Like a Good Neighbor: Monetary Policy, Financial Stability, and the Distribution of Risk*

Evan F. Koenig
Federal Reserve Bank of Dallas and Southern Methodist University

In an economy in which debt obligations are fixed in nominal terms, a monetary policy focused narrowly on controlling inflation insulates lenders from aggregate output risk, leaving borrowers as residual claimants. This concentration of risk has the potential to exacerbate the financial distress associated with adverse supply shocks. A better risk distribution is obtained if the price level is allowed to rise whenever output is unexpectedly weak. Illustrative examples are presented in which an appropriately countercyclical inflation policy exactly reproduces the risk allocation that one would observe with perfect capital markets.

JEL Codes: E52, E44, G10.

1. Introduction

The modern literature on optimal monetary policy views price variation as something to be avoided except insofar as it helps keep output near potential. Were it not for the Taylor-curve trade-off between inflation and output variability, monetary policymakers would be directed to hold inflation constant. This paper makes the simple point that price variation may be desirable for reasons that have absolutely nothing to do with output stabilization. If, in particular,

*I have benefitted from the comments of Nathan Balke, John Roberts, John Leahy, Charles Nelson, faculty and students at UNLV and the University of Wisconsin–Milwaukee, and participants in the IJCB 2012 Fall Conference in Santiago, Chile. Views expressed are my own and are not necessarily shared by colleagues at the Federal Reserve Bank of Dallas or elsewhere around the Federal Reserve System. Author contact: Evan.F.Koenig@dal.frb.org.

financial obligations are fixed in nominal terms, then countercyclical price-level changes can be used by the monetary authority to improve the allocation of risk between borrowers and lenders.

That financial obligations such as corporate pension liabilities and loan and lease payments are often specified in nominal terms is widely recognized.[1] Generally, though, the vulnerability of those with fixed nominal obligations to price shocks has been seen as reinforcing the case for a pre-announced price-level or inflation target. Irving Fisher (1933), for example, argued for price-level stability on grounds that unexpected deflation might initiate or help perpetuate a sequence of loan defaults and asset sales damaging to credit markets.[2] However, such thinking is incomplete. Households and firms obligated to make fixed nominal payments are exposed to financial stress whenever nominal income flows deteriorate relative to expectations extant when the obligations were accepted, independent of whether the deterioration is due to lower-than-expected inflation or to lower-than-expected real income growth. It follows that although purely random variation in the price level is undesirable, price variation that offsets shocks to real income may serve a useful insurance function. To highlight monetary policy's role in distributing risk (as opposed to its role in stabilizing output), this paper considers a simple endowment economy in which the product market clears at all times and fluctuations in output are exogenous. A monetary policy that targets aggregate nominal income is shown to exactly reproduce the risk distribution one would see if there were complete capital markets. The analysis is then extended to a production economy in which there are government-purchases, labor-supply, and productivity shocks. Now, monetary policy should target nominal consumption expenditures.

Related work includes articles by Doepke and Schneider (2006a, 2006b) which document the potential size of the shifts in the wealth

[1] "If one thinks about the important sets of contracts in the economy that are set in nominal terms, and which are unlikely to be implicitly insured or indexed against unanticipated price-level changes, financial contracts (such as debt instruments) come immediately to mind." (Bernanke 1995)

[2] See Fisher (1933, pp. 346–48). For more recent treatments, see Bernanke (2003) and Crawford, Meh, and Terajima (2009). Hall (1984), similarly, cites the vulnerability of pensioners to unexpected inflation as a reason to favor policy rules that limit price-level uncertainty.

distribution resulting from unexpected inflation and how these shifts might affect saving and work incentives. There is no discussion of unexpected inflation's potential role in spreading risk due to real shocks. Bohn (2009) analyzes how state-contingent *fiscal* policy can be used to improve the distribution of risk. There is no money in the economy. In an earlier article, Bohn (1988) flips this paper's analysis on its head. The monetary authority is assumed to set the money supply in advance of the current output realization, with the result that the price level moves opposite to output. The fiscal authority optimally chooses to issue at least some nominal debt in order to take advantage of the countercyclical price level and limit variation in the tax rate. Chari and Kehoe (1999) use a representative agent model to examine the optimal *combined* fiscal and monetary policy response to technology and government-purchases shocks. By assumption, government debts are fixed in nominal terms and taxes are distorting.[3] As in the current paper, it's found that the price level ought to move opposite to technology shocks and be positively related to government-purchases shocks. However, the reasoning is quite different from that offered here: Price movements are desirable not because they help to spread risk across households, but because they allow a smoother, less distorting tax rate path.

In contrast to Bohn, but consistent with Fisher and Chari and Kehoe, this paper takes it as given that debt contracts are written in nominal terms. The goal of the paper is not to explain the existence of nominal debt but to demonstrate that its monetary policy implications are quite different from those that much of the existing literature takes for granted.[4,5]

[3] Lustig, Sleet, and Yeltekin (2008) generalize Chari and Kehoe's analysis by allowing the government to issue multi-period debt, and by considering the possibility that output prices are "sticky."

[4] Unpublished manuscripts by Eagle and Domian (2005a, 2005b) look at how risk is distributed across households depending on contracting arrangements. The main focus of the papers is on optimal indexing, but there is also discussion of the policy implications of imperfect indexing. Only endowment economies are considered. In a more recent manuscript, Sheedy (2012) shows that the main results derived here generalize to an overlapping-generations economy where households have identical Epstein-Zin preferences. Nominal GDP targeting remains approximately efficient for a wide range of reasonable parameterizations when price stickiness is introduced into the economy. Aggregate productivity shocks are the only source of uncertainty in Sheedy's model, and the supply of

2. Formalization of the Risk-Sharing Argument

2.1 Basic Assumptions

To begin with, consider a two-period endowment economy with equal numbers of each of two types of household. Households of type 1 each receive real income of $y(1) > 0$ in period 1 and nothing in period 2. Households of type 2 each receive nothing in period 1 and real income of $y(2) > 0$ in period 2. Period 2 output can take on any of S values, $0 < y_1(2) < y_2(2) < y_3(2) < \ldots < y_S(2)$, with known probabilities $p_1, p_2, p_3, \ldots, p_S$, respectively. The utility of each type 1 household is given by $\mathrm{U}(c_1(1)) + \rho\mathrm{U}(c_1(2))$, where $c_1(1)$ and $c_1(2)$ are type 1 consumption in periods 1 and 2, respectively; $0 < \rho \leq 1$; and $\mathrm{U}'(\cdot) > 0$, $\mathrm{U}''(\cdot) < 0$, and $\mathrm{U}'(c) \to \infty$ as $c \to 0$. The utility of type 2 households, similarly, is given by $U(c_2(1)) + \rho U(c_2(2))$, where $c_2(1)$ and $c_2(2)$ are type 2 consumption in periods 1 and 2, respectively, and where $U'(\cdot) > 0$, $U''(\cdot) < 0$, and $U'(c) \to \infty$ as $c \to 0$. Strongest results are derived assuming that households have identical constant-relative-risk-aversion (CRRA) utility functions: $\mathrm{U}(c) = U(c) = (c^{1-\alpha} - 1)/(1 - \alpha)$, where $\alpha > 0$. Households are price takers in financial markets.

This simple model captures two important features of real-world economies. First, the timing of real income differs across households, providing an incentive for intertemporal trade.[6] Second, future

---

labor is fixed. Neither Sheedy nor Eagle-Domian consider the implications of bankruptcy for the inflation-targeting equilibrium.

[5]Why debts are specified in nominal terms is a long-standing mystery (Lacker 1991, pp. 17–18; Kiyotaki and Moore 1997, p. 243). Perhaps people assume that the central bank will pursue a policy that is efficient given such contracts. Problems arise when the central bank fails to ratify these expectations.

[6]Borrowing and lending can also result from cross-section differences in the rate of time preference (Kiyotaki and Moore 1997; Eggertsson and Krugman 2011; Guerrieri and Lorenzoni 2011). A decline in credit availability lowers the equilibrium real interest rate and can drive the economy up against the zero nominal interest rate bound. In Midrigan and Philippon (2011), short-term consumer credit serves as a substitute for cash in household purchases. Limits on credit are tied to home values but are also subject to exogenous shocks. Alternatively, only a subset of agents (entrepreneurs) have access to capital investment opportunities. These agents finance investment projects with funds borrowed from worker-consumers, either directly or through financial intermediaries (Bernanke, Gertler, and Gilchrist 1999; Gertler and Kiyotaki 2010). Debt is state contingent (Gertler and Kiyotaki 2010) and/or entrepreneurs are risk neutral (Bernanke, Gertler, and Gilchrist 1999) and absorb any aggregate risk.

Table 1. Consumption of Different Household Types when Capital Markets Are Complete

Type	Period 1	Period 2
1	$y(1) - q' \cdot s$	q_{i^*}
2	$q' \cdot s$	$y_{i^*}(2) - q_{i^*}$

aggregate output is uncertain. In combination with income-timing differences, this uncertainty creates an incentive for risk sharing. I deal first with an economy in which there are no barriers to state-contingent intertemporal trade. Then I consider monetary policy in an economy in which the only financial instrument is a nominal bond.

2.2 Complete Capital Markets

Suppose that type 2 households are able to sell Arrow-style state-contingent securities to type 1 households. Each such security pays one unit of output should a particular period 2 state arise, and nothing otherwise. If q_i denotes the quantity of security i sold by a representative type 2 household and s_i denotes its price, and if i^* is the realized state, then consumption is allocated as shown in table 1. Type 1 households maximize expected utility when

$$s_i \mathrm{U}'(y(1) - q' \cdot s) = \rho p_i \mathrm{U}'(q_i) \tag{1}$$

for each i. Similarly, the first-order conditions for a type 2 household are

$$s_i U'(q' \cdot s) = \rho p_i U'(y_i(2) - q_i) \tag{2}$$

for $i = 1, 2, \ldots, S$. These conditions require that the marginal rate of substitution between period 1 and period 2 consumption be equal across households for every possible output realization.

Equations (1) and (2) also imply that the ratio $U'(c_2(2))/\mathrm{U}'(c_1(2))$ of second-period marginal utilities is completely independent of the realized level of period 2 output. This result, in turn, implies that output risk is shared in equilibrium: If realized second-period output is high, the second-period consumption of both type

1 and type 2 households must be high; and if realized output is low, the consumption of both types of household must suffer. Formally, we know that $c_1(2) + c_2(2) = y(2)$ and that $U'(c_2(2))/\mathrm{U}'(c_1(2))$ is independent of $y(2)$. Log-differentiate these conditions to get $(c_1/y)dc_1/c_1 + (c_2/y)dc_2/c_2 = dy/y$ and $\mathrm{A}dc_1/c_1 = \mathrm{B}dc_2/c_2$, where all variables are evaluated at their period 2 values, and where $\mathrm{A} \equiv -c_1\mathrm{U}''(c_1)/\mathrm{U}'(c_1) > 0$ and $\mathrm{B} \equiv -c_2U''(c_2)/U'(c_2) > 0$ measure the relative risk aversion of type 1 and type 2 households, respectively. Solving,

$$\begin{aligned} dc_1/c_1 &= [\mathrm{B}y/(\mathrm{A}c_2 + \mathrm{B}c_1)](dy/y) \\ dc_2/c_2 &= [\mathrm{A}y/(\mathrm{A}c_2 + \mathrm{B}c_1)](dy/y). \end{aligned} \tag{3}$$

Both $c_1(2)$ and $c_2(2)$ are increasing in $y(2)$. Moreover, it is readily verified that $dc_1/c_1 < dy/y < dc_2/c_2$ if $\mathrm{A} > \mathrm{B}$ and $dc_2/c_2 < dy/y < dc_1/c_1$ if $\mathrm{B} > \mathrm{A}$: The consumption of whichever type household is more risk averse will vary less than in proportion to output, while the consumption of whichever type household is less risk averse will vary more than in proportion to output.[7] When households of both types are equally risk averse ($\mathrm{A} = \mathrm{B}$), the consumption of both will be proportional to output: $dc_1/c_1 = dc_2/c_2 = dy/y$.

In the case where all households have the same CRRA utility function $[\mathrm{U}(c) = U(c) = (c^{1-\alpha} - 1)/(1 - \alpha)]$, equations (1) and (2) are readily solved for q_i and s_i:

$$s_i = \rho p_i[y(1)/y_i(2)]^{\alpha} \qquad q_i = y_i(2)/(1 + z), \tag{4}$$

where $z \equiv \rho E\{[y(2)/y(1)]^{1-\alpha}\} > 0$. Security i's price is higher the higher is the probability that state i occurs and the lower is state i output. The quantity of security i sold is proportional to the amount of output in state i. Equilibrium consumption paths, shown in table 2, are obtained by substituting from equation (4) back into table 1. Each household consumes the same fraction of period 2 output as of period 1 output, and the consumption of every household is sensitive to period 2 output. Output risk is shared.

[7]Suppose, for example, that $\mathrm{A} > \mathrm{B}$. Then $dc_1/c_1 = \{\mathrm{B}y/[(\mathrm{A} - \mathrm{B})c_2 + \mathrm{B}y]\}(dy/y) < dy/y < \{[\mathrm{A}y/[\mathrm{A}y - (\mathrm{A} - \mathrm{B})c_1)]\}(dy/y) = dc_2/c_2$.

Table 2. Consumption of Different Household Types when Capital Markets Are Complete: Equilibrium when Creditors and Debtors Have the Same CRRA Utility Function

Type	Period 1	Period 2
1	$y(1)/(1+z)$	$y(2)/(1+z)$
2	$y(1)[z/(1+z)]$	$y(2)[z/(1+z)]$

2.3 Nominal Debt Contracts and Monetary Policy

The absence of complete state-contingent securities markets is an essential element in Fisher's debt-deflation story. The point of the analysis that follows is that if capital markets are, indeed, incomplete in the manner described by Fisher (and, arguably, as we observe to a considerable degree in the world around us), then optimal monetary policy does *not* generally take the form of a price-level target. To spread risk, the future price level should vary inversely with future output. In the CRRA utility case, optimal policy takes the form of a nominal spending target.

Without loss of generality, set the period 1 price level equal to 1. The monetary authority determines the period 2 price level, π, after observing $y(2)$.[8] Let D be the debt issued by each type 2 household in period 1, and let R denote the (gross) nominal interest rate. Then, consumption is allocated as shown in table 3. The table assumes that $y(2) > DR/\pi$, so that type 2 households ("debtors") are not driven into bankruptcy. The no-bankruptcy condition is discussed further below. For now, simply note that it restricts the value of period 2 output relative to the principal and interest due on outstanding debt.

Taking R as given, type 1 households ("creditors") maximize utility when

$$\mathrm{U}'(y(1) - D) = R\rho E[\mathrm{U}'(DR/\pi)/\pi]. \tag{5}$$

[8] Real-world central banks obviously do not have complete control of the price level. I seek to determine how policymakers ought to exercise whatever price-level control they *do* have.

Table 3. Consumption of Different Household Types when Capital Markets Are Incomplete

Type	Period 1	Period 2
1	$y(1) - D$	DR/π
2	D	$y(2) - DR/\pi$

Similarly, the first-order condition for each debtor is

$$U'(D) = R\rho E[U'(y(2) - DR/\pi)/\pi]. \tag{6}$$

These two equations determine D and R conditional on the policy rule of the monetary authority and the probability distribution of period 2 output.

From table 3 it is immediately clear that white-noise variation in the price level is bad: It creates fluctuations in the period 2 consumption of both creditors and debtors, reducing expected period 2 utility by Jensen's inequality. From this result, those who have looked at the monetary policy implications of nominal debt have concluded that π should be fixed in advance.[9] With π pre-set, however, creditors are completely insulated from output risk while debtors are residual claimants on output. The monetary authority can spread output risk more evenly across debtors and creditors by varying the future price level *systematically* with future output, raising π when $y(2)$ is low and lowering π when $y(2)$ is high.

Suppose, for example, that the monetary authority targets the nominal value of period 2 output, $\pi y(2)$. With $\pi y(2)$ set equal to a pre-announced number, n^*, table 3 becomes table 4.

Equations (5) and (6) reduce to

$$\mathrm{U}'(y(1) - D) = (\rho R/n^*)E\{y(2)\mathrm{U}'[(DR/n^*)y(2)]\} \tag{5'}$$

and

$$U'(D) = (\rho R/n^*)E\{y(2)U'[(1 - DR/n^*)y(2)]\}, \tag{6'}$$

[9]See the references in footnote 2. An extreme decline in π will increase the real value of debt obligations, DR/π, by enough to drive type 2 households into bankruptcy. During the Great Depression, the price level (as measured by the GDP price deflator) fell by about 30 percent.

Table 4. Consumption of Different Household Types when Capital Markets Are Incomplete: The Nominal GDP Targeting Case

Type	Period 1	Period 2
1	$y(1) - D$	$(DR/n^*)y(2)$
2	D	$(1 - DR/n^*)y(2)$

respectively. Note that the period 2 consumption of both creditors and debtors is now proportional to period 2 output.

If households share the same CRRA utility function [U(c) = $U(c) = (c^{1-\alpha} - 1)/(1 - \alpha)$], the household first-order conditions (equations (5′) and (6′)) are satisfied if, and only if,

$$D = y(1)[z/(1 + z)] \tag{7}$$

and

$$R = [n^*/y(1)]/z, \tag{8}$$

where, as before, $z \equiv \rho E\{[y(2)/y(1)]^{1-\alpha}\} > 0$. Equations (7) and (8) say that lending is proportional to period 1 output and that the nominal interest rate is proportional to the growth rate of nominal income, respectively. Total nominal debt payments are $DR = n^*/(1+z)$, real debt payments are $DR/\pi = y(2)/(1+z)$, and the ex post real interest rate is $R/\pi = [y(2)/y(1)]/z$, which is proportional to output growth. *When these expressions are substituted into table 4, the implied allocation of consumption across households and across time is identical to that obtained when capital markets are complete* (table 2). Thus, an economy with nominal debt contracts allocates aggregate output risk every bit as efficiently as an economy with a complete set of state-contingent securities, provided that the monetary authority targets nominal income.

Importantly, the no-bankruptcy condition is always satisfied under nominal income targeting: Recalling that $z > 0$, we have $DR/\pi = y(2)/(1 + z) < y(2)$. Under a price-level target, in contrast, debtors' second-period incomes, $y(2)$, will fall below their real debt obligations, DR/π, if realized period 2 output is sufficiently low. So, explicit bankruptcy costs would only serve to enhance the attractiveness of nominal income targeting relative to price-level targeting.

3. Can Bankruptcy Salvage Price-Level Targeting?

We have seen that in economies with simple nominal debt contracts, nominal income targeting—because of the way in which it spreads risk—minimizes the chances that debtors will be driven into bankruptcy by aggregate output fluctuations. Under a price-level or inflation target, in contrast, aggregate output risk is disproportionately borne by debtors. This risk concentration is inefficient. The obvious caveat is that creditors avoid output risk only if output shocks are not so large as to drive debtors into bankruptcy. Bankruptcy shifts risk back onto lenders, and it is reasonable to ask whether in an economy with large output fluctuations bankruptcy might cause the efficient risk allocation to be recovered. The answer to this question is "no." Each borrower, knowing that his consumption in the event of bankruptcy will, at the margin, be independent of the amount he owes, sees a distorted (understated) cost of taking on debt. As far as borrowers are concerned, in the event of default it's "in for a penny, in for a pound."[10] The result is an excess demand for loans at the interest rate that calls forth the optimal supply of loans. In equilibrium, debt and/or the interest rate are too high, and risk is not efficiently distributed.

To see that a price-level target fails to efficiently allocate risk in the presence of bankruptcy, it suffices to look at a stripped-down model economy in which period 2 output takes on only two possible values, "low" (y_L) and "high" (y_H), with probabilities p_L and $p_H = 1 - p_L$, respectively. (Additional states would only make it more difficult to approximate the efficient equilibrium.) In the case of interest, debtors are forced into bankruptcy when period 2 output is low.

---

[10] This effect is related to, but different from, the moral hazard problem that arises in debt models with imperfect monitoring. There, the fact that bankruptcy laws put a floor on losses encourages debtors who find themselves threatened by financial trouble to take excessive risks.

Without loss of generality, assume that the monetary authority targets a constant price level (a zero inflation rate), announcing in advance that it will hold $\pi = 1$. The typical type 2 household will then choose its level of borrowing, D, so as to maximize $U(D) + \rho[p_H U(y_H - RD) + p_L U(\beta)]$, where $0 < \beta < y_L$ is the level of consumption that is allowed bankrupts. Taking R and β as given, the household takes on debt until the net marginal utility of debt equals zero:

$$U'(D) - \rho R p_H U'(y_H - RD) = 0. \tag{9}$$

The typical type 1 household, meanwhile, chooses its level of lending, Δ, so as to maximize $\mathrm{U}[y(1)-\Delta]+\rho\{p_H \mathrm{U}(R\Delta)+p_L \mathrm{U}[(y_L-\beta)\Delta/D]\}$, where D is the average level of type 2 household indebtedness. Note that in the bankruptcy state, each creditor household receives a settlement that is proportional to the volume of its lending: Type 1 households may receive a low return in the event of bankruptcy, but they don't receive a zero return. Taking R, β, and D as given, the representative lender maximizes utility when

$$\rho R p_H \mathrm{U}'(R\Delta) + \rho[(y_L - \beta)/D] p_L \mathrm{U}'[(y_L - \beta)\Delta/D] - \mathrm{U}'[y(1) - \Delta] = 0. \tag{10}$$

The bond market clears in equilibrium, so that (10) becomes

$$\rho R p_H \mathrm{U}'(RD) + \rho[(y_L - \beta)/D] p_L \mathrm{U}'(y_L - \beta) - \mathrm{U}'[y(1) - D] = 0. \tag{10'}$$

We want to see whether it is possible to achieve an efficient allocation of risk in this economy. With complete contingent claims, each type 1 household consumes q_L in period 2 if the low-output state is realized, while type 2 households each consume $y_L - q_L$, (c.f. table 1). Accordingly, suppose that β is set equal to $y_L - q_L$. The first-order condition for lenders becomes

$$\rho R p_H \mathrm{U}'(RD) + \rho(q_L/D) p_L \mathrm{U}'(q_L) - \mathrm{U}'[y(1) - D] = 0. \tag{10''}$$

In the efficient equilibrium, we also know that $c_1(2) = q_H$ if the high-output state is realized in period 2, and that $c_1(1) = y(1) - (q_L s_L + q_H s_H)$, where s_L and s_H satisfy

$$s_i \mathrm{U}'[y(1) - (q_L s_L + q_H s_H)] = \rho p_i \mathrm{U}'(q_i)$$

for $i = L$, H (see equation (1)). It is readily verified that to achieve the complete-markets equilibrium consumption levels in a nominal debt economy, one must have

$$R = q_H/(q_L s_L + q_H s_H) \tag{11}$$

and

$$D = q_L s_L + q_H s_H, \tag{12}$$

and that these conditions are consistent with (10″). However, when equations (11) and (12) are substituted into the left-hand side of equation (9), one finds

$$\begin{aligned} U'(D) - \rho R p_H U'(y_H - RD) \\ &= U'(q' \cdot s) - \rho(q_H p_H / q' \cdot s) U'(y_H - q_H) \\ &= U'(q' \cdot s) - (q_H s_H / q' \cdot s) U'(q' \cdot s) \\ &= (q_L s_L / q' \cdot s) U'(q' \cdot s), \end{aligned} \tag{9'}$$

where the second equality follows from equation (2). Equation (9′) implies that at the interest rate given in equation (11), type 2 households want to borrow more than the amount given by equation (12): There is excess demand for credit. Again, the intuition is that because type 2 households' bankruptcy settlements are independent of their level of borrowing, they have an incentive to take on too much debt. Consequently, the credit market clears at a higher interest rate and/or higher level of debt than is consistent with achieving the complete-markets equilibrium allocation.[11]

In summary, risk is inefficiently allocated in an economy with simple nominal debt contracts and price-level targeting. If output variation is small enough that debtors are always able to meet their

[11] An appendix derives an explicit solution for the case in which utility is logarithmic.

obligations, then creditors are excessively insulated from aggregate output risk while the consumption of debtors is excessively sensitive to output. If output variation is large, then debtors may be forced into bankruptcy in the event of a poor output realization. The fact that each debtor's consumption in the bankruptcy state is independent of his level of indebtedness encourages overborrowing and drives up equilibrium debt and/or the equilibrium interest rate. As a result, there is a larger-than-optimal transfer to creditors when bankruptcy *fails* to occur.

4. A Production Economy

4.1 The Model

The analysis of section 2 carries over to a simple two-period competitive production economy in which households are distinguished by when they receive their labor endowments. Type 1 households (creditors) earn income in period 1, invest and lend, and live off of loan repayments and capital income in period 2. Type 2 households (debtors) earn labor income in period 2 and must finance their period 1 consumption by borrowing. There are equal numbers of the two types of household. The period 2 economy is subject to productivity, labor-supply, and government-purchases shocks. Taxes are lump sum.[12] Household utility is additively separable between consumption and leisure as well as across time, and the utility from consumption is assumed to be governed by the same function, $U(\cdot)$, for debtor households as for creditor households. Strongest results are obtained when $U(\cdot)$ exhibits constant relative risk aversion and the second-period production function is Cobb-Douglas with constant returns to scale, so that labor and capital income are proportional to aggregate output. Whether the period 1 real income of creditors, $y(1)$, is endogenous or exogenous is inconsequential. It's easiest to assume that it's exogenous.

Each creditor household chooses how much to lend, D, and invest, k, in period 1. In period 2, it decides how much labor, h,

[12] This assumption eliminates the Chari-Kehoe (1999) tax-smoothing argument for price-level variation.

to hire from debtor households. Formally, each creditor household chooses D, k, and h to maximize

$$U(c_1(1)) + \rho EU(c_1(2)) = U(y(1) - D - k) + \rho EU(y(2) - wh - g_1 + DR/\pi),$$

where w is the period 2 real wage, g_1 represents lump-sum taxes levied on each creditor household, and period 2 output is governed by a constant-returns-to-scale production function that satisfies the Inada conditions and is subject to an aggregate productivity shock, a:

$$y(2) = af(k, h). \tag{13}$$

Neither w, nor g_1, nor a is revealed until period 2. Whether π is known in period 1 depends on the conduct of monetary policy. First-order conditions for D, k, and h are as follows:

$$U'(c_1(1)) = R\rho E[U'(c_1(2))/\pi], \tag{14a}$$

$$U'(c_1(1)) = \rho E[af_k U'(c_1(2))], \tag{14b}$$

and

$$af_h = w. \tag{14c}$$

The first of these conditions is the analog of equation (5), above. Absent uncertainty, it would equate the marginal rate of substitution between current and future consumption to the real interest rate. Absent uncertainty, the second condition would equate this same marginal rate of substitution to the marginal product of capital. The third condition simply says that the creditor household hires labor up to the point where its marginal product equals the real wage.

Each debtor household chooses how much to borrow in period 1 and how many hours, h, to work in period 2, in order to maximize

$$U(c_2(1)) + \rho E[U(c_2(2)) - \eta V(h)] = U(D) + \rho E[U(wh - g_2 - DR/\pi) - \eta V(h)],$$

where g_2 represents lump-sum taxes levied on each debtor household, and $\eta > 0$ is a preference shock common to all borrowers. The disutility of work is assumed to increase at an increasing rate ($V' > 0$ and $V'' > 0$). Households know the realizations of w, g_2, η, and π when they choose their hours. First-order conditions for debt and hours take the form

$$U'(c_2(1)) = R\rho E[U'(c_2(2))/\pi] \tag{15a}$$

and

$$\eta V'(h)/U'(c_2(2)) = w, \tag{15b}$$

respectively. The first condition is the analog of equation (6). Absent uncertainty, it would require that the marginal rate of substitution between current and future consumption equal the real interest rate. The second condition requires that the marginal rate of substitution between leisure and consumption equal the real wage.

As in section 2, above, efficient risk sharing requires that intertemporal marginal rates of substitution be equal across households regardless of the realized state of the world. The marginal rates of substitution for creditors and debtors are given by

$$U'(c_1(1))/[\rho U'(c_1(2))] = RE[U'(c_1(2))/\pi]/U'(c_1(2)) \tag{16a}$$

and

$$U'(c_2(1))/[\rho U'(c_2(2))] = RE[U'(c_2(2))/\pi]/U'(c_2(2)), \tag{16b}$$

respectively, where equations (14a) and (15a) have been used to replace $U'(c_1(1))$ and $U'(c_2(1))$. At issue are the circumstances under which the right-hand sides of these expressions will be equal to each other across all possible realizations of the shocks that hit the economy in period 2. As above, meeting this condition requires that the second-period consumption of debtors and creditors move together: If debtors enjoy unusually high period 2 consumption, so should creditors, and vice versa. In the constant-relative-risk-aversion case $[U(c) = (c^{1-\alpha} - 1)/(1 - \alpha)]$, equations (16a) and (16b) imply, more specifically, that the period 2 consumption of creditors must be proportional to that of debtors for efficient risk sharing.[13] The analysis that follows seeks the monetary policy that satisfies this proportionality requirement, taking the total size of government, $g \equiv g_1 + g_2$, as exogenously given and assuming that taxes are distributed across creditors and debtors in proportion to their (non-interest) incomes. Time indices are dropped for convenience, as the focus is entirely on period 2.

4.2 Using Monetary Policy to Achieve Efficient Risk Sharing

Suppose that the production function in equation (13) is Cobb-Douglas:

$$y = ak^{1-\theta}h^{\theta}, \tag{13'}$$

with $0 < \theta \leq 1$. Suppose, also, that the burden of government falls on capital (creditors) and labor (debtors) in proportion to their shares of national income, so that $g_1 = (1-\theta)g$ and $g_2 = \theta g$. Then, simple algebra establishes that

$$c_1 = y - wh - g_1 + DR/\pi = (1-\theta)c + DR/\pi \tag{17a}$$

and

$$c_2 = wh - g_2 - DR/\pi = \theta c - DR/\pi, \tag{17b}$$

where $c \equiv y - (g_1 + g_2) = y - g$ is the amount of period 2 output that is available for household consumption. If the inflation rate, π, is set in advance, so that real value of period 2 debt repayments is independent of the realized state of the world, then equations (17a) and (17b) are clearly inconsistent with efficient risk sharing: c_1 varies

[13]The proof is essentially the same as that provided in section 2 above. (See equation (3) and the accompanying discussion.) Equate the right-hand sides of (16a) and (16b) to impose the risk-sharing condition and recognize that $c_1(2) + c_1(2) = y(2) - (g_1 + g_2) \equiv c(2)$. Log-differentiate these two equations to get $dc_1(2)/c_1(2) = dc_2(2)/c_2(2) = dc(2)/c(2)$.

less than in proportion to c, while c_2 varies more than in proportion to c. Too much risk is borne by debtors, too little by creditors.[14]

Risk sharing is efficient if, instead of targeting the inflation rate, the monetary authority targets period 2 nominal consumption: $\pi c = n^*$ for an arbitrary pre-announced nominal consumption target, n^*.[15] Equations (17a) and (17b) in this case become

$$c_1 = (1-\theta)c + DR/\pi = (1 - \theta + DR/n^*)c \tag{17$'$a}$$

and

$$c_2 = \theta c - DR/\pi = (\theta - DR/n^*)c. \tag{17$'$b}$$

The period 2 consumption of the representative creditor is now proportional to the period 2 consumption of the representative debtor, as required for efficient risk sharing. Creditors' share of aggregate consumption is equal to capital's share of national income plus debt obligations as a share of aggregate consumption. Debtors' share of aggregate consumption equals labor's share of national income less debt obligations as a share of aggregate consumption.

5. Implications

The above analysis has implications for credit rationing, for policy and policy evaluation, and for empirical assessments of nominal debt's recession role.

As previously noted, there is no risk of bankruptcy in response to aggregate output shocks if the monetary authority fixes nominal

[14] In principle, a tax policy that increases or decreases levies on debtors relative to those on creditors as aggregate consumption surprises either to the upside or to the downside can be used to improve this risk distribution. In particular, an efficient risk allocation is achieved, despite strict inflation targeting, if $g_1 = (1-\theta)g - (c - Ec)DR/(\pi^* Ec)$ and $g_2 = \theta g + (c - Ec)DR/(\pi^* Ec)$, where π^* is the pre-announced inflation rate and c is the economy-wide average of $y - g$ (which will be exogenous to each individual household if the economy is atomistic). The policy requires that taxes be adjusted more promptly in response to aggregate shocks than seems plausible in the real world.

[15] Note that the period 2 real purchasing power of the dollar is $1/\pi = c/n^*$, so that if the central bank wants to stabilize the expected purchasing power of the dollar, it should set $n^* = Ec$.

income in advance, whereas bankruptcy is a real possibility under an inflation or price-level target.[16] This result suggests that real-world credit limits will depend on the policy rule that lenders believe has been adopted by the monetary authority.

On policy, the above analysis indicates that insofar as risk sharing is an important consideration, central banks ought to minimize nominal income surprises—where a "surprise" is any movement not anticipated when current nominal debt contracts were negotiated.[17] Variants of nominal income targeting that try to stabilize income *forecasts* (Hall and Mankiw 1994) do not meet this criterion. Variants that make the nominal income target contingent on recent information will also be unsatisfactory from a risk-sharing perspective. Policies that seek to stabilize short-horizon income *growth*, because they make the current target income level contingent on a recent income realization, fall into this category. Also in this category are policies that make the current target income level or growth rate contingent on the latest estimates of the amount of slack in the economy (Hall 1984; McCallum and Nelson 1999a). Rules that depend on the deviation of output from trend output may allocate risk well, however, if the estimated trend is not sensitive to recent data.[18]

[16] Although in light of section 4 it would be more accurate to speak of fixing nominal *consumption* in advance, I will stick with the more commonly used "nominal income" terminology.

[17] Doepke and Schneider (2006a) document that the average duration of nonfinancial, private-sector nominal liabilities is on the order of five years. To facilitate efficient risk sharing, the Federal Reserve would need to commit to a target path for nominal income extending out at least that far.

[18] For example, a rule which requires that the central bank equate period t nominal income, $n(t) \equiv p(t) + y(t)$, to $n^*(t) = p(t-T) + T\pi^* + E_{t-T}y^*(t)$—where $p(t)$ and $y(t)$ are the logarithms of the price level and output at time t, π^* is the desired long-run inflation rate, $y^*(t)$ is the log of time t potential output, and E_{t-T} is the mathematical expectation conditional on information at $t-T$—will allocate risk efficiently provided that T is sufficiently large. In practice, the central bank would presumably set the real short-term interest rate at a relatively high level if, and only if, income is above target—i.e., if and only if

$$[p(t) - p(t-T) - T\pi^*] + [y(t) - E_{t-T}y^*(t)] > 0.$$

The only difference between this rule for setting the policy rate and a standard Taylor rule is that the latter sets $T = 1$. For a more complete discussion, see Koenig (2012).

Similarly, policy rules that depend on realized growth in the price level and/or output may be acceptable if growth is calculated over a sufficiently long horizon. The point is that there is a fairly wide variety of policy rules consistent with efficient risk sharing: Nominal income targeting need not mean "setting and forgetting" a target income path.

Most simulation studies ignore the role that monetary policy plays in allocating risk, so their conclusions about the relative performance of alternative policy rules are suspect.[19] In economies with nominal debt contracts, importantly, it is not just price and output variability that matter for performance (as is assumed in "Taylor-curve" analysis), but also the correlation between price and output fluctuations.[20]

Finally, several commentators have expressed skepticism about the significance of debt deflation's role in the 2008-09 "Great Recession" based on the relatively small decline in inflation over the course of the downturn.[21] This note has argued, though, that the financial stress resulting from fixed nominal debt obligations is due as much to adverse real-income shocks as it is to adverse inflation shocks: Fisher's "debt-deflation" story is incomplete. Although the role of debt deflation *narrowly defined* may have been limited in the Great Recession, financial strain placed on borrowers as a result of fixed nominal debt may, nevertheless, have contributed substantially to the downturn's severity. Support for this proposition comes from Mian, Rao, and Sufi (2011), where it is shown that U.S. counties in which the pre-Great Recession household debt/income ratio was high have experienced especially large increases in loan default rates and especially large decreases in a wide variety of categories of consumption: Aggregate output risk has been borne mostly by debtors.

[19] Examples of simulation studies to which this criticism applies include (among many others) McCallum and Nelson (1999b) and Rudebusch (2002).

[20] Suitable frameworks for evaluating policy are now in development (e.g., Christiano, Motto, and Rostagno 2010), but I am not aware of any attempts to apply them for this purpose.

[21] See Eichenbaum (2011) and Hall (2011). Similarly, based on the timing of declines of output and prices, Carlstrom and Fuerst (2001) argue that debt deflation explains little of the Great Depression.

6. Suggestive Evidence

If the story told here is correct, there ought to be a stronger negative relationship between nominal income growth surprises and financial stress indicators than there is between price growth surprises and financial stress indicators. Consistent with this expectation, a regression of the five-quarter change in the loan delinquency rate for commercial banks on nominal GDP growth and inflation surprises yields the following results:

$$\begin{array}{lll} \Delta\delta = -0.381(\Delta n - \Delta n^e) & + 0.105(\pi - \pi^e) & \text{Adj. } R^2 = 0.411 \\ \qquad\quad (0.094) & \qquad (0.164) & S.E. = 0.810 \end{array}$$

over a 1985:Q1–2010:Q4 sample. Here $\Delta\delta$ is the five-quarter change in the delinquency rate, $(\Delta n - \Delta n^e)$ is actual five-quarter nominal GDP growth less median expected growth from the Survey of Professional Forecasters (SPF), and $(\pi - \pi^e)$ is actual five-quarter GDP inflation less median SPF expected growth.[22] Newey West-corrected standard errors are reported in parentheses. One cannot reject the hypothesis that inflation surprises matter only insofar as they result in unexpected nominal GDP growth. Thus, the coefficient on inflation surprises has a P value of 0.523, while the coefficient on nominal GDP growth surprises has a P value of 0.0001.[23] Admittedly, the above regression could be subject to simultaneity bias.[24]

7. Concluding Remarks

If there are complete markets in contingent claims, so that agents can insure themselves against fluctuations in aggregate output and

[22] Delinquency data back to 1985:Q1 are available on the Board of Governors' web site. SPF data are available on the web site of the Federal Reserve Bank of Philadelphia. The longest SPF forecast horizon consistently available extends five quarters beyond the most recent official GDP estimate available to forecasters.

[23] Similar results are obtained using the "junk bond spread" or the "excess bond premium" in place of changes in the loan delinquency rate. Movements in the junk bond spread reflect changes in the default risk on lower-quality bonds (Gertler and Lown 1999; Mody and Taylor 2003). The excess bond premium is a new measure of the price of bond market risk developed from micro-level data by Gilchrist and Zakrajsek (2012).

[24] This caveat does not apply to the aforementioned study by Mian, Rao, and Sufi (2011), which uses instrumental-variable estimation.

the price level, then “money is a veil” as far as the allocation of risk is concerned: It doesn’t matter whether or not the monetary authority allows random variation in the price level or nominal value of output. If such insurance is *not* available, monetary policy will affect the allocation of risk. When debt obligations are fixed in nominal terms, a price-level target eliminates one source of risk (price-level shocks) but shifts the other risk (real-output shocks) disproportionately onto debtors. A more balanced risk allocation is achieved by allowing the price level to move opposite to real output. To illustrate the argument, an example is presented in which the risk allocation achieved by a nominal spending target reproduces exactly the allocation observed with complete capital markets. Empirically, measures of financial stress are more strongly related to nominal GDP surprises than to inflation surprises. These theoretical and empirical results cast doubt on the debt-deflation argument for a pre-announced price-level target or strict inflation target. More generally, they caution against evaluating alternative monetary policy rules using representative agent models that have no meaningful role for debt.

Appendix. Complete Analysis of the Two-State, Log-Utility Case

With $\mathrm{U}(c) = U(c) = \log(c)$, the contingent-claims equilibrium for an economy with two possible second-period output levels (y_L and $y_H > y_L$) takes the following form:

Equilibrium with Complete Contingent Claims

$$
\begin{array}{lll}
q_L = y_L/(1+\rho) & q_H = y_H/(1+\rho) & \\
s_L = \rho p_L y(1)/y_L & s_H = \rho p_H y(1)/y_H & \\
c_1(1) = y(1)/(1+\rho) & c_1(2) = y_L/(1+\rho) & \text{if } y(2) = y_L \\
 & \qquad\;\; = y_H/(1+\rho) & \text{if } y(2) = y_H \\
c_2(1) = y(1)\rho/(1+\rho) & c_2(2) = y_L\rho/(1+\rho) & \text{if } y(2) = y_L \\
 & \qquad\;\; = y_H\rho/(1+\rho) & \text{if } y(2) = y_H.
\end{array}
$$

(See equation (4) and table 2 in the main text, with $\alpha = 1$.) Exactly the same equilibrium output allocation is achievable with nominal debt contracts, provided that the monetary authority targets nominal income:

Equilibrium with Nominal Debt and a Nominal Income Target

$D = y(1)\rho/(1+\rho)$	$R/\pi = (1/\rho)[y_L/y(1)]$	if $y(2) = y_L$
	$= (1/\rho)[y_H/y(1)]$	if $y(2) = y_H$
$c_1(1) = y(1)/(1+\rho)$	$c_1(2) = y_L/(1+\rho)$	if $y(2) = y_L$
	$= y_H/(1+\rho)$	if $y(2) = y_H$
$c_2(1) = y(1)\rho/(1+\rho)$	$c_2(2) = y_L\rho/(1+\rho)$	if $y(2) = y_L$
	$= y_H\rho/(1+\rho)$	if $y(2) = y_H$.

(See table 4 and equations (7) and (8) in the main text, with $\alpha = 1$.)

With nominal debt and a price-level target ($\pi = \pi^* \equiv 1$), table 2 and equation (5) imply the following, provided that output fluctuations are not so large as to trigger debtor bankruptcy:

Equilibrium with Nominal Debt and a Price-Level Target: No-Bankruptcy Case

$D = y(1)\rho/(1+\rho)$	$R = DR(1+\rho)/[y(1)\rho]$	
$c_1(1) = y(1)/(1+\rho)$	$c_1(2) = DR$	
$c_2(1) = y(1)\rho/(1+\rho)$	$c_2(2) = y_L - DR$	if $y(2) = y_L$
	$= y_H - DR$	if $y(2) = y_H$.

Here, DR is the solution to the equation

$$DR = (1/\rho)(y_L - DR)(y_H - DR)/[p_H(y_L - DR) + p_L(y_H - DR)]. \tag{18}$$

Note that $(y_H - DR) > p_H(y_L - DR) + p_L(y_H - DR) > (y_L - DR)$. Substitute into the denominator of equation (18) to obtain

$$y_L/(1+\rho) < DR < y_H/(1+\rho). \tag{19}$$

The fixed second-period consumption of creditors is an average of what they would have consumed in an economy with complete markets. Output risk is borne entirely by debtors. Equivalently,

$$(1/\rho)[y_L/y(1)] < R < (1/\rho)[y_H/y(1)]. \tag{20}$$

The equilibrium interest rate in the no-bankruptcy case is a compromise between the ex post real rates observed under nominal income targeting.

Bankruptcy will be a non-issue if debtors always have enough period 2 income to meet their obligations. Since $y_H/(1+\rho) > DR$ in an economy with nominal debt and a price-level target, to rule out bankruptcy it is sufficient that $y_L \geq y_H/(1+\rho)$. If, however, output fluctuations are large enough that bankruptcy can't be ruled out, we must turn to equations (9) and (10′) in the main text to find the economy's equilibrium:

Equilibrium with Nominal Debt and a Price-Level Target: Contingent Bankruptcy

$$
\begin{array}{lll}
D = y(1)\rho/(1+\rho) & R = (1/\rho)[y_H/y(1)][(1+\rho)/(1+\rho p_H)] & \\
c_1(1) = y(1)/(1+\rho) & c_1(2) = y_L - \beta & \text{if } y(2) = y_L \\
 & \quad\;\; = y_H/(1+\rho p_H) & \text{if } y(2) = y_H \\
c_2(1) = y(1)\rho/(1+\rho) & c_2(2) = \beta & \text{if } y(2) = y_L \\
 & \quad\;\; = y_H[\rho p_H/(1+\rho p_H)] & \text{if } y(2) = y_H.
\end{array}
$$

For any given first-period income, $y(1)$, the level of debt is the same as in the nominal income targeting and no-bankruptcy cases already examined. However, creditors must now be compensated for default risk, so the equilibrium interest rate is higher than in these cases for any given $y_H/y(1)$. As a result, the fraction of output that goes to creditors in the good state is too large to be consistent with efficient risk sharing.

Summary

Risk is inefficiently allocated in an economy with simple nominal debt contracts and price-level targeting. If output variation is small enough that debtors always have the means to meet their obligations, then creditors are excessively insulated from output risk while the consumption of debtors is excessively sensitive to output. If output variation is large, then debtors may be forced into bankruptcy in the event of a poor output realization. The fact that each debtor's consumption in the bankruptcy state is independent of his level of indebtedness encourages overborrowing and drives up equilibrium debt and/or the equilibrium interest rate. As a result, there is a larger-than-efficient transfer to creditors when bankruptcy *fails* to occur.

References

Bernanke, B. S. 1995. "The Macroeconomics of the Great Depression: A Comparative Approach." *Journal of Money, Credit and Banking* 27 (1): 1–28.

———. 2003. "Some Thoughts on Monetary Policy in Japan." Speech before the Japan Society of Monetary Economics, Tokyo, May 31.

Bernanke, B. S., M. Gertler, and S. Gilchrist. 1999. "The Financial Accelerator in a Quantitative Business Cycle Framework." In *Handbook of Macroeconomics,* ed. J. B. Taylor and M. Woodford, 1341–93. Amsterdam: Elsevier.

Bohn, H. 1988. "Why Do We Have Nominal Government Debt?" *Journal of Monetary Economics* 21 (1): 127–40.

———. 2009. "Intergenerational Risk Sharing and Fiscal Policy." *Journal of Monetary Economics* 56 (6): 805–16.

Carlstrom, C. T., and T. S. Fuerst. 2001. "Perils of Price Deflations: An Analysis of the Great Depression." *Economic Commentary* (Federal Reserve Bank of Cleveland) (February 15).

Chari, V. V., and P. J. Kehoe. 1999. "Optimal Fiscal and Monetary Policy." In *Handbook of Macroeconomics,* Vol. 1, ed. J. B. Taylor and M. Woodford, 1671–1745 (chapter 28). Elsevier Science B.V.

Christiano, L., R. Motto, and M. Rostagno. 2010. "Financial Factors in Economic Fluctuations." ECB Working Paper No. 1192 (May).

Crawford, A., C. A. Meh, and Y. Terajima. 2009. "Price-Level Uncertainty, Price-Level Targeting, and Nominal Debt Contracts." *Bank of Canada Review* (Spring): 31–41.

Doepke, M., and M. Schneider. 2006a. "Inflation and the Redistribution of Nominal Wealth." *Journal of Political Economy* 114 (6): 1069–97.

———. 2006b. "Inflation as a Redistribution Shock: Effects on Aggregates and Welfare." NBER Working Paper No. 12319.

Eagle, D. M., and D. L. Domian. 2005a. "Quasi-Real Indexing: The Pareto-Efficient Solution to Inflation Indexing." Unpublished Manuscript, Eastern Washington University.

———. 2005b. "Sounding the Alarm on Inflation Targeting and Indexing." Unpublished Manuscript, Eastern Washington University.

Eggertsson, G. B., and P. Krugman. 2011. "Debt, Deleveraging, and the Liquidity Trap: A Fisher-Minsky-Koo Approach." Unpublished Working Paper (February 14).

Eichenbaum, M. 2011. "Discussion of Eggertsson and Krugman's 'Debt, Deleveraging, and the Liquidity Trap'." Paper presented at the Federal Reserve Bank of San Francisco conference on Monetary Policy at the Zero Lower Bound, February 25.

Fisher, I. 1933. "The Debt-Deflation Theory of Great Depressions." *Econometrica* 1 (4): 337–57.

Gertler, M., and N. Kiyotaki. 2010. "Financial Intermediation and Credit Policy in Business Cycle Analysis." In *Handbook of Monetary Economics,* ed. B. Friedman and M. Woodford, 547–99. Amsterdam: Elsevier.

Gertler, M., and C. Lown. 1999. "The Information in the High-Yield Bond Spread for the Business Cycle: Evidence and Some Implications." *Oxford Review of Economic Policy* 15 (3): 132–50.

Gilchrist, S., and E. Zakrajsek. 2012. "Credit Spreads and Business Cycle Fluctuations." *American Economic Review* 102 (4): 1692–1720.

Guerrieri, V., and G. Lorenzoni. 2011. "Credit Crises, Precautionary Savings, and the Liquidity Trap." Unpublished Working Paper (October).

Hall, R. E. 1984. "Monetary Strategy with an Elastic Price Standard." In *Price Stability and Public Policy.* Proceedings of the Economic Policy Symposium sponsored by the Federal Reserve Bank of Kansas City in Jackson Hole, Wyoming, August 2–3.

———. 2011. "Discussion of Eggertsson and Krugman's 'Debt, Deleveraging, and the Liquidity Trap'." Paper presented at the Federal Reserve Bank of San Francisco conference on Monetary Policy at the Zero Lower Bound, February 25.

Hall, R. E., and N. G. Mankiw. 1994. "Nominal Income Targeting." In *Monetary Policy*, ed. N. G. Mankiw, 71–93. Chicago: University of Chicago Press for the NBER.

Kiyotaki, N., and J. Moore. 1997. "Credit Cycles." *Journal of Political Economy* 105 (2): 211–48.

Koenig, E. F. 2012. "All in the Family: The Close Connection Between Nominal-GDP Targeting and the Taylor Rule." *Staff Papers* (Federal Reserve Bank of Dallas) No. 17 (March).

Lacker, J. M. 1991. "Why Is There Debt?" *Economic Review* (Federal Reserve Bank of Richmond) (July/August): 3–19.

Lustig, H., C. Sleet, and S. Yeltekin. 2008. "Fiscal Hedging with Nominal Assets." *Journal of Monetary Economics* 55 (4): 710–27.

McCallum, B. T., and E. Nelson. 1999a. "Nominal Income Targeting in an Open-Economy Optimizing Model." *Journal of Monetary Economics* 43 (3): 553–78.

———. 1999b. "Performance of Operational Policy Rules in an Estimated Semi-Classical Structural Model." In *Monetary Policy Rules,* ed. J. B. Taylor, 15–45. Chicago: University of Chicago Press for the NBER.

Mian, A., K. Rao, and A. Sufi. 2011. "Household Balance Sheets, Consumption, and the Economic Slump." Unpublished Manuscript, University of Chicago Booth School of Business.

Midrigan, V., and T. Philippon. 2011. "Household Leverage and the Recession." Unpublished Working Paper (April).

Mody, A., and M. P. Taylor. 2003. "The High-Yield Spread as a Predictor of Real Economic Activity: Evidence of a Financial Accelerator for the United States." *IMF Staff Papers* 50 (3): 373–402.

Rudebusch, G. D. 2002. "Assessing Nominal Income Rules for Monetary Policy with Model and Data Uncertainty." *Economic Journal* 112 (479): 402–32.

Sheedy, K. D. 2012. "Debt and Incomplete Financial Markets: A Case for Nominal GDP Targeting." Unpublished Manuscript, London School of Economics.