Monetary Growth and Financial Sector Wages*

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Abstract

We investigate the relation between monetary growth and compensation in the financial industry since the end of the Bretton Woods system. Estimating local projections, we find that the growth of the monetary base positively associates with a higher differential between financial and average wages. Our findings indicate that the effects are short lived, lending support to the temporary non-neutrality of money argued by David Hume and against the more permanent non-neutrality argued by Richard Cantillon. Our results help clarify debates on the non-neutrality of money going back to the eighteenth century.

Keywords: Cantillon effect, inequality, money non-neutrality, financial industry

JEL: D31, E31, E52

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1 Introduction

Academics and journalists, through detailing the high remuneration of financial executives, reveal that wages and compensation throughout the industry grew disproportionately since the 1970s (Cuñat and Guadalupe, 2009; Greenwood and Scharfstein, 2013; McGee, 2019). Monetary variables play little role in studies of compensation in the financial industry. The lack of attention is surprising because the financial industry includes the banking sector, which plays a key role in the monetary system by receiving base money from the Federal Reserve and loaning out new funds. We therefore examine if the massive increase in financial sector wages since the 1970s is solely an artifact of deregulation or if it was also caused by expansionary monetary policy since the end of Bretton Woods and the turn to pure fiat money. Although the empirical linkage between the switch to a more elastic currency and the growth in financial industry compensation may be coincidental, theoretical mechanisms make such an explanation possible, namely that the first receivers of new money benefit at the expense of those receiving new money later (Cantillon, [1755] 2015).

To fill the gap in the literature, our paper serves as the first to include measures of the money supply in examining compensation in the financial industry in the United States, and we continue this research further than prior papers investigating financial sector wages past the Great Recession. We thus examine the relation between monetary expansions and financial sector wages over 1975 to 2015 in the US. Using previously unavailable data, including new data on financial regulations (McLaughlin and Sherouse, 2018), we estimate impulse responses from local projections (Jordà, 2005). We find a significant, positive relation between the growth in the base money supply and wages in the financial industry. The effect is short lived. We provide evidence that first receivers of new money benefit at the expense of later recipients, therefore proving Cantillon effects in the financial industry. Because of the lack of persistence in this relation, we also provide evidence in favor of the formulation of Cantillon effects in Hume ([1752] 2007) and against the version of the theory presented in Cantillon

([1755] 2015). Prior work omitted the persistence of these non-neutralities of money; thus, we contribute by showing that Cantillon effects are transitory.

Such research is important because central bank monetary policy is assumed to be neutral in real terms. The impact of the financial industry on the economy is not yet fully understood. Investigating the relation between monetary policy and the financial industry helps central banks better understand more nuanced impacts of their policy decisions and helps economists better understand the role of finance in the economy by understanding what has driven growth in financial sector wages. Understanding, for example, how monetary policy shapes financial industry wages and wealth disparities helps explain why inequality increased during the pandemic despite monetary stimulus.

Our theory derives from Cantillon ([1755] 2015). As money starts in the financial industry, they are able to use new money first. Those in the financial sector are able to lend out the new money and receive interest payments; thus, their profits will rise. The increase in profits will lead to an increased desire for workers to enter the financial industry, and we expect wages to increase as financial firms have increased demand for skilled labor. As the first receivers of new money, the financial industry has the ability to bid up wages first; therefore, it follows that wages will be higher in this industry. From the perspective of finance more generally the link between money creation and wealth inequality becomes more important. To the extent that money creation influences wealth inequality (Bagchi, Curran and Fagerstrom, 2019), because the wealthy are early recipients of new money, we expect that the goods and services the wealthy demand will increase in price sooner than other goods and services. Wealthy people are more likely to invest in assets and use financial services; therefore, wages in this industry will increase faster than in other industries. The activity of the first receivers of new money bids up wages in the finance industry. Since 1980 wages in the financial sector have grown faster than wages in manufacturing and finance has represented an increasing share of GDP (Greenwood and Scharfstein, 2013; Philippon and Reshef, 2012). As the financial industry receives new money earlier, wages rise in this industry faster and earlier than they

rise in other industries.

Our paper focuses on the post-Bretton Woods era. To motivate our choice, we note that the conduct of monetary policy during the Bretton Woods period precluded the same growth in the money supply that occurred once the Bretton Woods agreement collapsed. The end of the Bretton Woods system ushered in significantly less constrained monetary policy and capital market deregulation (Bordo, 1993; Marston, 1993). US monetary policy was thus significantly less inflationary during Bretton Woods than afterward. Moving to a floating exchange rate regime gave the United States the ability to engage in more inflationary policies and represents a significant change in the policy environment.[1] Evidence therefore suggests beginning our inquiry into the relation between monetary policy and the financial industry after the Bretton Woods system collapsed. The papers that explore the impact of deregulation miss the impact of monetary policy; therefore, our paper fills a vital gap in the literature.

Prior to our paper, deregulation (Witko, 2016), the role that deregulation played in increasing human capital in the financial industry (Philippon and Reshef, 2012),[2] and the growth in the complexity of financial services (Greenwood and Scharfstein, 2013) served as the three main explanations for the growth in the financial industry.[3] Deregulation, however, was not the only major event related to finance and banking. The 1980s also saw the confirmation of Alan Greenspan as Federal Reserve Chairman and the increasingly asymmetric monetary policy that accompanied his tenure (Blinder and Reis, 2005; Hoffman and Schnabel, 2011). The literature does not point to monetary causes directly, and therefore previous investigations into wages in the financial industry may be missing a crucial variable. Our paper occupies a place between Witko (2016) and Philippon and Reshef (2012) by seeking to explain the growth of financial sector wages through a combination of policy and economic

[1] Giovannini (1993) notes that fixed exchange rates, especially those under commodity standards, bind central banks ability to inflate the money supply unless they all coordinate.

[2] Their finding, however, appears to be undercut by Denk (2015), which finds that wages in the financial industry are higher even after controlling for years of education.

[3] Duarte and Schnabl (2019) assert that loose monetary policy has contributed to this growth, but do not empirically support this theory.

variables.

Although these three papers offer compelling explanations for the growth in the financial industry, whether through political or economic causes, they suffer from two shortcomings. First, their research ends prior to the Great Recession. Following the financial crisis there was a large change to the regulatory environment in the US with the implementation of Dodd-Frank and Basel III. To the extent that these acts and accords represent increases in regulation, we expect the financial industry to be less important now than in 2007. If the financial industry remains important and wages remain high, then regulation may explain only part of the rise of finance. We are able to continue our study with data through 2015 by using financial wage data from the Bureau of Economic Analysis and regulation data from the Mercatus Center's RegData dataset (McLaughlin and Sherouse, 2018). The second shortcoming is that they devote little attention to monetary variables. Credit intermediation is a monetary transaction, and the growth in credit intermediation may be because of changes in the monetary regime brought about by the end of Bretton Woods. Such increases in financial transactions would lead to increased demand for labor in the financial industry, leading to higher wages.

2 Theory: Cantillon Effects

The main mechanism through which we expect monetary expansion to increase financial sector wages is Cantillon effects: when new money is created, people receiving the new money first are able to augment their spending by purchasing goods and services at pre-inflation prices.[4] As they spend their new money, it passes through increasing numbers of hands, raising those prices in tune with the consumption preferences of successive individuals. People receiving new money later face higher prices before their own wages increase, and therefore have their relative wealth lowered by the increased purchasing power of first receivers. Instead of inflation being general, and therefore neutral in real terms, prices rise first in the industries

[4]We relegate analysis from a stylized monetary model to section 1 of the online appendix.

most patronized by the creators of new money. In this way the relative price structure changes, when money supply rises.[5] Hume ([1752] 2007) posits a similar theory in his essay '*Of Money*', but limits the distortion to the short run. To our knowledge, no paper has attempted to look at the time dimension of this potential non-neutrality of money; therefore, we contribute to the literature by determining if Cantillon effects are persistent or transitory. In Bagchi *et al.* (2019) the authors argue that the wealthy receive the new money first and that the receipt of new money increases wealth inequality by enabling the wealthy to purchase capital goods and labor at lower relative prices than those people receiving the new money later or not at all. In the present paper, we focus on *income* inequality.

As the central bank injects new money into the financial sector through Open Market Operations,[6] the financial industry increases the volume of loans and uses the profits to bid up the wages of financial workers relative to those workers in the rest of the economy. As the wealthy benefit from money creation, the sectors of the economy that they patronize will also benefit from Cantillon effects. To the degree that the wealthy demand financial services, we expect Cantillon effects to benefit the financial sector through that channel as well. A similar model developed in Williamson (2008) finds that households connected to financial markets benefit from increases in the money supply and are able to increase their consumption over that of unconnected households. We find, therefore, that theory predicts a positive relation between money supply growth and financial industry compensation. Theory gives no indication whether the changes are likely to be long lasting or transitory. If labor can shift between sectors quickly, then an increase in the supply of financial workers will push wages down in the financial sector and up in the rest of the economy; but the relative wage will remain elevated if labor is sticky. Labor being able to adjust more quickly would be evidence in favor of the version of Cantillon effects posited in Hume ([1752] 2007), while adjustment would be evidence of the original formulation in Cantillon ([1755] 2015).

[5]Money production was limited in Cantillon's time to the marginal production cost of gold. Such limits constrain the magnitude of Cantillon effects.

[6]We stick with the term Open Market Operations because most of our sample precedes the Federal Reserve's switching to a floor system.

Because of the positive relation between money creation and financial variables, we expect to see higher financial industry wages in eras of looser monetary policy than in eras of tighter monetary policy. Since the end of Bretton Woods monetary policy has become increasingly 'asymmetric', meaning that monetary policy loosens more in response to crises than it tightens in response to booms (Hoffman, 2009). Empirically, we see asymmetric monetary policy by finding more negative deviations from the Taylor Rule than positive deviations. As Hoffman and Schnabel (2011) note, money market interest rates in the US have been drifting downwards since the 1980s.[7] Although we cannot say that monetary policy prior to the end of Bretton Woods was excessively tight, as credit booms occurred during the 1920s, 1950s, 1960s, and 1970s (Brown, 2017), the gentle decline towards low interest rates since the 1980s is new. Perhaps more important than the decline in interest rates itself is the cause of the decline; although some have argued that it was due to demographic trends, increasingly loose monetary policy was the cause of the longer term trend in declining interest rates (Borio *et al.*, 2017). Credit expansions did not begin in the immediate aftermath of Bretton Woods, but the gradual decline in interest rates with no offsetting increase represents a change worth investigating, as lower interest rates allow for a more rapid expansion of credit (Dell'Ariccia *et al.*, 2012).

The literature devotes most attention to deregulation. Strong evidence suggests that deregulation will increase the pay of workers in the financial industry. Witko (2016) investigates the empirical link between financial industry size and deregulation and finds that deregulation increases financial industry size. The authors expect deregulation to increase wages in the financial industry by lowering compliance costs and therefore allowing for expansion in output. They also expect financial deregulation to increase the importance of the financial industry by legalizing new financial instruments and allowing for the merger of different kinds of financial firms. In addition, Philippon and Reshef (2012) find that dereg-

[7] As an example, Blinder and Reis (2005) notes that Greenspan kept the Federal Funds Rate 47 basis points below what the Taylor Rule suggested in 1998. Such deviation speaks to Greenspan's prevailing preference to clean up after a bust rather than to stop a boom; such a preference is inherently asymmetric.

ulation encouraged the hiring of high-skilled workers by financial firms because deregulation allowed the financial sector to offer more innovative products. Deregulation therefore boosts financial sector wages not just by expanding output generally but by increasing the complexity of offered financial services, in turn requiring more skilled workers to exploit fully these innovations. Our paper has a significant advantage over other papers looking at deregulation because we are able to focus on the number of words of regulation and the number of specific commands in regulations in the financial sector thanks to the RegData dataset created by the Mercatus Center (McLaughlin and Sherouse, 2018). The dataset allows for a finer grained approach than in previous studies, which count laws as in Witko (2016), or other datasets meant for international comparisons such as Abiad *et al.* (2008) and Denk and Gomes (2017); furthermore, the Abiad *et al.* (2008) measure of financial regulation is constant since 1999.

Unionization rates, included in Witko (2016), proxy the strength of labor. As financial workers tend to be nonunionized, we expect a negative relationship between unionization and the relative wage in the financial industry. As unions get weaker, they are less able to organize and demand higher wages in non-financial industries, and therefore stronger unions will impact the relative wage ratio by increasing the denominator rather than by reducing the numerator. Not all collective bargaining arrangements are handled by unions, however, and so we use the collective bargaining rate provided by the OECD instead of the unionization rate itself in our empirical specification.

3 Data and Method

3.1 Data

We obtain quarterly frequency data from 1975Q1 to 2015Q4. Two years prior to 1975 marks the collapse of the Bretton Woods system (Eichengreen, 2008) and hence a structural shift in the conduct of monetary policy. Data on relative wages are available from 1975Q1. By expanding our sample to 2015, we are able to track how the financial industry has changed since the Great Recession and how changes in monetary policy and regulation have impacted

financial sector compensation. To our knowledge, this paper is the first to study compensation in the US financial industry in the aftermath of the Great Recession. Table 1 lists the data sources and includes complete summary statistics for the data employed in our paper.[8]

Data on financial and average wages and compensation come from the Bureau of Economic Analysis. Data on monetary aggregates come from the St. Louis Federal Reserve Economic Database (FRED). Financial regulation data come from the Mercatus Center's RegData (McLaughlin and Sherouse, 2018). Financial regulations are measured as both the number of words of regulations and the number of commands. Collective bargaining rates are from the OECD. Regulation data and collective bargaining rates are interpolated from annual frequency data. Lastly, we use the output gap data from Holston *et al.* (2017). We use the output gap to control for the counter-cyclicality of monetary policy. Because of noticeable time trends in most of our variables, we detrend the data to avoid issues of collinearity and non-singularity in the matrices used in the local projections.[9]

Our key variable is the average wage in the financial industry relative to the average wage in the overall economy.[10] The financial sector is defined as Finance, Insurance, and Real Estate (FIRE), as that is the most disaggregated industry classification we have for our sample.[11] We can disaggregate finance and insurance from real estate starting in 1990, but this causes us to omit too many observations to be an illuminating exercise. The wage ratio trends upwards from around parity in 1975 to 1.65 in 2015, on average, indicating that the average wage of employees in the financial industry is 65 percent higher than average wages in the economy. We note, however, that the relative wage rises non-monotonically, peaking in Q1 of 2007 at 2.13 during the height of the housing boom before falling in 2009 and rising

[8]Summary statistics for annual versions of the data used in SVAR estimation are in section 2 of the online appendix.

[9]Although vector autoregressions (VAR) require variables to be stationary for hypothesis testing (Enders, 2014), local projections do not (Olea and Plagborg-Møller, 2021).

[10]The correlation is over 0.99 between the ratios of the average wages in the financial sector to the average wages in the entire economy and the average wages in the financial sector to the average wages in the entire economy outside of the financial sector. Similar correlations obtain for compensation data.

[11]Witko (2016) uses FIRE instead of finance and insurance when examining the financialization of the US economy, and the correlation between FIRE wages and finance and insurance wages from 1990 on, when finance and insurance wages are available separately from FIRE wages, is over 0.99.

as the economy recovered from the Great Recession. Financial wages were hit harder than average wages during the Global Financial Crisis and recovered more quickly. Moreover, both the median and the mean are around 1.35. Since monetary policy played such an active and important role in the aftermath of the crisis, especially through the use of Quantitative Easing and zero interest rate policies, the theory posited that those in the financial industry benefit from access to new money sooner than others in the economy becomes more plausible. Because of missing employment data for financial sector employees in 1973 and 1974, our data on financial sector wages begins in 1975Q1. Although we do not look at financial sector employment directly, we rely on employment figures to calculate average wages per employee in the financial sector and the economy at a quarterly frequency.

For our monetary variable, we use the growth rate of the monetary base. The growth rate of the monetary base represents the purest form of the Cantillon effect theory because of its more precise control by the central bank and by being the narrowest definition of money. We choose the growth rate over the level of the monetary base because Cantillon effects are concerned with new money rather than with the total amount of money in the economy, and growth measures how much new money has been added to the economy. Base money growth is relatively stable over much of the sample, but has a massive spike in 2008 during the Great Recession, reaching 63 percent. The money supply rarely contracts, with a minimum of −2.86 percent in 2014Q4; the maximum of 63% is a once-off occurrence in 2008Q4, the second highest being 15.92% in 2009Q1. Base money growth averaged 2.34 percent over the sample, with a median of 1.63 percent in 1991Q3. Despite the stability in average growth rates across much of the sample, volatility declines in the 1990s and remains low until 2008, covering most of the Great Moderation.

We choose deregulation because of its importance in both Witko (2016) and Philippon and Reshef (2012) and because of the role that deregulation plays in political discourse surrounding the financial industry. The Mercatus Center's RegData dataset analyzes the text of the *Code of Federal Regulations* (CFR) to calculate the number of words concerning finan-

cial regulations and counts the number of specific commands by counting words indicating obligations or orders pertaining to the financial industry (McLaughlin and Sherouse, 2018). The authors of the dataset study the CFR to see which industry each regulation targets by looking for strings of words that relate to certain industries to calculate accurately which regulations apply to which industries. Although we agree with previous studies that there was substantial deregulation of the financial industry in the 1980s, with the minimum value of regulation being in 1986, we find that the financial industry substantially re-regulated by 2015, with over 126,800 regulations. For our measure of deregulation, an increase means an increase in the number of commands or words of regulations. Previous studies that stopped before the end of the Global Financial Crisis missed the re-regulation of the financial industry in the United States.

We select unionization as a control variable in part due to its inclusion in Witko (2016). As not all collective bargaining arrangements are handled by unions specifically, we use the measure of collective bargaining from the OECD instead of the union membership rate. Collective bargaining exhibits a clear downward trend, falling from 26.7 percent of the labor force in 1975 to 11.8 percent by 2014. The decrease is non-monotonic, however, indicating that collective bargaining increases in some years and quarters. As with regulation, we interpolate this variable from annual frequency data.

Last, to account for the counter-cyclicality of monetary policy, we include the measure of the output gap from Holston *et al.* (2017). In our paper, monetary policy is exogenous. We justify our assumption as we are including the output gap, as reverse causality from relative wages to changes in the monetary base is not a concern, and as ours is the first paper on this topic. To define the measure, a positive output gap occurs when GDP is above natural output and a negative output gap occurs when GDP is below natural output.

3.2 Local Projections

We estimate local linear and cubic projections as in Jordà (2005).[12,13] Local projections are popular for relative ease of estimation and inference, inference not requiring asymptotic delta method approximations, robustness to misspecification of the data generating process, and accommodation for non-linear specifications. Local projections are also robust to non-stationary data and to the estimation of impulse responses at long horizons (Olea and Plagborg-Møller, 2021). We use eight periods for horizons, where our periods are measured in quarters. For our dataset, seven lags are optimal, corresponding to about two years. Our local projection contains five variables: base money growth, relative wage, collective bargaining, log of financial regulation (number of commands), and output gap. Collecting the five variables in the time series vector $\mathbf{y}$, we project $\mathbf{y}_{t+s}$ onto the linear space generated by $(\mathbf{y}_{t-1}, \mathbf{y}_{t-2}, \ldots, \mathbf{y}_{t-p})'$

$$\mathbf{y}_{t+s} = \boldsymbol{\alpha}^s + \mathbf{B}_1^{s+1}\mathbf{y}_{t-1} + \mathbf{B}_2^{s+1}\mathbf{y}_{t-2} + \ldots + \mathbf{B}_p^{s+1}\mathbf{y}_{t-p} + \mathbf{u}_{t+s}^s \quad s = 0, 1, 2, \ldots, h \tag{1}$$

where $\boldsymbol{\alpha}^s$ is an $n \times 1$ vector of constants and the $\mathbf{B}_i^{s+1}$ are slope matrices of coefficients for each lag i and horizon $s+1$. We set $n = 5$, $h = 8$, and $p = 7$. Normalizing $\mathbf{B}_1^0 = \mathbf{I}$, our impulse responses will be

$$\hat{IR}(t, s_i, \mathbf{d}_i) = \hat{\mathbf{B}}_1^s \mathbf{d}_i \quad s = 0, 1, 2, \ldots, h$$

where column $\mathbf{d}_i$ $(i = 1, \ldots, n)$ of matrix $\mathbf{D}$ represents the relevant experimental shocks.

Impulse responses from linear models suffer from four restrictions: (i) symmetry of response to negative and positive shocks; (ii) shape invariance, where responses to shocks of

[12] In previous versions of the paper, we estimated vector auto-regressions with short-run restrictions and sign restrictions; we relegate VAR IRFs to the supplementary appendix. There is, however, no specific reason to expect that the data are generated by a VAR, especially as the model includes regulatory variables. As the paper looks at the impact of aggregated monetary policy on sectoral wages, furthermore, no real concerns about reverse causality motivate the use of a multivariate setting. That said, we are interested in dynamic responses; thus, the local projection method (Jordà, 2005) is of interest, which provides computation methods for impulse response functions that do not rely on the specification and estimation of the unknown true multivariate dynamic system.

[13] We thank Pavel Kapinos for sharing code on cubic local projections.

different magnitudes are scales of one another; (iii) history independence, where the shape of the responses is independent of the local conditional history; and (iv) multidimensionality, where responses are high-dimensional nonlinear functions of parameter estimates, complicating calculation of standard errors and rapidly compounding misspecification errors. Linear local projections alleviate the fourth concern, but are plagued by the first three. Cubic local projections overcome all four issues. We therefore allow this more flexible local projection with the following regression

$$\mathbf{y}_{t+s} = \boldsymbol{\alpha}^s + \mathbf{B}_1^{s+1}\mathbf{y}_{t-1} + \mathbf{Q}_1^{s+1}\mathbf{y}_{t-1}^2 + \mathbf{C}_1^{s+1}\mathbf{y}_{t-1}^3 + \mathbf{B}_2^{s+1}\mathbf{y}_{t-2} + \cdots + \mathbf{B}_p^{s+1}\mathbf{y}_{t-p} + \mathbf{u}_{t+s}^s \quad s = 0, 1, 2, \ldots, h \tag{2}$$

where we preclude cross-product terms so $\mathbf{y}_{t-1}^2 = (y_{1,t-1}^2, y_{2,t-1}^2, \ldots, y_{n,t-1}^2)$; therefore, the impulse response at time s becomes

$$\begin{aligned} IR(t, s, \mathbf{d}_i) &= \{\hat{\mathbf{B}}_1^s(\mathbf{y}_{t-1} + \mathbf{d}_i) + \hat{\mathbf{Q}}_1^s(\mathbf{y}_{t-1} + \mathbf{d}_i)^2 + \hat{\mathbf{C}}_1^s(\mathbf{y}_{t-1} + \mathbf{d}_i)^3\} \\ &\quad - \{\hat{\mathbf{B}}_1^s\mathbf{y}_{t-1} + \hat{\mathbf{Q}}_1^s(\mathbf{y}_{t-1})^2 + \hat{\mathbf{C}}_1^s(\mathbf{y}_{t-1})^3\} \\ &= \{\hat{\mathbf{B}}_1^s\mathbf{d}_i + \hat{\mathbf{Q}}_1^s(2\mathbf{y}_{t-1}\mathbf{d}_i + \mathbf{d}_i^2) + \hat{\mathbf{C}}_1^s(3\mathbf{y}_{t-1}^2\mathbf{d}_i + 3\mathbf{y}_{t-1}\mathbf{d}_i^2 + \mathbf{d}_i^3)\} \\ &\quad s = 0, 1, 2, \ldots, h \end{aligned}$$

We normalize $\mathbf{B}_1^0 = \mathbf{I}$, $\mathbf{Q}_1^0 = \mathbf{0}_n$, and $\mathbf{C}_1^0 = \mathbf{0}_n$. Scaling $\boldsymbol{\lambda}_i \equiv (\mathbf{d}_i, 2\mathbf{y}_{t-1}\mathbf{d}_i + \mathbf{d}_i^2, 3\mathbf{y}_{t-1}^2\mathbf{d}_i + 3\mathbf{y}_{t-1}\mathbf{d}_i^2 + \mathbf{d}_i^3)'$ and denoting $\hat{\boldsymbol{\Sigma}}_C$ the HAC variance-covariance matrix of the coefficients $\hat{\mathbf{B}}_1^s$, $\hat{\mathbf{Q}}_1^s$, and $\hat{\mathbf{C}}_1^s$ in (2), we compute the 95-percent confidence interval for the impulse response at time s as $1.96 \pm (\boldsymbol{\lambda}_i'\hat{\boldsymbol{\Sigma}}_C\boldsymbol{\lambda}_i)$. Confidence intervals for non-linear local projections will be wider than those for linear projections as we estimate more coefficients for cubic projections, and correspondingly, fewer degrees of freedom.[14]

[14] We adapt cubic local projection code from Hwa *et al.* (2018), kindly shared with us by the authors.

4 Results

4.1 Baseline Results

Figures 1– 4 show the variable responses to shocks to base money growth and the log of financial regulation. We draw three conclusions. First, base money growth and relative wages are statistically significantly positively correlated. Second, this result obtains only upon impact and disappears at further lags, suggesting evidence in favor of Hume's short-run effect over Cantillon's. The lack of persistence is expected with Open Market Operations, as Open Market Operations do not pertain to longer term assets, in particular, those assets considered by Quantitative Easing. Third, in contrast to money growth, however, regulation and relative wages are insignificantly positively correlated contemporaneously, but the relation becomes significantly negative one and two quarters after the shock to regulation. Previous studies found a positive relation between deregulation and wages, whereas our finding of a delayed response makes sense because it takes time for regulations to go into effect.

Our key result is shown in the upper middle graph in Figure 1. A one standard deviation shock to base money growth is contemporaneously associated with a 2.83 percentage-point average increase in relative wages. The result is statistically and economically significant upon impact. On regulation, the upper middle graphs in Figures 2 and 4 show that although the relation between regulation and relative wages is insignificant upon impact, one period after the shock to regulation we see an average decrease in relative wages of 1.5 (number of commands) or 1.79 (number of words).

4.2 Robustness

We next look at whether base money growth shocks of different signs and magnitudes have differential effects. For our sample from 1975Q1 to 2015Q4, base money growth is negative in 18 out of 164 quarters. Its range, excluding one extreme outlier in 2008Q4 of 63%, is between about −1.7 to +5.3 standard deviations from the median of 1.6%, where one

standard deviation is 2.7%.

Our non-linear local projections allow us to explore the impact of a negative shock to base money growth, where the response functions are not a mirror image of the response functions from the positive shock as with the linear local projection, which is symmetric in sign. Figure 5 displays responses to a negative shock to base money growth. Asymmetric results arise from a reduction in base money using cubic local projections, whereby the response of relative wages is strongly significantly more negative upon impact. The qualitative patterns are similar to before, albeit in the opposite direction, but quantitatively the results are not mirror images of Figure 1.

Non-linear local projections also allow us to explore the impact of shocks of different magnitude, unlike linear local projections, characterized by shape invariance to scale. Figure 6 shows results from standard deviation shocks to base money growth of size 0.5, one, and two. With a shock size of half of one standard deviation, corresponding to the median base money growth, the response of relative wages weakens, but not by less than the scale of the shock; at further horizons, however, responses cross over. With a two standard deviation shock the initial rise in relative wages dampens by more than a half, though responses are amplified in absolute value during periods two and three, with qualitative differences between later periods.

Our results are robust to a plethora of extensions in earlier versions of the paper including short-run restricted VARs. Reduced form VARs show similar results, though we do not stress interpreting these results as the shocks cannot be materially interpreted. In addition to these alternative empirical models, we develop a stylized monetary model that presents our theory. Results are consistent with the theory model. We relegate the mathematical model and the VARs to the supplementary appendix.

4.3 Discussion

Our primary results, namely that there is a positive, significant relation between base money growth and the wages of financial sector workers relative to workers in the rest of the

economy, but that the relationship is short lived, perfectly aligns with Hume's formulation of Cantillon effects in his essay *Of Money* (Hume, [1752] 2007):

> When any quantity of money is imported into a nation, it is not at first dispersed into many hands; but is confined to the coffers of a few persons, who immediately seek to employ it to advantage. Here are a set of manufacturers or merchants, we shall suppose, who have received returns of gold and silver for goods which they sent to Cadiz. They are thereby enabled to employ more workmen than formerly, who never dream of demanding higher wages, but are glad of employment from such good paymasters. If workmen become scarce, the manufacturer gives higher wages, but at first requires an encrease of labour; and this is willingly submitted to by the artisan, who can now eat and drink better, to compensate his additional toil and fatigue. He carries his money to market, where he finds every thing at the same price as formerly, but returns with greater quantity and of better kinds, for the use of his family. The farmer and gardener, finding, that all their commodities are taken off, apply themselves with alacrity to the raising more; and at the same time can afford to take better and more cloths from their tradesmen, whose price is the same as formerly, and their industry only whetted by so much new gain. It is easy to trace the money in its progress through the whole commonwealth; where we shall find, that it must first quicken the diligence of every individual, before it encrease the price of labour. [...] At first, no alteration is perceived; by degrees the price rises, first of one commodity, then of another; till the whole at last reaches a just proportion with the new quantity of specie which is in the kingdom.

We expect, therefore, to see the wages of workers in the financial sector bid up immediately as new money enters financial firms before this money circulates throughout the rest of the economy and bids up the wages of workers in other sectors. This transmission mechanism

explains our results in Figure 1. The wages of workers in the financial sector are bid up, raising the relative wage. Then the money enters other sectors and bids their wages up, mechanically decreasing the relative wage, being what we see during periods 1 and 2 in Figure 1.

When examining the impact of base money growth on financial sector compensation, although marginally insignificant, our results look similar in Figure 3. The lack of statistical significance is unsurprising. According to the BEA, though wages and salaries include bonuses, compensation includes all other forms of remuneration, including healthcare, contributions to pensions, and other forms of insurance. Cantillon effects, which are purely monetary, are thus less likely to impact variables that measure and include non-monetary compensation. It seems implausible that the bidding up of wages in the financial sector increases the cost of financial worker healthcare, for example. Our results, therefore, not only reveal that Hume ([1752] 2007) had the more accurate formulation of Cantillon effects, but also reveal that the channel through which Cantillon effects benefit finance, that is, through wages and bonuses rather than through broader forms of compensation benefits.

Our results for the impact of regulation on financial sector wages, seen in Figures 2 and 4 suggest that regulation is associated with lower financial sector wages, but that it takes time for the regulations to set in. This is to be expected, as regulations typically do not go into effect as soon as they are written, but rather are designed to be effective on a particular start date. The results also suggest that the effect of financial regulations is temporary, indicating either that financial firms are able to adjust to the new regulations or that relative regulation matters; if all industries are being increasingly regulated at the same rate, we may expect that an increase in financial regulation initially lowers financial wages, but that this is offset by increasing regulations in other industries. It is less clear why the magnitude of the increase in our impulse response function differs between Figure 2 and Figure 4. We prefer, nevertheless, to rely on the number of specific commands over the number of words of regulations as a measure of the regulatory burden because it is unclear that two regulations

of different word counts should be given different weights. A longer command may have more filler words, or may simply take longer to get the point across without necessarily being a more onerous regulation. Weighing each specific command equally, therefore, means that we make no assumptions about the level of burden imposed by each command.

In Figure 5, we see a larger response of financial industry wages to negative shocks of base money growth than to positive shocks. The asymmetry arises because there are fewer negative shocks to base money growth and just under half of them occurred after the financial crisis, when financial sector wages declined the most. In 2008Q1, just before the financial crisis, the wage ratio was 2.49, indicating that financial sector wages were 249 percent of average wages. Since 2008, we witnessed five out of the eighteen instances of negative base money growth, and the wage ratio did not return to 2.4 until 2015. We conclude, therefore, that negative base money growth and strong declines in financial sector wages tend to occur together.

When we look at the non-linearity of the response of financial sector wages to shocks of different sizes in Figure 6, we see that although shocks of one half and one standard deviation produce similar results, shocks of two standard deviations produce responses that are smaller in magnitude. The heterogeneity indicates that smaller shocks represent the asymmetric monetary policy we discussed earlier, of new money being produced in relatively normal times and injected into the financial sector, while larger shocks represent responses to recessions and other crises, which tend to lower the relative wage. This difference is evident because of the timing of the large shocks. Of the five largest values of base money growth, all five occurred after the financial crisis before financial sector wages recovered. Although we do control for the output gap, the Federal Reserve looks at other economic conditions when deciding the conduct of monetary policy. Viewed holistically, our results line up with the version of Cantillon effects in Hume ([1752] 2007), and they are also in accord with the actual structure of pay in the financial sector and with the conduct of monetary policy by central banks before the financial crisis and the switch to a floor system.

5 Conclusion

Varying but noncontradictory reasons explain the increase in the importance of the financial industry. That is, the explanations offered in Philippon and Reshef (2012), Greenwood and Scharfstein (2013), and Witko (2016) do not conflict, but instead build upon each other in explaining why the financial industry has grown to represent increasing segments of the US economy and has benefited workers in the financial industry. Our paper does not seek to overturn these explanations. The local projections confirm the positive relation between deregulation and financial industry wages. What our paper offers is another channel impacting the growth of wages in the financial industry: monetary policy. As outlined in our account of Cantillon effects, expansionary monetary policy will benefit the financial workers at the expense of workers outside of the financial industry. Our results confirm this channel in the very short run, with the positive impacts of monetary expansions on financial sector wages not persisting past the quarter of the shock.

Previous studies of the financial industry were limited both by their samples ending before the financial crisis and by their lack of focus on monetary variables. We overcome these issues by extending our sample to 2015 and testing for Cantillon effects through the use of monetary aggregates. What the theory and our results suggest is that central banks need to be aware of the distributional impact their policies have on the distribution of American wages and plan monetary interventions accordingly. Our results also suggest significant short run non-neutralities of money due to the relation between the monetary base and the wages of financial workers. Our results, therefore, hint at the solution to the discrepancy in the first two formulations of Cantillon effects as established by Cantillon ([1755] 2015) and Hume ([1752] 2007). The persistent impact suggested by Cantillon has less empirical support than the temporary, short run theory developed by Hume. Cantillon effects remain an understudied area of monetary economics, but because of their impact on wealth inequality (Bagchi *et al.*, 2019) and their impact on sectoral income inequality in the United States, there is a strong

argument that Cantillon effects deserve more attention and recognition in the economics profession.

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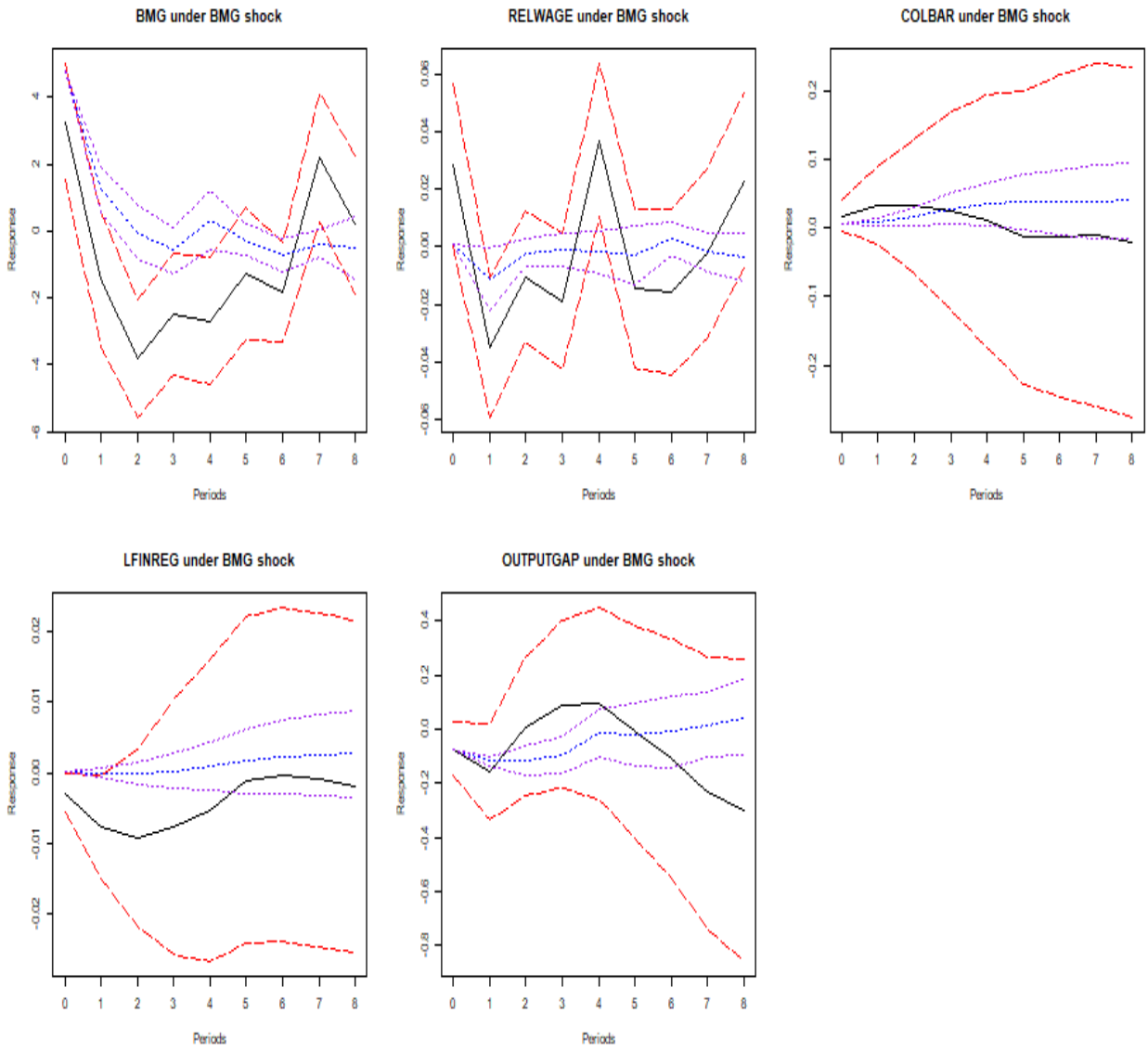
Table 1: Descriptive Statistics

	Mean	Median	Minimum	Maximum	Standard Deviation	Observations
Relative Wage	1.35	1.35	0.98	2.13	0.27	164
Relative Compensation	1.27	1.31	0.86	1.58	0.21	164
Base Money Growth	2.34	1.62	−2.86	63.00	5.46	164
Number of Commands	7.86	7.51	5.76	12.69	1.43	164
Number of Words	8.05	7.56	5.57	14.14	1.81	164
Collective Bargaining	17.40	16.36	11.80	26.75	4.75	164
Output Gap	−0.25	−0.11	−6.58	4.19	2.09	164

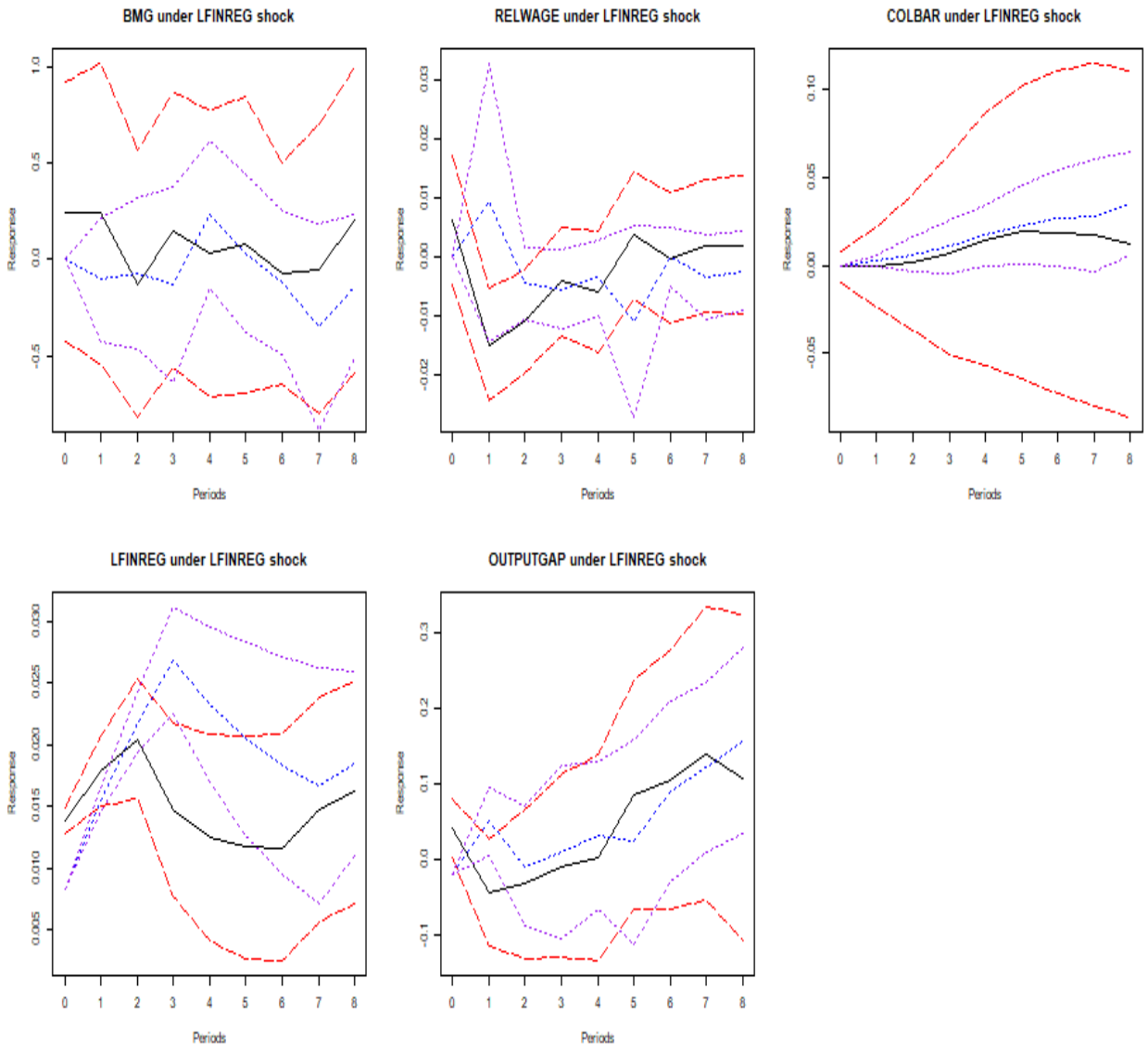
Notes: Relative wage: ratio of the average wage in the financial industry to the average wage in the economy; source: Bureau of Economic Analysis. Monetary base growth rate comes from St. Louis FRED. Financial regulation is the number of commands and number of words in the RegData dataset from McLaughlin and Sherouse (2018). Number of regulations is in tens of thousands and number of words is in millions, in the descriptive statistics, but we use logarithms of the raw data in regressions. Collective bargaining rates are from the OECD. The output gap comes from Holston *et al.* (2017). The output gap is measured such that a positive output gap occurs when GDP is above natural output and a negative output gap occurs when GDP is below natural output. In the local projections, we detrend the data subject to a constant trend and we log both regulation measures.

Figure 1: Local Projection Impulse Responses to a Shock to Base Money Growth



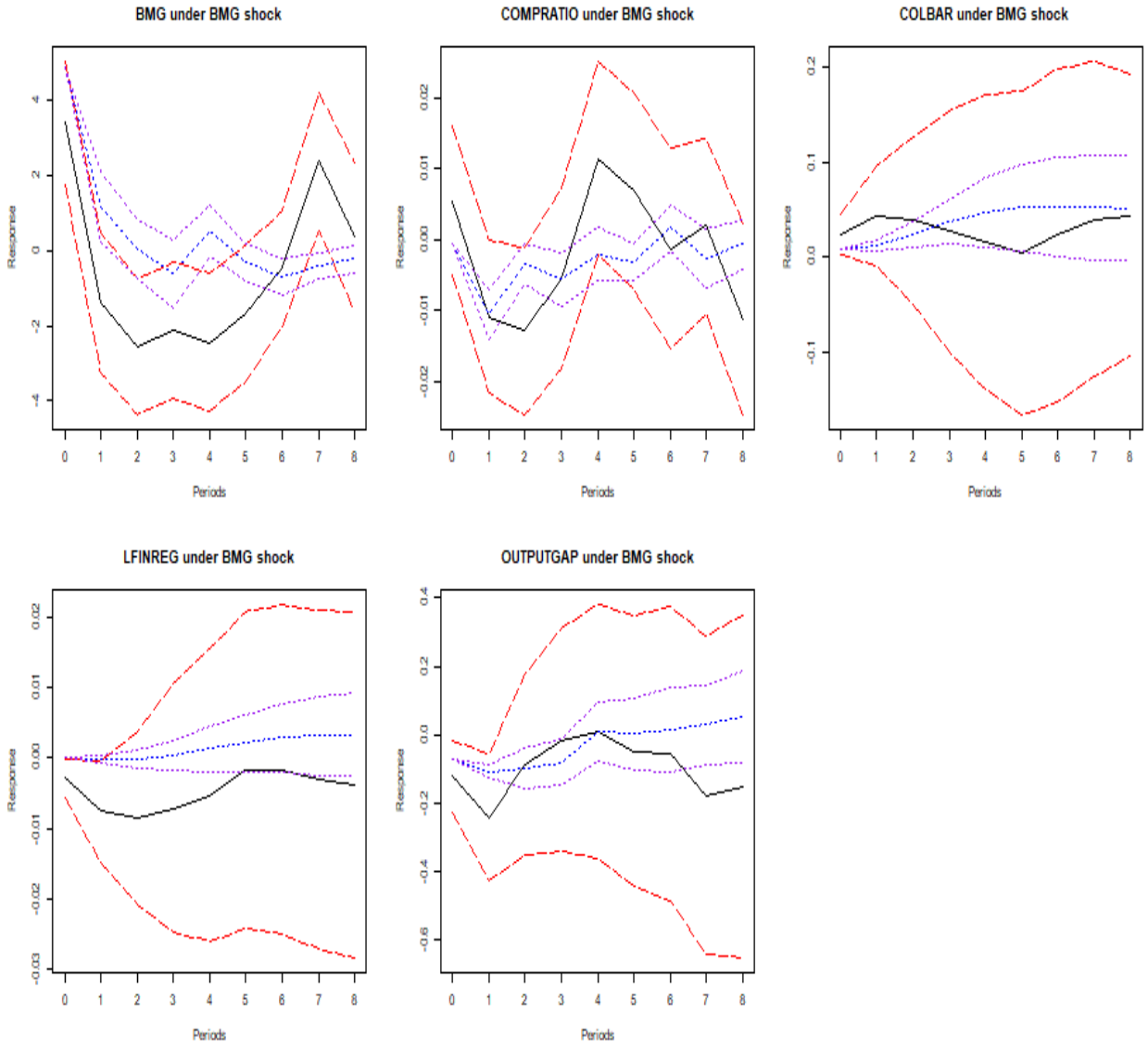
Notes: BMG: base money growth; RELWAGE: relative wage; COLBAR: collective bargaining; LFINREG: log of the number of regulations (commands); OUTPUTGAP: output gap. See notes at the end of Table 1 for details on variables. 90% confidence intervals (medians) for cubic local projections are in red (black) and for linear local projections are dotted purple (blue). Periods are in quarters.

Figure 2: Local Projection Impulse Responses to a Shock to Financial Regulation



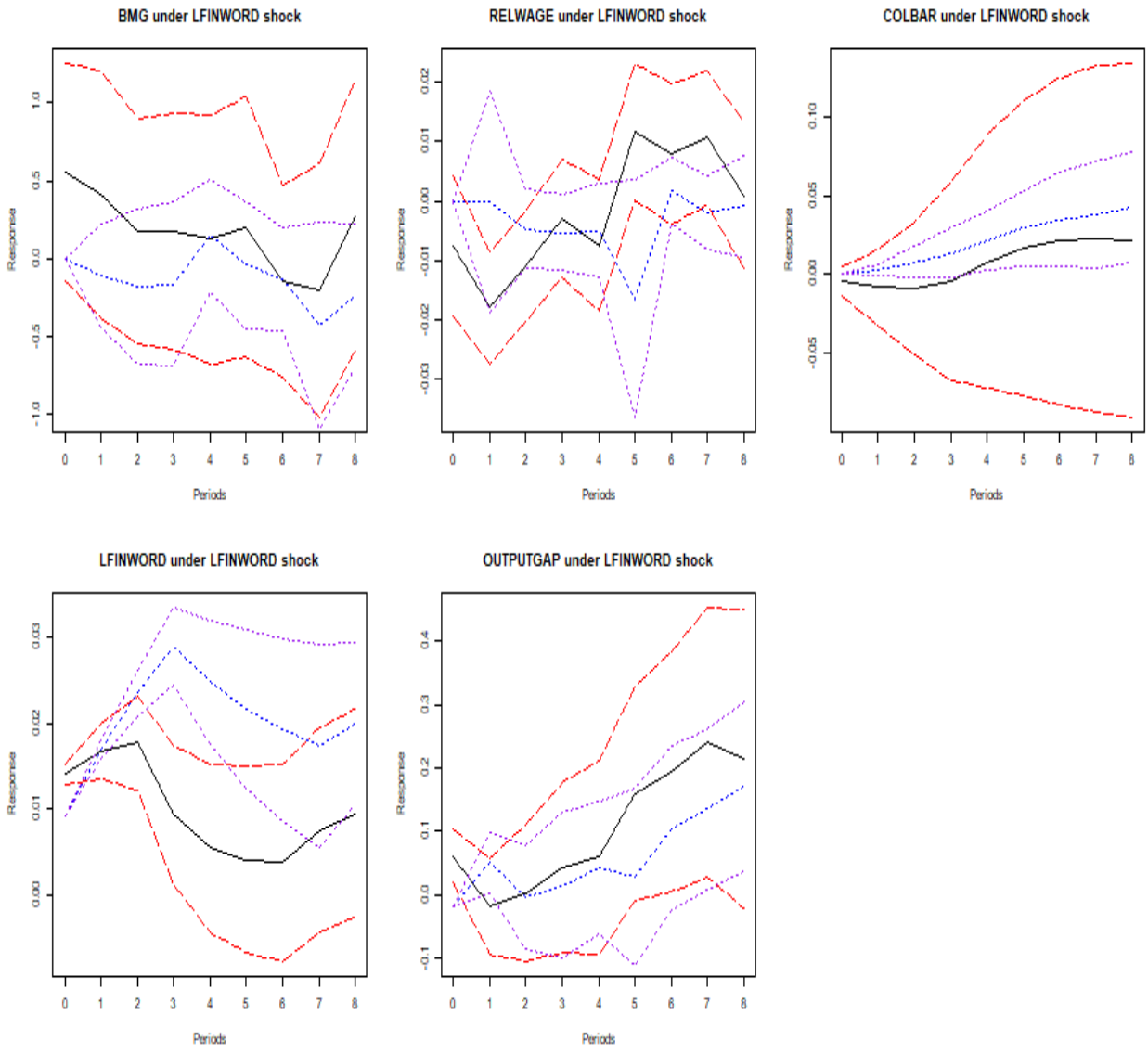
Notes: BMG: base money growth; RELWAGE: relative wage; COLBAR: collective bargaining; LFINREG: log of the number of regulations (commands); OUTPUTGAP: output gap. See notes at the end of Table 1 for details on variables. 90% confidence intervals (medians) for cubic local projections are in red (black) and for linear local projections are dotted purple (blue). Periods are in quarters.

Figure 3: Local Projection Impulse Responses to a Shock to Base Money Growth
(Relative Compensation Rather than Relative Wages)



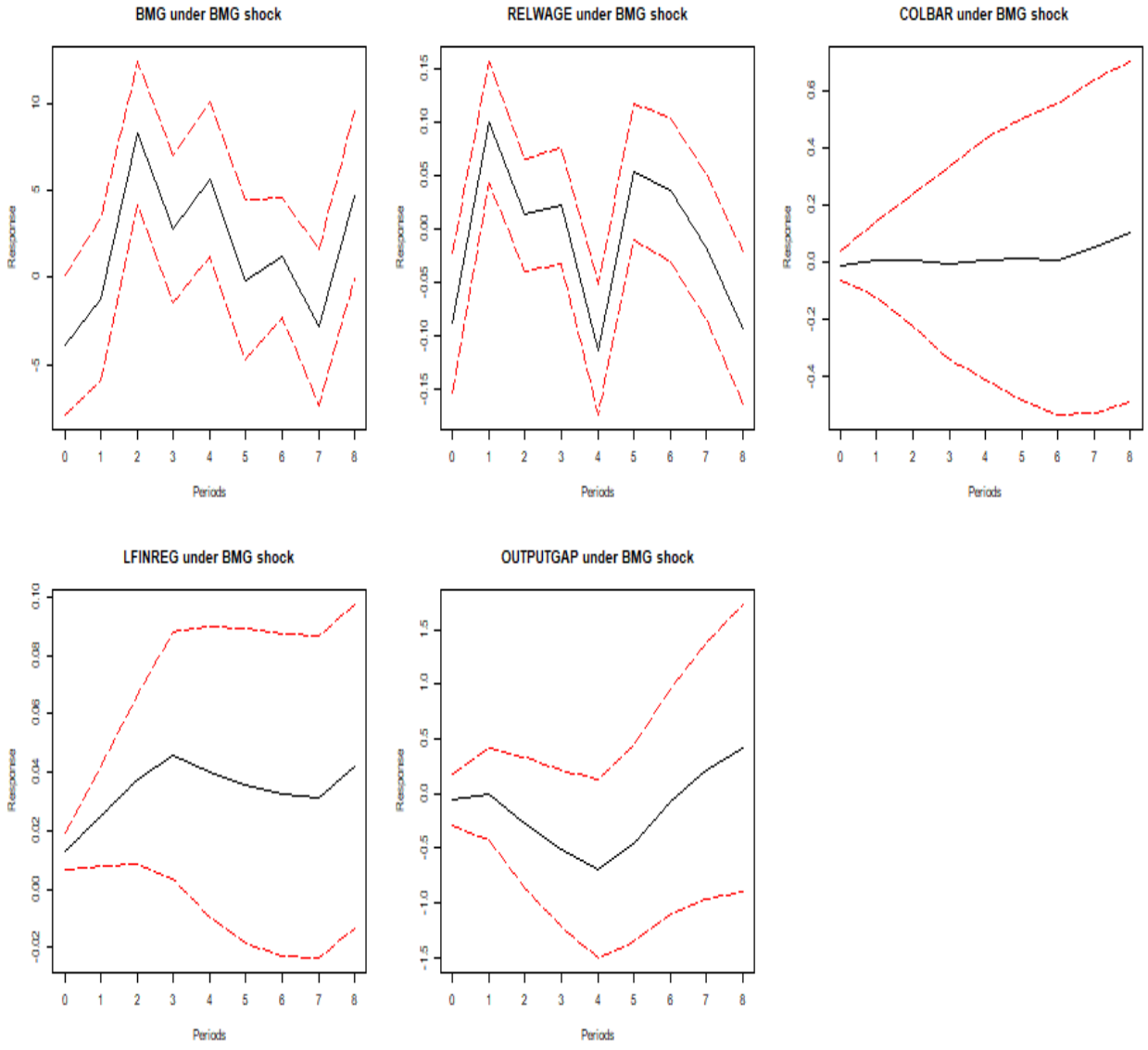
Notes: BMG: base money growth; COMPRATIO: relative compensation; COLBAR: collective bargaining; LFINREG: log of the number of regulations (commands); OUTPUTGAP: output gap. See notes at the end of Table 1 for details on variables. 90% confidence intervals (medians) for cubic local projections are in red (black) and for linear local projections are dotted purple (blue). Periods are in quarters.

Figure 4: Local Projection Impulse Responses to a Shock to Financial Regulation (Words)



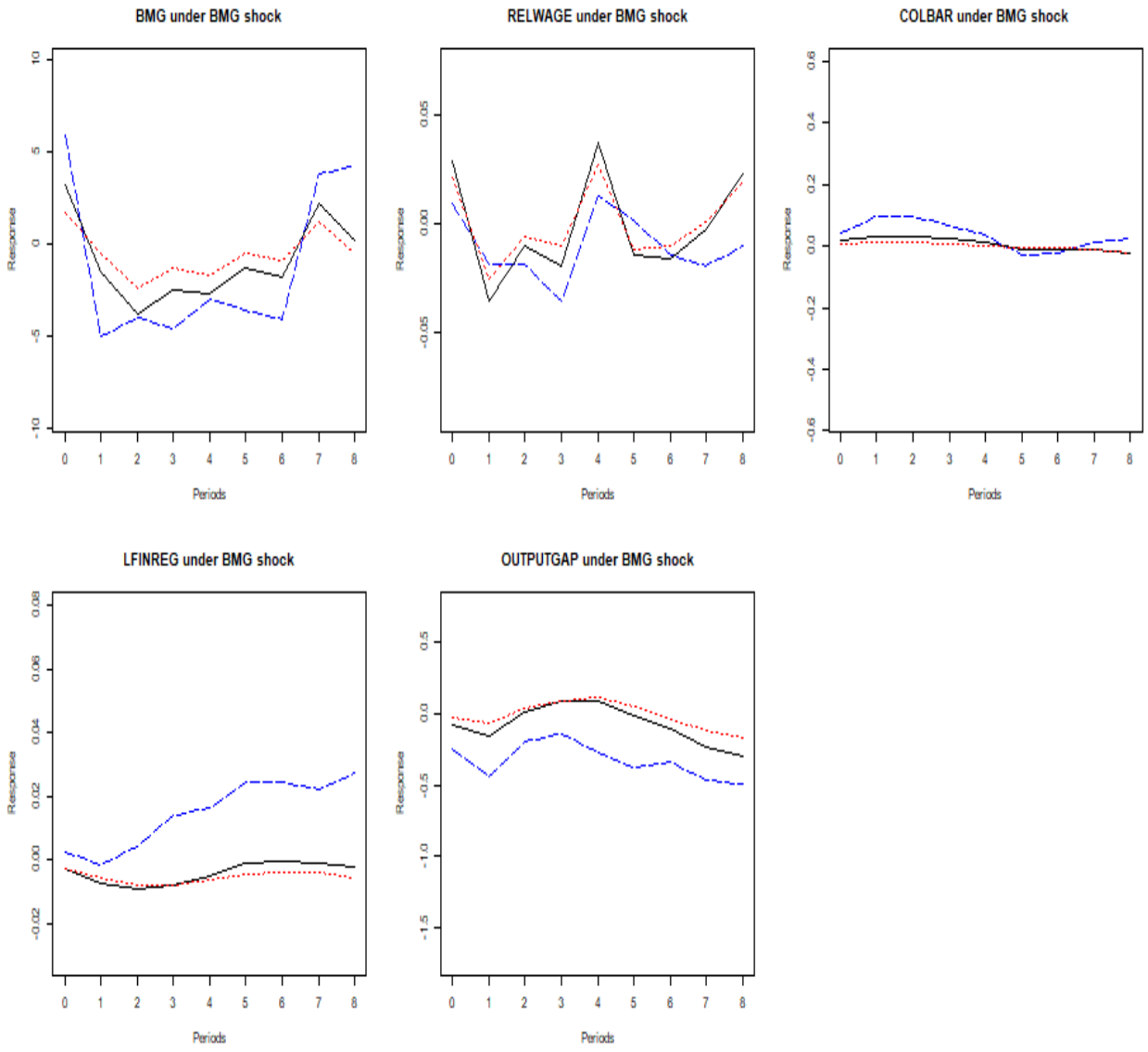
Notes: BMG: base money growth; RELWAGE: relative wage; COLBAR: collective bargaining; LFINWORD: log of the number of words in regulations; OUTPUTGAP: output gap. See notes at the end of Table 1 for details on variables. 90% confidence intervals (medians) for cubic local projections are in red (black) and for linear local projections are dotted purple (blue). Periods are in quarters.

Figure 5: Local Projection Impulse Responses to a Negative Shock to Base Money Growth



Notes: BMG: base money growth; RELWAGE: relative wage; COLBAR: collective bargaining; LFINREG: log of the number of regulations (commands); OUTPUTGAP: output gap. See notes at the end of Table 1 for details on variables. 90% confidence intervals (medians) for cubic local projections are in red (black). Periods are in quarters.

Figure 6: Local Projection Impulse Responses to Different Shock Sizes to Base Money Growth



Notes: BMG: base money growth; RELWAGE: relative wage; COLBAR: collective bargaining; LFINREG: log of the number of regulations (commands); OUTPUTGAP: output gap. See notes at the end of Table 1 for details on variables. Median responses for cubic local projections are drawn to a 0.5 standard deviation shock (red dots), to a one standard deviation shock (black line), and to a two standard deviation shock (blue dashes). Periods are in quarters.