actually *increase* output. This approach, following Uribe (2022), assumes superneutrality of money. But is this assumption justified? Many economists argue that a higher permanent inflation rate leads to a better-working labor market by reducing the real effect of downward nominal wage rigidity. In this case, inflation works as 'grease in the wheel' mechanism leading to higher output (dating back to Tobin, 1972). In fact, the recent debate in low-inflation economies on the optimality of the 2% inflation target also relates to whether superneutrality holds. If a 4% target is considered better than a 2% target, is has to be because superneutrality does not hold. Conversely, policy-oriented economists from high-inflation countries often argue the opposite: that a higher inflation rate is dysfunctional for the working of the economy, leading to lower output (early contributions are Dornbusch and Edwards, 1991, De Gregorio, 1992, Fischer, 1993, among others). What is clear is that there are plenty of arguments given on both sides of the spectrum which suggest that superneutrality does not hold.

Thus, in the second part of the paper, we lift this assumption. We show that superneutrality does not strictly hold, but the output effects from changes in long-run inflation rate are on average small and become negative as inflation increases. Without superneutrality the short-term effects of permanent shocks also changes and become weaker when average inflation is higher.

Overall, our analysis suggests that results obtained for the US or other low-inflation, advanced economies do not easily translate to other countries. Our results support the common view held by central banks that monetary policy is typically unable to move long-run output and can lead to negative effects if inflation rises above the typically defended range.

This paper is related to analyses on the welfare costs of inflation. A first type of studies has focused on its role as a distortionary tax leading to inefficient levels of cash balances (e.g., Friedman, 1969, Lucas, 2000, and more recently Ireland, 2009 and Kurlat, 2019). A second approach, particularly in the context of New Keynesian models, centers on misallocation costs around price dispersion (e.g., Tomassi, 1996, Woodford, 2011, Nakamura et al., 2018, Sheremirov, 2020). Empirically, Barro (1996), Bruno and Easterly (1998), and Easterly (2001) also show a negative association between inflation and growth.

Closer to our approach, using a bivariate SVAR framework, Bullard and Keating (1995) find evidence of departures from superneutrality in countries with low average inflation rates, where permanent increases in inflation are associated with long-run increases in output. Rapach (2003) estimates a trivariate VAR model including the nominal interest rate and finds similar results, as permanent shocks to inflation are associated with higher output for most countries. We expand these previous results by considering a larger set of countries with an updated sample, particularly including emerging and developing countries with historically higher inflation rates. Differently from Bullard and Keating (1995), our three-variable model allows us to distinguish permanent and transitory monetary shocks and observe their short-run implications. We confirm their results within this longer sample and different methodology, though by including higher-inflation countries, we can make stronger statements about the effects of inflation increases.

Finally, this paper is also related to discussions regarding the resurgence of the so-called neo-Fisherian approach. As nominal interest rates and inflation cointegrate, the question is whether higher inflation/interest rates lead to an expansion of output. In this regard, Valle e Azevedo et al. (2022) is also relevant to our analysis, as they found a strong long-run relationship between the nominal interest rate and inflation (near one-to-one); a result that we use as part of our identification strategy. They also extend the results in Uribe (2022) about the effects of permanent monetary shocks to six advanced economies with historically low inflation, using a simplified VAR-based methodology. Relative to their work, we analyze a larger set of countries, including emerging as well as medium- and high-inflation economies. Moreover, with our approach we can impose the same short-run restrictions to identify the transitory monetary shock as in Uribe's work, while they identify a temporary shock that can be a mixture of both real and monetary surprises. Finally, we also explore the implications of lifting the superneutrality assumption, which they do not, allowing us to characterize the potential long-run effects of permanent monetary shocks.

The remainder of the paper is organized as follows. Section 2 explains our simplified methodology, which allows us to impose both short- and long-run identifying restrictions within a structural VAR framework. The data description is also included there. Section 3 discusses the results under the superneutrality assumption. Section 4 documents how results change without imposing superneutrality. Finally, Section 5 concludes.

2 Empirical approach

2.1 Estimation

Our point of reference is the empirical model in Uribe (2022): a state-space model for three observed variables: nominal interest rate (i_t , log of the gross interest rate), inflation rate (π_t , log-difference of the price level) and real GDP (y_t , in logs). Despite having only three variables, the state-space structure allows identifying four orthogonal shocks: two monetary (one temporary and the other permanent) and two real or non-monetary (also one temporary and another permanent). He uses the following identification assumptions:

- U.1 There are two orthogonal stochastic trends, one determining the long-run behavior of nominal variables i_t and π_t (permanent monetary shock) while the other is the stochastic trend of y_t (permanent real shock). These two trends are assumed to be integrated of order one, and thus also i_t , π_t and y_t feature this characteristic. A corollary of these assumptions is that the permanent monetary shock has no long-run impact on y_t and that only the permanent monetary shock can affect both i_t and π_t in the long run.
- U.2 The interest and inflation rates are cointegrated, with a one-to-one relationship, such that the ex-post real rate $(r_t \equiv i_t \pi_t)$ is stationary.
- U.3 The transitory monetary shock has a zero direct effect on output and inflation.¹

Assumptions U.1 and U.2 are consistent with DSGE models featuring long-run money superneutrality, where monetary policy is the sole determinant of long-run inflation. Finally,

¹Uribe alternatively assumes that this shock can have a non-negative direct effect on output and inflation (i.e. sign-restrictions). However, both alternatives yield comparable results.

while Uribe identifies four shocks, he focuses on the consequences of the two monetary disturbances.

We provide a simpler estimation strategy that still allows identifying both monetary shocks, which are the focus of the analysis, without using a state-space model. Consider the vector x_t collecting the following three variables $x_t \equiv [\pi_t, y_t, i_t]'$. Given the presence of one cointegration relationship with three variables, applying the results in Gonzalo and Ng (2001), the vector x_t has an $MA(\infty)$ representation that can be written as

$$\Delta x_t = \Phi^P(L)\epsilon_t^P + \Phi^T(L)\epsilon_t^T, \tag{1}$$

where Δ denotes the time-difference operator, ϵ_t^P is a 2 × 1 vector of permanent shocks while ϵ_t^T is a scalar disturbance with only transitory effects, all of them i.i.d. with the further property that $E(\epsilon_t^P \epsilon_t^T) = 0$ (i.e. permanent shocks are uncorrelated with the temporary one). The infinite lag polynomials $\Phi^P(L)$ (3 × 2) and $\Phi^T(L)$ (3 × 1) are such that rank[$\Phi^P(1)$] = 2, where $\Phi^P(1)$ indicates the cumulative effect of permanent shocks (i.e. the long-run effect on the level of x_t), while $\Phi^T(1) = 0$ (the temporary shock cannot have, by definition, long-run effects). Imposing further constraints in $\Phi^P(1)$ (i.e. long-run restrictions, described below) will allow us to further split the vector ϵ_t^P into a permanent monetary shock and a permanent non-monetary/real shock. If ϵ_t^T is the only temporary shock, we cannot impose further short-run restrictions (as in assumption U.3) that would allow us to call this a temporary monetary shock, we provide below a framework that allows for more than one transitory shock (and therefore more structural shocks than observables).

Given this discussion, we proceed in three steps. We first estimate a VAR on the vector $w_t \equiv [\Delta \pi_t, \Delta y_t, r_t]'$, with a SVAR representation,

$$w_t = A_1 w_{t-1} + \dots + A_p w_{t-p} + B\epsilon_t,$$
(2)

²Lütkepohl (2008) results imply that, in a system with *n* variables, *n* shocks and *r* co-integration relationships, at most *r* transitory shocks can be identified, and the number of short-run restrictions on these shocks that can be imposed is r - 1. In our case, r = 1, so no short-run restrictions can be imposed.

where ϵ_i are i.i.d. shocks with a diagonal variance matrix (normalized to the identity matrix without loss of generality), A_j are the lag matrices and B contains the short-run effects of each structural shock. This VAR is the triangular representation (Phillips, 1991) of the equivalent co-integrated VEC model that imposes the long-run relationship U.2.

Let D denote the matrix collecting the long-run accumulated effects on w_t for each structural shock.³ In particular, the first two rows of D contain the long-run effects on the *levels* of π_t and y_t , while the third row has the accumulated effect on r_t ; which has no interpretation under the assumption that r_t is stationary. We impose the following zero restrictions in the long-run matrix D,⁴

$$D = \begin{bmatrix} \cdot & 0 & 0 \\ 0 & \cdot & 0 \\ \cdot & \cdot & \cdot \end{bmatrix}.$$
 (3)

In words, the two zeros in the first row indicate that only the first shock can affect inflation in the long run (the same holds for interest rates, following the cointegration assumption U.2). The first zero in the second row indicates that the first shock cannot affect the level of output in the long run, while the zero in the second row, third column, indicates that the third shock has no long run effect on output either. Therefore, the first element in ϵ_i corresponds to the permanent monetary shock while the second is the non-monetary/real permanent shock. Relative to the $MA(\infty)$ representation in (1), this step gives us an estimate for $\Phi^P(L)$ and it is therefore enough to characterize the impulse responses of both permanent shocks.

In the second step we apply a historical decomposition to obtain the vector \tilde{w}_t , defined as the path of w_t that is not explained by permanent shocks. Moreover, using the cointegration relationship and initial values, from \tilde{w}_t we can compute the vector \tilde{x}_t : the "gap" between the three original variables and their permanent components (in terms of (1), $\Delta \tilde{x}_t = \Delta x_t - \Phi^P(L)\epsilon_t^P$). In other words, \tilde{x}_t only depends on transitory shocks.

The final step consists in estimating a VAR model for \tilde{x}_t , imposing short-run restrictions

³If $A(L) = A_1L + A_2L^2 + ... + A_pL^p$ denotes the polynomial in the lag operator characterizing the VAR's lag structure, the cumulative long-run effect is computed as $D \equiv [I - A(1)]^{-1}B$.

⁴The symbol " \cdot " indicates an unrestricted coefficient.

in line with assumption U.3. In particular, given the order of variables in the vector \tilde{x}_t , we use a recursive/Cholesky order, where the transitory monetary shock is the third one (i.e. the one that contemporaneously does not affect inflation and output but it does move the nominal interest rate). This assumption is in line with the related SVAR literature identifying transitory monetary shocks, e.g. Christiano et al. (1999), Stock and Watson (2001), among others. Notice that we are clearly working in a partial identification framework, as we are identifying only one transitory shock, but there are other transitory shocks driving \tilde{x}_t that we are not interested in exploring.

Overall, this procedure allow us to identify the two monetary shocks that are the focus of Uribe (2022), using an approach that is easier to implement. A final distinction is worth highlighting: while he uses a Bayesian approach to estimate his empirical model, we rely on a frequentist approach, characterizing parametric uncertainty using bootstrap methods. The lack of informative priors in our analysis imply that wider confidence bands are expected relative to Uribe's credible sets.⁵

As we mentioned, the assumptions in Uribe (2022) imply money is superneutral in the long run: permanent changes in inflation have no impact on real variables (output and the real rate here). However, these are over-identifying restrictions: to identify the permanent shock to inflation it is enough to assume that there are only two permanent shocks and that one of them cannot have a long-run impact on inflation (i.e. only the zeros in the first row of matrix

⁵There is another subtle distinction between our VAR approach and the assumptions in Uribe (2022). The way Uribe imposes zero restrictions (although this also holds in the sign-restrictions case) to identify the transitory monetary shock implies these hold not only in the period the shock hits (as we are imposing by constraining the matrix B, and as it is generally done in the related literature), but instead the restrictions are satisfied even after the initial period. According to equations (1) and (2) in the paper, the deviations of the three variables from their stochastic trends are affected by a set of non-observable exogenous variables (z_t) through the matrix C over which he imposes short-run restrictions. In turn, these z_t are assumed to be independent AR(1) processes driven by identified i.i.d. shocks. Thus, as long as the AR(1) coefficient for the transitory monetary shock is positive, placing restrictions on C matrix does not only constrain the contemporaneous effect of the shock but also on every other period afterwards; with an effect only vanishing asymptotically as the AR(1) coefficient is assumed to be less than 1 (The prior for this AR(1) parameter is a Beta distribution with a mean of 0.3 and standard deviation of 0.2, implying a probability of the parameter being greater than 0.1 equal to 82% and, as it is a continuous distribution, the probability of this coefficient being nil is equal to zero). Thus, the assumptions in Uribe (2022) are much stronger that the typical constraints used in the literature, which are generally imposed only on the contemporaneous effect (e.g. Christiano et al. (1999) or Stock and Watson (2001)). Instead, our VAR approach, by using constraints on B, imposes less restrictive assumptions. This difference is also likely to result in wider confidence bands in our case.

D, plus the assumption that the third variable w_t is stationary, are required to identify the permanent monetary shock). Therefore, after exploring whether the results obtained for the US in Uribe (2022) extend to other countries, we will explore the robustness of these results to lifting the superneutrality assumption.⁶ Our conjecture is that, for low inflation countries, deviations from superneutrality are mild, and therefore results will be similar. However, in high inflation countries, permanent changes in inflation may have detrimental effects, which are likely omitted if superneutrality is assumed.

Therefore, alternatively we assume that the permanent monetary shock can affect the level of long-run output. This is simply implemented by leaving unrestricted the element in the second row, first column, of matrix D, i.e.

$$D = \begin{bmatrix} \cdot & 0 & 0 \\ \cdot & \cdot & 0 \\ \cdot & \cdot & \cdot \end{bmatrix}.$$
 (4)

How does this methodology replicates the results in Uribe (2022) for the US? Figure 1 show our results under the superneutrality assumption, which follow the paper quite closely.⁷ A permanent monetary shock leads to a transitory increase in output and an increase in inflation that initially overshoots its permanent effect. Instead, a negative transitory monetary shock leads to a contraction in output and a reduction in inflation, both displaying a hump-shaped response. In both cases nominal interest rates increase on impact, but notice that after the permanent monetary shock the real rate initially falls, as the nominal rate lags the increase in the inflation rate. The opposite occurs for the transitory monetary contraction.

⁶As our two-stage estimation highlights, the superneutrality assumption is not only relevant to identify the effects of permanent monetary shocks, but it also influences the inference after transitory shocks.

⁷The comparable figure in Uribe (2022) is the bottom panel of Figure 8, that uses the same short-run identification strategy we implement. However, our results are also in line with the paper's baseline result in Figure 3.



Figure 1: Effects of permanent and transitory monetary shock: US under superneutrality

Note: The graphs in the left column display the IRF after a Permanent Monetary Shock (normalized to generate a 1% annualized increase in inflation in the long run) while those on the right column correspond to the Transitory Monetary Shock (normalized to generate a 1% annualized increase in the interest rate on impact). The first row depicts the response of the nominal interest rate (*i*, in annualized percentages), the second is the log of the real GDP level (*y*, percentages), the third is inflation (π , in annualized percentages) and the fourth is the real interest rate (*r*, in annualized percentages).

From the figure, one can easily describe how permanent and monetary shocks operate. Permanent monetary shocks induce a short-run reduction in the real interest rate, whereas transitory monetary shocks do the opposite. The estimation is agnostic as to why this occurs. A plausible explanation is that permanent monetary shocks involve a period of adaptation until the new equilibrium settles in. Inflation surprises on the upside and leads in the meantime to a reduction in the real interest rate. The opposite occurs when the central bank decides to hike in order to reduce inflation.

2.2 Data

The empirical model is estimated using quarterly data on real GDP, inflation, and interest rates for 80 countries. Appendix A contains specific data sources for each variable and for each country. The main data source is the IMF's International Finance Statistics (IFS). For some countries we extended the series backwards by using information from different national agencies. Inflation is calculated using consumer price index data in most cases, although in some for which this was no available we used the implicit GDP deflator. GDP and inflation figures were adjusted for seasonality (either the original source provided a seasonally adjusted series or X-13 ARIMA-SEATS was used).

Of the three variables, the one that most restricts the sample is generally the nominal rates. Whenever available, we used the relevant monetary policy rate from the IFS, the Bank for International Settlements, and also from Benati (2021). The other nominal rate that is relatively widely available is the deposit rate (mostly from the IFS). Thus, whenever available, we extended the policy rate series backward using the deposit rate series. While in the short run policy and deposit rates may have different dynamics, in the long run they should move proportionally. Therefore, any potential bias introduced by the use of deposit rates is likely to be negligible in identifying the effect of permanent monetary shocks. For transitory monetary shocks, this is less clear. For instance, we could be capturing shocks to minimum reserve requirements for banks that would induce a change in the deposit rate without necessarily moving the policy rate. This should be a cautionary note to our results about the transitory shock.

We also restrict the sample to countries for which we have at least 30 quarterly observations available for the three series (7.5 years). Moreover, the sample for all countries finishes in 2019.IV, to exclude observations influenced by Covid. Overall, the cross-country average sample size is 100 observations (25 years), with a median of 82 (20 years). More than 40% of our countries' observations are above the mean, 7 countries have more than 200 observations (the largest sample is for the US, with 262 observations), while 7 countries have at most 40 data points (the shortest sample is for Malta, with 30 observations).

3 Results under superneutrality

We first focus on the analysis maintaining the assumption of superneutrality, thus extending the results in Uribe (2022) to the other countries in our sample. All individual impulse responses are reported in the appendix, while here we provide a summary of the results from different perspectives. We will first describe the effects of permanent monetary shocks, followed by a similar analysis for temporary monetary shocks.

3.1 Permanent monetary shocks

Table 1 summarizes results for the permanent monetary shock, considering point estimates of the responses, 4 quarters after the shock hit (which we label "short-run responses"). The shock is normalized so that it increases the long-term inflation (and also the nominal rate) by an annualized 1%. The first block is devoted to the response of the real GDP level, the second to inflation, and the last to the real rate. Besides including the US for comparison purposes, we display results separating between other advanced and emerging countries, and the latter group is further divided geographically (Appendix A also indicates the grouping for each country). We report the across-country mean, median, standard deviation and fraction of positive values; for both the level as well as the accumulated response for each variable (i.e., the response 4 quarters after the shock and the sum of the responses up to 4 quarters following the shock).

In terms of the GDP response, we see that the average short-run response for each group is positive, qualitatively in line with previous results. However, we can also see that there is a nontrivial amount of cross-country heterogeneity: In fact, the median is smaller than the mean for each group, and for 30% of the countries, the point estimate is negative. It also seems that the GDP expansion is more limited for the average emerging country than for advanced economies, with LAC countries displaying the lowest average values. A similar pattern emerges if we look at the cumulative GDP response after a year.

Turning to the short-run response of inflation, we see that for almost all the countries the

response after a year is positive (in line with Uribe (2022)). The average response is somehow larger than for the US, except for LAC countries. We also see that the median of the responses is generally smaller than the mean for most groups, although the difference is not as large as what we described for GDP. In addition, recalling that the long run response of inflation is normalized to be 1%, we see the shock tends to overshoot inflation in the short run relative to the new long-run value, converging from above, similar to the response obtained for the US. In turn, this will be relevant to understand the behavior of the real rate. If we instead focus on the cumulative effect on inflation, we can also see that the average for most groups is also larger than for the US, except for the LAC group.

The last panel of Table 1 displays the real-rate short-term responses. In line with the differences highlighted for inflation, the average real-rate drop is larger than for the US, with the exception of the LAC group. The median effect is generally smaller, pointing to significant cross country-heterogeneity. Indeed, at least 20% of the countries in each group displays a positive real-rate response. The cumulative effect paints a similar picture.

We next explore if the cross country-variation in the short run GDP responses can be related to the mean or the volatility of inflation. Figure 2 plots the point estimate of the GDP response one year after a permanent monetary shock (normalized to generate a 1% increase in annualized inflation in the long run) against the average annualized inflation in the sample for each country. For visual purposes, the graph excludes 3 countries with extreme GDP responses (defined as more than two standard deviations of the cross-country variation). We can see a mild negative relationship: countries with larger average inflation tend to experience a slightly smaller expansion after a permanent monetary shock.

		Ι	Level			Accu	mulated		
Country Group	Mean	Med	StDev	Frac>0	Mean	Med	StDev	Frac>0	N
				GDP					
US	0.37				1.63				1
Other Advanced	0.37	0.07	1.5	0.6	1.03	0.22	6.9	0.6	29
European Emerging	0.13	0.02	0.5	0.6	0.82	0.17	1.5	0.6	8
Asian Emerging	0.16	0.03	1.6	0.7	0.87	0.24	4.8	0.7	15
LAC	0.10	0.04	0.2	0.7	0.44	0.28	0.7	0.8	17
Other Emerging	0.15	0.13	0.2	0.6	0.50	0.70	2.5	0.7	10
All	0.22	0.04	1.1	0.7	0.80	0.25	4.8	0.7	80
			In	flation					
US	1.26				5.35				1
Other Advanced	1.57	1.17	3.7	0.9	5.75	4.86	21.9	0.9	29
European Emerging	1.57	1.23	1.1	1.0	9.60	5.96	8.0	1.0	8
Asian Emerging	1.84	1.23	2.1	1.0	9.83	6.81	10.5	1.0	15
LAC	1.11	1.02	0.7	0.9	3.82	4.02	5.3	0.9	17
Other Emerging	1.55	1.57	1.1	0.9	13.20	10.24	9.5	1.0	10
All	1.52	1.20	2.5	1.0	7.35	5.73	15.0	0.9	80
			$R\epsilon$	eal rate					
US	-0.40				-2.46				1
Other Advanced	-1.25	-0.53	3.9	0.2	-4.55	-2.84	21.0	0.1	29
European Emerging	-0.83	-0.56	1.4	0.3	-6.84	-3.30	8.8	0.1	8
Asian Emerging	-0.95	-0.18	2.2	0.2	-6.70	-3.84	10.5	0.1	15
LAC	-0.18	-0.11	0.7	0.4	-0.88	-0.54	5.4	0.5	17
Other Emerging	-0.63	-0.66	1.0	0.2	-9.92	-7.29	9.5	0.0	9
All	-0.84	-0.33	2.6	0.2	-4.99	-2.83	14.6	0.2	80

Table 1: Summary of the short-run (1 year) effects after permanent monetary shocks, assuming superneutrality

Note: The table has three blocks of columns. The first correspond to level responses, displaying results for 1 year after the shock. The second block of columns is analogous, but displaying accumulated, also 1 year after the shock hits. The last column reports the number of countries in each group. Within each block of columns, four statistics are reported, based on the point estimates obtained for the specific response in each country: the mean, the median and the standard deviation across countries in each group (expressed in percentages), as well as the fraction of countries in each group with positive values for the particular response (for the US only one value is reported in each block, as there is a single country in that group). Responses after a permanent monetary shock are normalized to generate a 1% annualized increase in inflation in the long run.

To further explore this relationship, Table 2 reports the result of bivariate regressions for several samples: all countries (All), considering only those with a sample larger than 20 years (>20y), excluding countries with extreme values (No Extreme), countries that meet both conditions (No Extreme & >20y), and also focusing on those with less than 10% average inflation (No Extreme, >20y & $\bar{\pi} < 10$). All these were computed using the point estimates of the responses. However, these are estimated with sampling error. To control for this, we run a similar regression, with the full sample, but using as the left-hand-side variable the point estimates divided by the bootstrap standard errors (All S.E. Adj). This is akin to a weighted least square regression, in which each observation is weighted according to the inverse of the uncertainty of the estimated response.

The top panel of the table reports results when the regressor is the average inflation in the sample (p-values reported in brackets). In all cases the estimated relationship is negative, although only in the cases "No Extreme" and "No Extreme & >20y" these are significant at standard values.



Figure 2: Short-run output effect of permanent monetary shock under superneutrality $IRF_u(h=4)$ vs. Average of Inflation (N=77) after a Mon. Perm. shock

Note: The variable in the horizontal axis is the point estimate of the GDP response one year after a permanent monetary shock, normalized to generate a 1% increase in annualized inflation in the long run. In the horizontal axis, the average annualized inflation in the sample for each country is included. The graph excludes outliers (more than 2 standard deviations).

In the bottom panel similar regressions are computed, but using the in-sample volatility of inflation as the right-hand-side variable. We can also see in these regressions a negative relationship, although in most of these results are statistically significant. To provide a quantitative assessment of the estimated coefficient, the in-sample volatility of inflation for the US is 3%, while the average volatility across countries is 9%. Thus, a regression coefficient of -0.006 (like in the last column) implies that in the average country the short-run output effect of a permanent shock will be -0.02 percentage points smaller than in the US (recall that the short-run GDP response in the US is 0.37).

				No Extreme	No Extreme,	All
	All	>20y	No Extreme	& > 20y	>20 y & $\overline{\pi} < 10$	S.E. Adj
		Perm.	Mon. (unit sh	ock) vs average	e inflation	
Const.	0.270	0.382	0.137	0.164	0.370	0.642
	[0.09]	[0.10]	[0.01]	[0.05]	[0.08]	[0.00]
Elast.	-0.006	-0.009	-0.003	-0.004	-0.048	-0.011
	[0.17]	[0.13]	[0.05]	[0.09]	[0.15]	[0.14]
Ν	80	45	77	44	38	80
		Perm.	Mon. (unit she	ock) vs inflatio	n volatility	
Const.	0.245	0.345	0.124	0.152	0.407	0.619
	[0.09]	[0.09]	[0.01]	[0.04]	[0.02]	[0.00]
Elast.	-0.003	-0.004	-0.001	-0.002	-0.058	-0.006
	[0.12]	[0.08]	[0.02]	[0.05]	[0.04]	[0.05]
N	80	45	77	44	38	80

 Table 2: Short-run output effect of permanent shocks vs average and volatility of inflation

Note: Results from cross-country regressions between the point estimate of the GDP-level response 1 year after a permanent monetary shock and either the average annualized inflation (first horizontal block) or the standard deviation of annualized inflation (second horizontal block) in the sample for each country. Each column represents different groups of countries: all the countries (All), only those with a sample larger than 20 years (>20y), excluding countries with extreme values defined as GDP response larger (smaller) than the cross-country average response plus (minus) two standard deviations (No Extreme), countries satisfying both conditions (No Extreme & >20y), countries with no extreme values and average annualized inflation smaller than 10% (No Extreme, $\bar{\pi} < 10$), and all countries with observations weighted by the bootstrap standard-error of the estimated response (All S.E. Adj). The permanent monetary shock is normalized to increase inflation 1% in the long run (*Perm. Mon. (unit shock*)). In each of these blocks, the first and third row report the estimated constant and slope coefficients from the regressions, the second and fourth (in brackets) show heteroscedasticity-adjusted p-values for the respective coefficient, and the last is the number of countries in each group.

Overall, under superneutrality we find a negative relationship between the short-run GDP responses after a permanent shock and both average inflation and its volatility. However, this relationship seems to be quantitatively weak. This result may be influenced by the assumption of superneutrality, which motivates the discussion in a following section.

3.2 Temporary monetary shocks

We now perform the same analysis but applied to the effects following a transitory monetary shock. Table 3 summarizes the results. In terms of the short-run output responses, the cross-country average of the individual estimates are negative for all groups, as estimated for the US. However, dispersion is larger than what we saw for the permanent shock, and the fraction of countries with a GDP response with the same sign as for the US is smaller. Still, as in the case after a permanent shock, LAC countries tend to have a milder output effect following a temporary shock than what happens on average for the other groups.⁸

The short-run effect on inflation is also mostly negative on average, as in the US. The exceptions are the European Emerging and (to a lesser degree) Other Emerging groups that feature mostly positive responses. However, as we saw with the GDP effects, the degree of dispersion seems to be significantly larger that what we found for the permanent shock.

In line with the inflation results, the real rate seems to increase in the short run for most countries, with the exception of the European Emerging and the Other Emerging groups. Again, we see more heterogeneity in these responses than what we documented following a permanent shock.

We then study if the cross-section heterogeneity in the short-run output response is related to the average and the volatility of inflation. Figure 3 displays the scatter plot against average inflation, while Table 4 reports the regression results for the different samples.

⁸The large (in absolute value) mean in the Emerging Asia group is driven by two outliers: Singapore and Mongolia.

		L	evel			Accur	nulated		
Country Group	Mean	Med	StDev	Frac>0	Mean	Med	StDev	Frac>0	N
				GDP					
US	-0.53				-1.35				1
Other Advanced	-0.92	-0.11	5.7	0.4	-3.83	-0.30	22.1	0.4	29
European Emerging	-0.42	-0.11	1.0	0.3	-0.42	-0.15	2.4	0.4	8
Asian Emerging	-2.23	-0.51	5.5	0.4	3.54	-0.32	23.3	0.5	15
LAC	-0.04	0.00	5.4	0.5	-0.47	-0.01	17.3	0.5	17
Other Emerging	-0.29	0.15	1.3	0.6	-1.04	0.49	4.3	0.6	10
All	-0.84	-0.03	5.0	0.4	-1.01	-0.05	18.8	0.5	80
			Ir	nflation					
US	-0.32				-0.46				1
Other Advanced	-3.73	-0.64	13.7	0.4	-14.44	-1.73	63.9	0.4	29
European Emerging	5.31	0.89	13.1	0.8	19.01	7.83	67.2	0.8	8
Asian Emerging	-21.57	-0.73	83.0	0.3	-231.03	-2.68	861.0	0.3	15
LAC	-4.75	-0.27	12.7	0.4	-8.47	-0.99	65.5	0.4	17
Other Emerging	-0.50	1.27	5.1	0.7	0.41	6.31	19.2	0.7	9
All	-6.02	-0.34	38.5	0.4	-48.65	-0.92	386.8	0.4	80
			R	eal rate					
US	0.65				2.96				1
Other Advanced	4.66	1.05	16.8	0.7	19.80	5.10	81.6	0.8	29
European Emerging	-6.35	-1.60	15.0	0.5	-22.40	-5.99	77.5	0.5	8
Asian Emerging	22.60	0.78	86.5	0.7	241.68	4.04	894.1	0.7	15
LAC	5.47	0.58	13.6	0.6	14.04	2.91	67.2	0.8	17
Other Emerging	0.36	-1.22	5.2	0.3	0.38	-4.96	20.3	0.3	9
All	6.61	0.60	40.5	0.7	53.63	2.93	402.8	0.7	80

Table 3: Summary of the short-run (1 year) effects after temporary monetary shocks, as-suming superneutrality

Note: This table is analogous to Table 1, but using responses after a temporary monetary shock, that are normalized to generate a 1% annualized increase in the interest rate at the moment the shock hits.



Figure 3: Short-run output effect of temporary monetary shock under superneutrality

 $IRF_{y}(h=4)$ vs. Average of Inflation (N=75) after a Mon. Trans. shock

Note: The variable in the horizontal axis is the point estimate of the GDP response one year after a temporary monetary shock, normalized to a 1% increase in annualized interest rate at the moment the shock is materialized. In the horizontal axis, the average annualized inflation in the sample for each country is included. The graph excludes outliers (more than 2 standard deviations).

Once we exclude extreme values, the regression seems to indicate a positive and significant correlation between output responses and both average inflation and inflation volatility. In other words, the power of a temporary monetary shock to affect aggregate demand seems to be milder for countries with a history of higher and more volatile inflation.

				No Extreme	No Extreme,	All
	All	>20y	No Extreme	& > 20y	>20 y & $\overline{\pi} < 10$	S.E. Adj
		Temp.	Mon. (unit she	ock) vs Averag	e inflation	
Const.	-1.278	-1.822	-0.518	-0.606	-1.262	-0.090
	[0.04]	[0.06]	[0.02]	[0.00]	[0.00]	[0.49]
Elast.	0.057	0.069	0.013	0.014	0.150	-0.003
	[0.15]	[0.12]	[0.05]	[0.00]	[0.02]	[0.55]
Ν	80	45	75	42	37	80
		Temp.	Mon. (unit she	ock) vs inflatio	n volatility	
Const.	-1.005	-1.474	-0.466	-0.556	-0.970	-0.099
	[0.09]	[0.12]	[0.03]	[0.00]	[0.00]	[0.41]
Elast.	0.018	0.024	0.005	0.006	0.092	-0.002
	[0.10]	[0.06]	[0.06]	[0.00]	[0.06]	[0.46]
N	80	45	75	42	37	80

 Table 4: Short-run output effect of temporary shocks vs average and volatility of inflation

Note: This table is analogous to Table 2, but related to the temporary monetary shock, normalized to represent an increase in the policy rate of 1% at the moment the shock hits (*Temp. Mon.* (unit shock)).

However, if we focus on the last column in Table 4, which considers responses adjusted by the degree of estimation uncertainty, this positive relationship disappears and it is not statistically significant. Therefore, relative to what we described for the permanent shock, it is less obvious that the degree of heterogeneity the GDP responses could be accounted for by differences in the mean or the volatility of inflation.

Overall, the effects following a temporary shock seem to be on average qualitatively similar to the results for the US. However, there is a lot of dispersion across countries, and in a nontrivial amount of countries (even excluding outliers) the sign of the responses are not the expected ones.

4 Results lifting superneutrality

The previous exercise, in the spirit of the original estimation in Uribe (2022), imposes the constraint of superneutrality. What happens when we lift this assumption? We will study two types of implications. First, we analyze how the short run-responses, after both shocks,

characterized in the previous section differ without this assumption. Second, excluding superneutrality opens the door for a long-run effect on output after a permanent monetary shock, and thus we characterize the cross-country evidence of this effect.

4.1 Short-run effects without superneutrality

We first compare the results for the US. Figure 4 is the analogous to Figure 1. The only noticeable difference is the GDP response after a permanent shock, where we see that the point estimate seem to converge to a positive number. However, this long run effect does not seems to be significantly different from zero. Still, the short term dynamics are quite similar: the point estimates during the first year are somehow larger in this case, but the confidence bands overlap, thus any difference is likely not statistically significant. Therefore, it seems that for the US, the superneutrality assumption does not significantly alter the inference regarding either monetary shock.

Table 5 discusses the short-run GDP responses to both monetary shocks when extending the analysis to all the countries in our sample. The top panel corresponds to the effect of the permanent monetary shock. Remember that assuming superneutrality the effect of a permanent monetary shock was positive for all groups of countries (see Table 1). When we lift this assumption the average effect is virtually unchanged, but there is substantially more variation among groups with several of them showing a negative response (mostly emerging economies). This indicates that there are some specific emerging countries that experience large output drops following the permanent shocks. Indeed, for the three groups with a average negative response, the fraction of cases with a positive effect is lower relative to those in Table 1, specially among Latin American countries.



Figure 4: Effects of the permanent and transitory monetary shock: US without superneutrality

Note: This Figure is analogous to Figure 1

	1	year af	er shock		1	year aft	er shock	
Group	Mean	Med	StDev	> 0	Mean	Med	StDev	> 0
	Per	manent	t Moneta	ry Sh	ock			
USA	0.67				2.58			
Other Advanced	0.60	0.52	0.6	0.9	2.02	1.93	1.8	0.9
European Emerging	0.58	0.10	0.7	0.8	1.89	0.57	2.1	0.9
Asian Emerging	-0.12	0.14	1.4	0.6	0.10	0.54	4.4	0.6
LAC	-0.15	0.07	0.7	0.5	-0.41	0.27	2.4	0.5
Other Emerging	-0.21	0.03	0.9	0.6	-0.20	0.17	2.8	0.6
All	0.21	0.16	0.9	0.7	0.88	0.70	2.9	0.7
	Tra	nsitory	Moneta	ry She	bck			
USA	-0.52				-1.34			
Other Advanced	0.35	-0.11	8.0	0.4	0.02	-0.37	26.7	0.4
European Emerging	-0.18	-0.04	0.7	0.4	-0.56	-0.39	1.8	0.3
Asian Emerging	-2.93	-0.57	5.8	0.3	3.14	-0.41	27.0	0.5
LAC	-1.51	-0.01	4.0	0.4	-4.83	-0.03	12.5	0.4
Other Emerging	-0.01	0.04	1.2	0.6	-0.48	0.14	4.4	0.6
All	-0.80	-0.10	5.9	0.4	-0.63	-0.33	20.9	0.4

 Table 5: Summary of short-run GDP effects after both shocks, no superneutrality

Note: This table is analogous to Table 1, but computed using the specification that lift the assumption of zero long-run effect on output after a permanent monetary shock.

To further explore the differences in the results under both superneutrality assumptions, the top panel in Table 6 runs a simple regression between the point estimates of the short-run GDP responses to a permanent monetary shock obtained under superneutrality and those without it. If these responses where not altered by the superneutrality assumption, we should obtain a coefficient in this regression equal to one. We do find positive relationship, but it is generally less than one and not significantly different from zero. Moreover, when we weight by the parametric uncertainty obtained under neutrality assumption, the relationship is slightly negative and not significant. Therefore, it seems that the superneutrality assumption is quite relevant to estimate the short-run effects following a permanent monetary shock.

				No Extreme	All
	All	> 20y	No Extreme	& > 20y	S.E. Adj
		Perm	. Mon. (unit .	shock)	
Const.	0.143	-0.055	0.098	0.049	0.560
	[0.26]	[0.71]	[0.00]	[0.50]	[0.00]
Elast.	0.371	0.810	0.045	0.198	-0.002
	[0.12]	[0.16]	[0.61]	[0.34]	[0.40]
Ν	80	45	77	40	80
		Temp	. Mon. (unit .	shock)	
Const.	0.000	0.000	0.000	0.000	-0.065
	[0.27]	[0.68]	[0.58]	[0.14]	[0.51]
Elast.	0.950	1.201	0.996	1.094	0.000
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Ν	80	45	74	41	80

 Table 6: Short-run output effects: The relevance of the superneutrality assumption

Note: In this table, the dependent variable is the one-year ahead output response obtained with the superneutrality assumption, while the regressor is the same response but obtained lifting the superneutrality assumption. The group of countries is analogous to previous tables.

As we did before, we explore whether the cross-country heterogeneity in the short-run output responses is related to the average inflation in each country (results for the volatility of inflation are similar). The top panel of Table 7 reports the results for the non-superneutrality case following a permanent shock. Relative to the previous results in Table 2, here we see a more negative correlation, which is statistically significant in all the alternatives, even if corrected by sampling uncertainty. Moreover, in countries with an average inflation below 10% (the sixth column in the table), the negative relationship is an order of magnitude stronger. Therefore, once the superneutrality assumption is lifted, it is more clear that any potentially benefit in terms of short-term output expansion that a permanent shock might generate, gets diluted for countries with a higher average inflation.

				No Extreme	No Extreme	A11
	All	>20y	No Extreme	& >20y	$>20y \& \overline{\pi} < 10$	S.E. Adj
			Perm. Mon	. (unit shock)		
Const.	0.289	0.571	0.462	0.456	0.969	1.514
	[0.03]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Elast.	-0.010	-0.015	-0.015	-0.011	-0.113	-0.059
	[0.04]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Ν	80	45	77	40	34	80
			Temp. Mon	. (unit shock)		
Const.	-0.775	-1.818	-0.416	-0.549	-1.221	-0.179
	[0.32]	[0.05]	[0.15]	[0.05]	[0.01]	[0.25]
Elast.	-0.004	0.017	-0.007	-0.007	0.171	-0.013
	[0.89]	[0.55]	[0.75]	[0.73]	[0.03]	[0.28]
Ν	80	45	76	43	37	80

 Table 7: Short-run output effect and average inflation without superneutrality

Note: This table is analogous to Table 2, but computed using the specification that lift the assumption of zero long-run effect on output after a permanent monetary shock.

We next turn to the comparison of the effects originated by temporary monetary shocks. Comparing the bottom panel in Figure 5 with the previous results in Table 3, we see the overall average short-run effect on GDP is similar, as well as the median for most groups. However, we also see more overall dispersion, particularly in Other Advanced (the only group to show an average positive effect) as well as LAC countries, where the effect becomes significantly more negative.

Nonetheless, looking at the bottom panel in Table 6, we see that, contrary to what we find for permanent shocks, there is a strong relationship between the short-run GDP response following a transitory shock obtained under superneutrality and those without that assumption. These results show that lifting the superneutrality assumption do not significantly change the responses to a transitory monetary shock. In other words, the analysis of short-run monetary policy is not fundamentally affected by the overidentifying restriction of superneutrality.

In turn, the relationship between the responses to a temporary shock and average inflation (the bottom panel in Table 7) is mostly negative but not significant. The only positive and significant result is found for those countries with no extreme values, more than 20 years of data and less than 10% average inflation.

Overall, the results show that the superneutrality assumption, while not relevant for the US, may have non-trivial consequences once we consider other countries. In particular, any potential short-run expansionary effect of permanent shocks tend to be milder for countries with higher average inflation.

4.2 Long-run output effects without superneutrality

As we mentioned, without the superneutrality assumption, permanent monetary shocks may have non-trivial effects on activity in the long run. As we saw, for the US the deviation from superneutrality does not seem to be statistically significant. Still, as mentioned, there is a large literature suggesting that there should be deviations from superneutrality both in low and high inflation countries. Our framework allows to provide evidence on these channels. To do so, in what follows, we examine the response of GDP five years after the permanent shock hits, which we label as the long-run response.

Table 8 is similar to Table 1 but, by focusing now on these long-run responses, summarizes our findings regarding the existence of superneutrality. In general, the mean and median of the point estimates seem to be positive on average, with Other Advanced economies having a mean and a median close to the US point estimate. However, for LAC and Other Emerging countries the average is actually negative and the median is close to zero.

	5 y	vears af	ter shock	K	5 y	years af	ter shock	Σ	
Group	Mean	Med	StDev	> 0	Mean	Med	StDev	> 0	Ν
		Perman	nent Mor	netary	Shock				
USA	0.43				10.47				1
Other Advanced	0.56	0.56	0.6	0.9	11.13	10.36	11.3	0.9	29
European Emerging	0.77	0.12	1.1	0.6	13.19	2.28	16.9	0.8	8
Asian Emerging	0.62	0.12	2.5	0.7	2.34	2.50	22.1	0.7	15
LAC	-0.24	0.00	0.8	0.5	-4.01	-0.05	15.4	0.5	17
Other Emerging	-0.35	-0.01	1.1	0.4	-5.77	-1.30	18.7	0.4	9
All	0.31	0.18	1.4	0.7	4.51	3.89	17.6	0.7	80

Table 8: Summary of long-run GDP effects after both monetary shocks, no superneutrality

Note: This table is analogous to Table 1, but computed using the specification that lift the assumption of zero long-run effect on output after a permanent monetary shock.

Figure 5 displays a scatter plot between the long run GDP effect and the average inflation. Even excluding outliers we can appreciate the extent of the heterogeneity in the results. Moreover, a negative relationship between these responses and average inflation is clearly present. This can further be seen in the top panel of Table 9. In all the alternative groups this correlation is negative and statistically significant, even when observations are weighted by the parametric uncertainty behind the point estimates. As average inflation increases, the output effect decrease. These results replicate and extend those of Bullard and Keating (1995), suggesting that the scope for monetary policy affecting output is very limited in size and that it vanishes quickly as the inflation rate increases. We find a similar result in the bottom panel, where we contrast the GDP responses against inflation volatility.

Moreover, this negative relationship is not only driven by countries with a high-inflation history. If we just focus on countries with average inflation smaller than 10%, the negative relationship is even stronger. In fact, although not reported, if we recompute the sixth row adjusting for the parametric uncertainty, the coefficient is -0.4, more than three times larger. Overall, even for countries with moderate and low inflation, any expansionary short-run effect that a permanent monetary shock might generate will quickly disappear with higher inflation rates.



Figure 5: 5-years output effect of permanent monetary shock without superneutrality

Note: The variable in the horizontal axis is the point estimate of the GDP response five years after a permanent monetary shock, normalized to generate a 1% increase in annualized inflation in the long run. In the horizontal axis, the average annualized inflation in the sample for each country is included. Extreme values (more than two standard deviations) are excluded from this graph.

				No Extreme	No Extreme,	All,
	All	> 20y	No Extreme	& > 20y	>20 y & $\overline{\pi} < 10$	S.E. Adj
		Perm.	Mon. (unit sh	ock) vs average	e inflation	
Const.	0.438	0.548	0.458	0.431	0.930	1.102
	[0.03]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Elast.	-0.016	-0.014	-0.016	-0.011	-0.112	-0.045
	[0.04]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Ν	80	45	76	41	66	80
		Perm.	Mon. (unit she	ock) vs inflatio	n volatility	
Const.	0.360	0.484	0.382	0.382	0.754	0.901
	[0.04]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Elast.	-0.005	-0.006	-0.005	-0.005	-0.079	-0.016
	[0.06]	[0.00]	[0.00]	[0.00]	[0.00]	[0.02]
Ν	80	45	76	41	35	80

 Table 9: 5-year output effect and average inflation without superneutrality

Note: This is analogous to Table 7, but the dependent variable in the regression is the response of output 5 years after the shock. Only Permanent shocks are displayed, for the long run effect of temporary shock is zero by construction.

5 Conclusion

In this paper we have developed a simpler methodology that allows to extend Uribe (2022) decomposition of transitory and permanent monetary shocks to a larger set of countries. We first show that our methodology replicates his findings for the US, and that those results broadly extend on average to our sample of 80 countries. However, we show there is a significant degree of heterogeneity in the results. Monetary policy in general (i.e. the effect of both transitory and permanent shocks) weakens as the average inflation of the country increases.

Our main results, however, concern the extension in which we stress the model by lifting the overidentifying assumption of superneutrality. An interesting first finding is that the nature of transitory monetary shocks appear to be very similar regardless of the superneutrality assumption. In fact the coefficients of the short-run output effect of transitory monetary shocks are quite similar across both models. This means that the traditional debate on the effectiveness of monetary policy when long-run inflation objectives are not in question, can be analyzed both in models with or without superneutrality. The omission of the debate on superneutrality in this literature seems not to pose a problem. This equivalence also shows in the finding that higher inflation weakens the real effects of monetary policy, but without superneutrality this "weakening" effect seems stronger.

When analyzing the effect of permanent monetary shocks (to be interpreted as changes in long run inflation) we find that there are deviations from superneutrality. These deviations, while small, follow the pattern previously argued in the debate: positive on average for low inflation (the grease the wheels argument) and negative for larger inflation rates (the missalocation effects of higher inflation). Overall, the positives effects seem to disappear very quickly as average inflation increases.

Our results are informative to a number of monetary policy debates. First, they support the idea that high inflation has negative output effects and that countries would benefit from bringing inflation to normal levels. Disinflation from high levels is expansionary and not contractionary.

What does our paper say about the debate about US inflation target? We find that in

the US the long-run effect of a permanent increase in inflation does not have a statistically significant effect on output (and the point estimate itself is relatively low). In turn, as average inflation rises, the potential expansionary effect of a further increase in the inflation target are quickly diminishing. More importantly, our results on the effect of transitory monetary shocks shows that a permanent increase in the inflation target would weaken the effects of *short term* monetary policy management. Overall the balance speaks unfavorably for an increase in the inflation target.

This paper, half a century later, continues to validate Lucas' inverted Phillips curve finding and provides support for the general tenets of central banks: focus on price stability and avoid attempts to permanently improve output.

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A Data sources

Country	Code	GDP	CPI	Interest Rate	First Obs	Last Obs	Num Obs	Group
Algeria	ALG	ONS	IFS CPI	IFS Deposit Rate	1999.I	2017.I	73	Other Em
Angola	ANG	INE	IFS CPI	IFS Mon. Pol. Rate and Deposit Rate	2010.I	2019.IV	40	Other Em
Argentina	ARG	BCRA and IN- DEC	INDEC and Provincial Statistical Institutes	BCRA and FIEL Mon. Pol. Rate	1970.II	2019.IV	199	LAC
Australia	AUS	IFS	IFS CPI	IFS Mon. Pol. Rate	1969.III	2019.IV	202	Other Ad
Azerbaijan	AZE	Central Bank of Azerbai- jan	IFS CPI	IFS Mon. Pol. Rate	2001.II	2019.IV	75	Asia Em
Belgium	BEL	OECD	IFS CPI	FRED Mon. Pol. Rate	1980.II	1998.IV	75	Other Ad
Bhutan	BOT	IFS	IFS CPI	IFS Deposit Rate	2006.I	2019.IV	56	Asia Em
Bolivia	BLV	INE	IFS CPI	IFS Deposit Rate	1990.I	2019.IV	120	LAC
Brazil	BRA	IBGE	IFS CPI	IFS Mon. Pol. Rate and Deposit Rate	1982.III	2019.IV	150	LAC
Bulgaria	BGR	IFS	IFS CPI	IFS Mon. Pol. Rate and Deposit Rate	2000.I	2019.IV	80	Euro Em
Canada	CAN	IFS	IFS CPI	FRED Mon. Pol. Rate	1961.II	2019.IV	235	Other Ad
Cape Verde	CVE	INE	IFS CPI	IFS Mon. Pol. Rate and Deposit Rate	2007.I	2019.IV	52	Other Em
Chile	CHL	Banco Central de Chile	IFS CPI	Banco central de Chile Mon. Pol. Rate and IFS Deposit Rate	1986.II	2019.IV	135	LAC
China	CHN	IFS	IFS CPI	IFS Mon. Pol. Rate and Deposit Rate	1992.II	2019.II	109	Asia Em
Colombia	COL	DANE	IFS CPI	Banco de la Republica Mon. Pol. Rate and IFS Deposit Rate	1994.II	2019.IV	103	LAC
Costa Rica	CRI	IFS	IFS CPI	IFS Mon. Pol. Rate and Deposit Rate	1991.II	2019.IV	115	LAC
Croatia	HRV	IFS	IFS CPI	BIS Mon. Pol. Rate	$1995. \mathrm{II}$	2018.III	94	Other Ad
Cyprus	CYP	IFS	IFS CPI	IFS Deposit Rate	1996.I	2008.II	50	Other Ad

Table 10: Sample and sources

Country	Code	GDP	CPI	Interest Rate	First	Last	Num	Group
Ū					\mathbf{Obs}	\mathbf{Obs}	\mathbf{Obs}	-
Czech	CZE	IFS	IFS CPI	IFS Mon. Pol. Rate and	1996.I	2019.IV	96	Other Ad
Republic				Deposit Rate				
Denmark	DNK	IFS	IFS CPI	FRED Mon. Pol. Rate	1980.II	2019.IV	159	Other Ad
Dominican	DOM	IFS	IFS CPI	SICA Mon. Pol. Rate and	1991.III	2019.IV	114	LAC
Republic				IFS Deposit Rate				
Egypt	EGY	Central	IFS CPI	IFS Mon. Pol. Rate and	2006.I	2019.IV	56	Other Em
		Bank of		Deposit Rate				
		Egypt						
El Sal-	SLV	SICA	SICA CPI	SICA Deposit Rate	1991.I	2019.IV	116	LAC
vador								
EURO	EU	IFS	FRED CPI	IFS Mon. Pol. Rate	1991.I	2019.IV	84	Other Ad
Finland	FIN	Eurostat	IFS CPI	BIS Mon. Pol. Rate and	1985.I	1998.IV	56	Other Ad
				IFS Deposit Rate				
France	FRA	IFS	IFS CPI	IFS Deposit Rate	1980.II	1998.IV	75	Other Ad
Georgia	GEO	IFS	IFS CPI	IFS Mon. Pol. Rate and	2003.I	2019.IV	68	Euro Em
				Deposit Rate				
Germany	DEU	IFS	IFS CPI	Benati (2021)	1970.II	1998.IV	115	Other Ad
Greece	GRC	IFS	IFS CPI	IFS Deposit Rate	1995.II	2006.I	44	Other Ad
Guatemala	GTM	SICA	IFS CPI	IFS Deposit Rate	2001.I	2019.IV	76	LAC
Honduras	HND	SICA	SICA CPI	SICA Deposit Rate	2000.I	2019.IV	80	LAC
Hong	HKG	IFS	IFS CPI	IFS Mon. Pol. Rate, Be-	1990.I	2019.IV	120	Other Ad
Kong				nati (2021) and IFS De-				
				posit Rate				
Hungary	HUN	IFS	IFS CPI	IFS Mon. Pol. Rate and	1995.I	2019.IV	100	Euro Em
	TOT			Deposit Rate	1000 -	0010 TT 1		
Iceland	ISL	IFS Non	IFS CPI	BIS Mon. Pol. Rate and	1998.1	2019.IV	88	Other Ad
T 1.	IN ID	100		IFS Mon. Pol. Rate	2000 TT	0010 TT 1	-	
India	IND	IFS	IFS CPI	BIS Mon. Pol. Rate and	2000.11	2019.IV	79	Asia Em
.	IDM	TDO	IDG GDI	IFS Mon. Pol. Rate	2000 I	0010 111	~~	
Indonesia	IDN	IFS	IFS CPI	IFS Mon. Pol. Rate	2000.1	2019.IV	80	Asia Em
Israel	ISR	OECD	IFS CPI	IFS Mon. Pol. Rate	1995.1	2019.IV	100	Other Ad
.	T 1 3 6	and IFS			1000 TT	0010 TT 1	~ ~	
Jamaica	JAM	IFS	IFS CPI	IFS Mon. Pol. Rate and	1996.11	2019.IV	95	LAC
Ŧ	IDM	TT .1	IDG GDI	Deposit Rate	1055 III	2010 11		
Japan	JPN	Uribe	IFS CPI	Uribe (2022) and IFS	1955.111	2019.IV	258	Other Ad
т 1		(2022) IDC		Mon. Pol. Rate	100 4 T	0010 11	104	A · 5
Jordan	JOR	IFS	IFS CPI	IFS Mon. Pol. Rate and	1994.1	2019.IV	104	Asıa Em
TZ 11 -	TZ A 17	IDO		Deposit Kate	2005 111	0010 11	F 0	
Kazakhsta	nKAZ	IFS	IFS CPI	IFS Mon. Pol. Rate	2005.111	2019.IV	58	Asia Em

Table 11: Sample and sources, cont.

Table 12: Sample and sources, com	Table 12:	Sample	and	sources,	cont.
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Country	Code	GDP	CPI	Interest Rate	First	Last	Num	Group
					\mathbf{Obs}	\mathbf{Obs}	\mathbf{Obs}	
Kenya	KEN	IFS	IFS CPI	IFS Mon. Pol. Rate and	2009.I	2019.IV	44	Other Em
				Deposit Rate				
Korea	KOR	IFS	IFS CPI	IFS Mon. Pol Rate, Be-	1964.II	2019.IV	223	Other Ad
				nati (2021) and IFS De-				
TT	IIGB	100		posit Rate	1000 77	0010 T		
Kyrgyzstan KGZ		IFS	IFS CPI	IFS Mon. Pol. Rate and	1999.11	2019.IV	83	Asia Em
T 1 .	LDC	IDC		Deposit Rate	0007 I	0010 IV	50	
Lesotho	LES	IFS	IFS CPI	IFS Deposit Rate	2007.I 1005 I	2019.1V	52 49	Other Em
Litinuama Malta			IFS CPI	IFS Deposit Rate	1990.I	2000.1V	48	Other Ad
Marta	MEY	IF 5 INFCI	IFS CPI	Banco do Movico Mon	2000.11 1003 I	2007.111 2010 IV	3U 108	
Mexico	MLA	INEGI		Pol Bato and IFS Do	1995.1	2019.10	108	LAC
				posit Bate				
Mongolia	MNG	Central	IFS CPI	IFS Mon. Pol. Rate and	2000.I	2019.IV	80	Asia Em
	1.11 (0.	Bank of		Deposit Rate	-00011	_010.1	00	11510 1111
		Mongolia		1				
Myanmar	MYA	IFS	IFS CPI	IFS Deposit Rate	1988.II	1997.IV	39	Asia Em
(Burma)				-				
New	NZL	OECD	IFS CPI	IFS Mon. Pol. Rate and	1982.II	2019.IV	151	Other Ad
Zealand				Deposit Rate				
Nicaragua	NIC	SICA	SICA CPI	SICA Deposit Rate	2006.I	2019.IV	56	LAC
Nigeria	NIG	IFS	IFS CPI	IFS Mon. Pol. Rate and	2010.I	2019.IV	40	Other Em
		01		Deposit Rate				
North	NMC	IFS	IFS CPI	IFS Deposit Rate	2005.I	2019.IV	60	Euro Em
Macedo-								
nia	NOD	IDC			1070 I	0010 IV	104	
Norway	NOR	162	IFS CPI	IFS Mon. Pol. Rate and Deposit Pate	1979.1	2019.10	164	Other Ad
Panama	$\mathbf{P}\mathbf{A}\mathbf{N}$	SICA	SICA CPI	SICA Deposit Bate	2005 IV	2010 IV	57	LAC
Paraguay	PRV	IFS	IFS CPI	IFS Mon Pol Bate and	2005.1V 1994 H	2019.1V 2019 IV	103	
1 araguay	1 101	11.0	11.0 01.1	Deposit Rate	1554.11	2015.1 V	100	LIIC
Peru	PRU	Banco	IFS CPI	IFS Mon. Pol. Rate and	1988.H	2019.IV	127	LAC
1 01 0	1 100	central		Deposit Rate	100000	_010.1		2.10
		de Peru		I				
Philippines PHL		IFS	IFS CPI	IFS Mon. Pol. Rate and	2000.I	2019.IV	80	Asia Em
				Deposit Rate				
Poland	POL	IFS	IFS CPI	IFS Mon. Pol. Rate and	1995.II	2019.IV	99	Euro Em
				Deposit Rate				

Table 13:	Sample	and	sources,	cont.
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Country	Code	GDP	CPI	Interest Rate	First	Last	Num	Group
-					\mathbf{Obs}	\mathbf{Obs}	\mathbf{Obs}	_
Portugal	PRT	IMF and Eurostat	IFS CPI	IFS Deposit Rate	1980.II	1998.IV	75	Other Ad
Qatar	QTR	Central Bank of Oatar	IFS CPI	IFS Mon. Pol. Rate	2011.I	2019.IV	36	Asia Em
Romania	ROU	IFS	IFS CPI	IFS Mon. Pol. Rate and Deposit Rate	1995.II	2019.IV	99	Euro Em
Rwanda	RWA	IFS	IFS CPI	IFS Deposit Rate	2006.I	2019.IV	56	Other Em
Saudi Arabia	KSA	IFS	IFS CPI	IFS Mon. Pol. Rate	2010.I	2017.IV	32	Asia Em
Serbia	SRB	IFS	IFS CPI	IFS Mon. Pol. Rate and Deposit Rate	2000.IV	2019.IV	77	Euro Em
Singapore	SGP	IFS	IFS CPI	IFS Mon. Pol. Rate and Deposit Bate	1977.I	2019.IV	172	Other Ad
Slovakia	SVK	IFS	IFS CPI	IFS Mon. Pol. Rate and Deposit Rate	1995.I	2008.IV	56	Other Ad
Slovenia	SVN	IFS	IFS CPI	IFS Deposit Rate	1995.II	2009.III	58	Other Ad
South Africa	ZAF	IFS	IFS CPI	IFS Mon. Pol. Rate, BIS Mon. Pol. Rate and IFS Deposit Rate	1993.I	2019.IV	108	Other Em
Spain	ESP	IFS	IFS CPI	IFS Deposit Rate	1982.I	1998.IV	68	Other Ad
Sri Lanka	LKA	IFS	IFS CPI	IFS Mon. Pol. Rate and Deposit Rate	2010.I	2019.IV	40	Asia Em
Sweden	SWE	Eurostat	IFS CPI	BIS Mon. Pol. Rate IFS Mon. Pol. Rate and De- posit Rate	1992.IV	2019.IV	109	Other Ad
Switzerlan	dCHE	IFS	IFS CPI	IFS Mon. Pol. Rate and Benati (2021)	1985.II	2019.IV	139	Other Ad
Tanzania	TAN	Bank of Tanzania	IFS CPI	IFS Deposit Rate	2001.I	2019.IV	76	Other Em
Thailand	THA	IFS	IFS CPI	IFS Mon. Pol. Rate and Deposit Rate	2003.I	2019.IV	68	Asia Em
Turkey	TUR	OECD	IFS CPI	IFS Mon. Pol. Rate and Deposit Rate	1980.II	2019.IV	159	Euro Em
UK	GBR	IFS	IFS CPI	IFS, Benati (2021) and BIS Mon. Pol. Bate	1955.III	2019.IV	258	Other Ad
USA	USA	IFS	BIS CPI	FRED Mon. Pol. Rate	1954.III	2019.IV	262	USA
Uruguay	URU	BCU	BCU CPI	BCU Mon. Pol. Rate	1980.II	2019.IV	159	LAC

B IRFs under super neutrality



Figure 6: Effects on real GDP after a permanent monetary shock



Figure 7: Effects on real GDP after a permanent monetary shock, cont.



Figure 8: Effects on inflation after a permanent monetary shock



Figure 9: Effects on inflation after a permanent monetary shock, cont.



Figure 10: Effects on nominal interest rate after a permanent monetary shock



Figure 11: Effects on nominal interest rate after a permanent monetary shock, cont.



Figure 12: Effects on real interest rate after a permanent monetary shock



Figure 13: Effects on real interest rate after a permanent monetary shock, cont.



Figure 14: Effects on real GDP after a temporary monetary shock



Figure 15: Effects on real GDP after a temporary monetary shock, cont.



Figure 16: Effects on inflation after a temporary monetary shock



Figure 17: Effects on inflation after a temporary monetary shock, cont.



Figure 18: Effects on nominal interest rate after a temporary monetary shock



Figure 19: Effects on nominal interest rate after a temporary monetary shock, cont.



Figure 20: Effects on real interest rate after a temporary monetary shock



Figure 21: Effects on real interest rate after a temporary monetary shock, cont.