Fiscal-Monetary Interactions in the 2020's: Some Insights from HANK Models*

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Abstract

I summarize insights from heterogeneous-agent New Keynesian (HANK) models on the interaction between fiscal and monetary policy, with a focus on the macroeconomic experience of the early 2020s. I highlight three features of HANK economies—heterogeneous marginal propensities to consume, the failure of Ricardian equivalence, and an upward-sloping steady-state asset supply curve—that alter how fiscal and monetary forces interact relative to representative-agent models. I discuss two domains of policy: the effects of fiscal stimulus on inflation and the price level, and the fiscal consequences of changes in nominal interest rates. I illustrate these mechanisms in the context of the Covid pandemic by presenting simulations from the calibrated HANK model in Kaplan and Miyahara (2025), which evaluates counterfactual scenarios for the United States for output, inflation, and the price level under alternative policy responses. The analysis underscores that monetary and fiscal policy are inescapably intertwined, and that HANK models provide a useful framework for quantifying these interactions.

JEL Codes: E2, E3, E4, E5, E6

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1 Introduction

Heterogeneous-agent New Keynesian (HANK) models are dynamic stochastic general equilibrium (DSGE) models that combine households who face idiosyncratic income risk and incomplete financial markets with firms that face nominal rigidities in the form of sticky prices or wages. Today, these models represent the research frontier for analyzing monetary and fiscal policy. This note summarizes some insights from HANK models pertaining to the interaction between fiscal and monetary policy that are relevant to the macroeconomic experience of the United States and other countries during the first half of the 2020's.

First, in Section 2, I summarize three features of household spending behavior that underpin the different ways that monetary and fiscal policy interact in HANK models, compared with their representative agent (RANK) counterparts: (i) heterogeneity in marginal propensities to consume (MPCs); (ii) failure of Ricardian equivalence; and (iii) an upward-sloping steady-state supply curve for assets. This section draws on Kaplan (2024), a longer talk I gave at the Reserve Bank of Australia and Treasury in 2024.

Second, in Sections 3 and 4, I discuss two specific policy areas where fiscal and monetary forces interact, and I explain how HANK models impart new lessons and reinforce some older lessons that are often forgotten. In Section 3, I describe the effects of funded and unfunded fiscal stimulus payments on inflation and the long-run price level. This is an example of how fiscal policy affects the central bank's ability to manage inflation. In Section 4, I describe the effects of a change in the nominal interest rate on inflation, and how the government budget constraint places restrictions on its short and long run effects. This is an example of how monetary policy affects the Treasury's fiscal position. This section draws on Kaplan (2025), which I prepared for the 2025 Econometric Society World Congress and in which I describe nine implications of fiscal-monetary interactions in HANK models.

Third, in Section 5, I illustrate how these forces played out in the context of the large shocks and policy responses to the Covid pandemic in the United States. I summarize quantitative experiments from Kaplan and Miyahara (2025), who use a quantitative HANK model to produce counterfactual simulations that answer the question: How would output, inflation and prices evolved in the US had monetary and fiscal policy acted differently over this period?

2 Relevant Features of HANK Models

HANK and RANK models differ in their assumptions about how households spend and save. I use the acronym HANK to refer to both flexible and sticky price versions of heterogeneous agent models, both for convenience and because the flexible price economy is the limit of the sticky price economy in which pricing frictions vanish. The terminology should be interpreted as reflecting the most recent incarnation of the class of macroeconomic models developed by Bewley (1986), Imrohoroğlu (1989), Huggett (1993) and Aiyagari (1994). Three aspects of these differences are especially relevant for the fiscal-monetary interactions that I discuss.

2.1 Heterogeneous marginal propensities to consume (MPCs)

Households in HANK models face uninsured idiosyncratic income risk and borrowing constraints, giving rise to a precautionary savings motive. This in turns leads to a consumption policy function that is concave in wealth. Low-wealth households, particularly those close to their borrowing constraint or with temporarily low income, have a high MPC, often near 100%, whereas high-wealth households have a low MPC that is similar in magnitude to the interest rate, as in a representative household model. In two-asset HANK models with both liquid and illiquid assets, it is primarily households' holdings of liquid wealth, rather than their total wealth, that determines their MPC out of small shocks. In equilibrium, this dependence of MPCs on wealth and income gives rise to a distribution of MPCs across the population, and an average MPC between these two extremes.[1]

There is overwhelming empirical evidence for such heterogeneity in MPCs. Studies of fiscal stimulus payments and other income shocks routinely estimate quarterly average MPCs of around 20%-40%, together with substantial heterogeneity that correlates with liquid wealth.[2] The data also reveal that a sizable fraction of households (on the order of one-quarter to one-half) hold near-zero liquid wealth. These "hand-to-mouth" households, most of whom also hold non-trivial amounts of illiquid wealth (the "wealthy hand-to-mouth"), have high MPCs and do not respond much to interest rate changes.

2.2 Failure of Ricardian equivalence

Because of the precautionary savings motive and heterogeneous MPCs, HANK economies violate Ricardian equivalence. In a RANK model with infinitely lived households, the timing and distribution of lump-sum taxes or transfers does not matter for consumption. The representative household's spending depends only on the present value of net transfers. By contrast, in HANK models the timing and distribution of transfers do matter for spending. The timing of transfers matters because households with low wealth raise their spending in response to a lump sum transfer, even if it is compensated with an equivalent lower transfer in the future. The presence of a borrowing constraint or strong precautionary motive leads these households to act as if they had a shorter horizon than a representative household. The distribution of taxes and transfers matters because of heterogeneity in MPCs. Levying a lump-sum tax on a low-MPC household and transferring the proceeds to a high-MPC household raises aggregate consumption, even though such a policy is budget-neutral. A corollary is that even in the absence of distortionary taxation,

[1] See Kaplan and Violante (2022) for an overview of MPCs in heterogeneous agent economies.

[2] See Havranek and Sokolova (2020) for a meta-analysis of these empirical studies and cites therein.

the timing of deficits and the allocation of fiscal burdens across households influences aggregate spending.

2.3 Upward sloping steady-state asset supply curve

In RANK models, the only active savings motive is intertemporal substitution and hence the steady-state asset supply curve is perfectly elastic at $r = \rho$, where ρ is the household discount rate. At interest rates above ρ, the representative household accumulates an infinite amount of savings, and at interest rates below ρ, it dis-saves indefinitely. When $r = \rho$ the household is indifferent about the timing of its consumption and hence any level of assets is consistent with a steady state.

In HANK models, the steady-state asset supply curve is upward sloping, and so the steady-state real interest rate depends on all the features of the economy that affect asset supply and demand. The reason is that households' willingness to accumulate assets at a given interest rate is driven not only by intertemporal substitution, but also the strength of the precautionary motive. This in turn depends on the degree of uninsured idiosyncratic risk, the tightness of borrowing constraints and their level of wealth. As wealth rises, the precautionary motive becomes weaker, leading to a steady-state asset supply curve that, in typical calibrations, increases smoothly in the interest rate and approaches infinity as the interest rate approaches the rate of time preference. I denote the steady-state real asset supply curve as $\mathbf{a}(r)$.[3]

None of these features are unique to HANK models. For example, two-agent New Keynesian (TANK) models feature MPC heterogeneity(Galí et al., 2007; Bilbiie, 2008); overlapping generations (OLG) models violate Ricardian equivalence (Aguiar et al., 2023; Angeletos et al., 2024); bonds-in-utility (BIU) models feature an upward sloping steady-state asset supply curve (Kaplan et al., 2023). Other classes of models that exhibit some or all of these features include those with learning (Eusepi and Preston, 2018) and monetarist models (Bassetto and Cui, 2018).

2.4 Asset market clearing and the Government Budget Constraint

In both HANK and RANK models without capital, the asset market clearing condition equates the real value of outstanding government debt to the aggregate assets of households,

$$\mathbf{a}(r) = \mathbf{b}(r, \dots), \tag{1}$$

where $\mathbf{b}(r, \dots)$ is the steady-state issuance of government debt (the asset "demand" curve), which in the simplest HANK models is determined by fiscal and monetary policy. Changes in the economy that affect the degree of uninsured risk or the strength of the precautionary motive change the

[3] I refer to this as a "supply" curve, rather than a "demand" curve because that is the tradition following Aiyagari (1994) who modeled households as "supplying" capital and firms as "demanding" capital. However, I acknowledge that in a model where households hold government debt, it might be more appropriate to label this as a "demand" curve for government debt. In any case, this is just language with no substantive implications.

amount of assets that households are willing to hold at a given interest rate and lead to shifts in the steady-state asset supply curve $\mathbf{a}(r)$. The steady-state real interest rate, which is sometimes referred to as the "natural" interest rate, therefore depends on both the features of the economy that affect the degree of precautionary savings, as well as the shape of the asset demand curve, $\mathbf{b}(r, \dots)$. In contrast, in RANK models, if a steady-state exists, then the natural interest rate is always equal to ρ, regardless of other features of the economy.

In benchmark HANK models it is usually assumed that households hold government bonds directly. However, this need not be the case, and it is not in reality. Households hold deposits in financial institutions which use them to issue loans to firms, other households, and the government. Most government bonds are held by financial institutions. As long as it is modeled as being competitive, with a fixed intermediation cost, the financial sector is a veil that can be safely ignored in the model.[4]

The government budget constraint is

$$\dot{b}_t = r_t b_t - s_t, \tag{2}$$

where b_t is the real value of outstanding debt, r_t is the real interest rate and s_t is the real value of the primary surplus. So, if a steady-state exists, then the level of debt in that steady state must be related to the real rate and primary surplus as

$$b^* = \frac{s^*}{r^*} \tag{3}$$

For example, if a government follows a fixed surplus rule that sets $s_t = \bar{s}$, then the asset market clearing condition is

$$\mathbf{a}(r^*) = \frac{\bar{s}}{r^*}. \tag{4}$$

In a HANK model with a fixed surplus, the steady-state equilibrium interest rate r^* is the one that satisfies equation (4). The same equations hold in the corresponding RANK model, but since the supply curve $\mathbf{a}(r^*)$ is perfectly elastic at $r = \rho$, the equilibrium real rate is $r^* = \rho$.

2.5 Positive Government Debt

In reality governments do issue debt, and for almost all developed countries, its steady-state level is positive so $b^* > 0$. Moreover, in reality households do hold positive amounts of liquid safe assets

[4] Although households hold many other types of assets besides government bonds, and governments borrow from many other lenders besides domestic households, it happens that the aggregate amount of liquid wealth held by US households is roughly the same as the level of US government debt. Equating the two is not a bad approximation as a calibration of simple one-asset HANK models, justifying the use of the market clearing condition (1). Richer models, however, incorporate many of these other sources of asset demand and supply.

in the aggregate so $\mathbf{a}(r^*) > 0$. It follows that in any empirically plausible HANK model, the steady-state level of government debt is non-zero.

This simple observation has an important implication: the full consequences of the government budget constraint (2) must be brought to bare on the economy. One cannot subvert its effects by appealing to an economy with zero government debt as is often done in RANK models, or to a version of a HANK model where, in equilibrium, aggregate wealth is zero (sometimes referred to as a "zero liquidity" limit). While such simplifications are often amenable to analytic results, they are not useful for studying questions whose answers depend on fiscal-monetary interactions.

Some historical background is useful for context. The interconnectedness of fiscal and monetary policy has a long intellectual history, which in the context of modern macroeconomic models with rational expectations, dates back to Sargent (1981),Sargent and Wallace (1981), Sargent and Wallace (1982) and Wallace (1981).[5] The implications of the government budget constraint for flexible price economies were developed further by Leeper (1991), Sims (1994),Woodford (1995) and Cochrane (1998), and these insights have since been extended to sticky price New Keynesian economies, starting with Davig and Leeper (2007), Sims (2011) and Cochrane (2011). However, starting in the 1990s, many of the insights in these and related papers were overlooked or ignored by large parts of the policy and research profession, particularly in regard to the study of business cycles and short-run stabilization policy. This occurred in part because the version of the RANK model proposed by Woodford (2003) and Galí (2008) became widely adopted as the standard framework for analyzing monetary and fiscal stabilization policy. That version of the RANK model makes a series of assumptions that reduce the importance of the government budget constraint and nullify many of these earlier insights. The most important of those assumptions are the combination of (i) Ricardian equivalence and (ii) passive fiscal policy, in the language of Leeper (1991). An example of such a passive fiscal rule is one in which the government raises primary surpluses through non-distortionary lump-sum taxation and sets surpluses s_t to satisfy

$$s_t = \bar{s} + \phi\left(b_t - \bar{b}\right) \tag{5}$$

with $\phi > r^*$. Such a fiscal rule, together with the representative agent assumption, implies that the steady-state level of debt $b^* = \bar{b}$ has no effect on the economy whatsoever and so one can assume $b^* = 0$ without loss of generality. As a result many of the implications of the government budget constraint no longer bite on the economy. But this is a very special case. In general, when Ricardian equivalence does not hold, as in HANK models, assuming $b^* = 0$ is not without restriction. Hence in everything that follows, I assume that the steady-state level of debt is positive, $b^* > 0$.

2.6 A Useful Integral Equation

Integrating the government budget constraint (2) forward in time from an initial condition $b_0 > 0$, yields an integral restriction on the joint time path of inflation, nominal rates and primary surpluses

[5] See Leeper and Leith (2016) and Cochrane (2023) for detailed discussion and literature reviews.

that turns out to be useful for understanding many of the results that follow,

$$\frac{b_0}{b_\infty} = \int_{t=0}^{\infty} \omega\left(t\right) e^{-\int_{j=0}^{t}\left(\hat{i}_j - \hat{\pi}_j\right)d\tau} e^{\hat{s}_j} dt, \tag{6}$$

where $\hat{i}_t$ and $\hat{\pi}_t$ are paths of deviations of nominal interest rates and inflation from steady-state, $\hat{s}_t$ are log deviations of the primary surplus from steady-state, and $\omega\left(t\right) := r^* e^{-r^* t}$ is a non-negative, decreasing weighting function that integrates to 1.[6] This equation holds in *any* equilibrium in which the economy starts at a steady-state with a non-zero level of real government debt, regardless of what type of fiscal and monetary rules are used to implement the equilibrium.

One can also integrate forward the log-linearized version of (2) to obtain an equivalent integral restriction that holds for small deviations from steady-state,

$$\log \frac{b_0}{b_\infty} = \int_{t=0}^{\infty} \omega\left(t\right) \left(\hat{\pi}_t - \hat{i}_t + \hat{s}_t\right) dt, \tag{7}$$

I will return to these equations and explain their implications for monetary-fiscal interactions below.

3 Lessons About Fiscal Stimulus

In this section I analyze the effects of a fiscal stimulus program in which the government issues an amount of new nominal debt equivalent in value to a fraction Δ of its outstanding debt, and uses the proceeds to make a one-time lump sum transfer to households. I assume that monetary policy holds the nominal rate constant throughout at $i_t = \bar{i}$.

3.1 Fiscal Stimulus Payments in RANK

Funded Fiscal Stimulus in RANK Assume first that the fiscal stimulus program is funded, in the sense that at the time of the transfer the government announces a plan to repay the new debt by raising future non-distortionary taxes, for example using a rule like in (5). Because of Ricardian equivalence, there is no effect on output, inflation or the price level. Households fully internalize that the costs of the additional future taxes exactly offset the initial stimulus payment and their present value budget constraint is left unchanged. So funded fiscal stimulus payments have no effect in RANK.

Unfunded Fiscal Stimulus in RANK Now assume that at the time of the transfer the government announces that it does *not* plan to repay the new debt and will keep the primary surplus

[6] Equation (6) assumes a positive steady-state real rate, $r^* > 0$. With $r^* < 0$ an analogous equation holds for any economy that returns to steady state, with similar implications.

unchanged from its steady-state level of $\bar{s}$. To understand the effects of this policy, it is useful to first consider a flexible price endowment economy. The amount of *nominal* debt immediately after the policy is $B_0 = B^* (1 + \Delta)$. Since prices are flexible, the real interest rate remains unchanged at ρ. And since the nominal rate is unchanged, the inflation rate is therefore unaffected by the policy and remains constant at $\bar{\pi} = \bar{i} - \rho$. Therefore the only possible change in the economy is a one-time jump in the price level.

To compute the size of the jump in the price level, note that the steady-state of the government budget constraint (3) requires that the real value of government debt is $b^* = \frac{\bar{s}}{\rho}$, and so is unaffected by the fiscal stimulus program. The present value government budget constraint is therefore the same before and after the change and is given by

$$b^* = \frac{B^*}{P^*} = \frac{B^* (1 + \Delta)}{P_0}, \tag{8}$$

where P_0 is the price level immediately after the stimulus. The effect of the stimulus is therefore an immediate jump in the price level of size Δ so that $P_0 = P^* (1 + \Delta)$, with no change in any real variables or inflation.

What about in a sticky price economy? With sticky prices the same forces manifest as an inflationary boom in which inflation temporarily rises above its steady state level, and the cumulative increase in the price level is close to Δ. To see why, set $\hat{i}_t = \hat{s}_t = 0$ in equation (7) (by assumption the nominal rate and primary surpluses are both unchanged by the policy). Since prices are sticky, there is no change in the price level on impact, and so the real value of debt immediately after the transfer is $b_0 = (1 + \Delta) b^*$. Moreover, because the economy returns to the same real steady-state, $b_\infty = b^*$ and so equation (7) implies

$$\log (1 + \Delta) \approx \int_{t=0}^{\infty} \omega (t) \hat{\pi}_t dt. \tag{9}$$

To relate this to the long-run increase in the price level, note that

$$\begin{aligned}
\frac{P_\infty}{P_0} &\approx 1 + \int_{t=0}^{\infty} \hat{\pi} (t) \, dt \\
&= 1 + \int_{t=0}^{\infty} \omega (t) \hat{\pi} (t) \, dt - \int_{t=0}^{\infty} [\omega (t) - 1] \hat{\pi} (t) \, dt \\
&= 1 + \log (1 + \Delta) - \int_{t=0}^{\infty} [\omega (t) - 1] \hat{\pi} (t) \, dt \\
&= 1 + \Delta - \varepsilon_1 - \varepsilon_2.
\end{aligned} \tag{10}$$

Equation (10) says that for small shocks, the cumulative increase in the long-run price level is approximately Δ. The first term in the approximation, $\varepsilon_1 := \Delta - \log (1 + \Delta)$ is the log approximation error and is negative. When inflation is declining monotonically over time, the second term in the approximation $\varepsilon_2 = \int_{t=0}^{\infty} [\omega (t) - 1] \hat{\pi} (t) \, dt$ is positive. In practice, for small shocks both discrepancies are small, and the cumulative price increase is well approximated by $1 + \Delta$.

3.2 Fiscal Stimulus Payments in HANK

Unfunded Fiscal Stimulus is More Inflationary in HANK In HANK models, there is an additional force that leads to more short-run inflation and, for large shocks, a larger cumulative increase in the price level. It arises because MPC heterogeneity leads to real redistribution.

As above, it useful to first consider the case of a flexible price, endowment economy. The stimulus program gives each household an additional amount of nominal resources ΔB^*. If the price level were to immediately jump to $P_0 = P^* (1 + \Delta)$ as it does in the RANK economy, then households with higher initial wealth than the average would suffer a fall in real wealth, and vice-versa. Intuitively, the stimulus program gives real resources to households in an additive way, but the rise in the price level takes real resources away from households in a multiplicative way. A household with the average wealth in the economy would be unaffected for the same reason that the representative agent is unaffected by the same experiment in a RANK model.

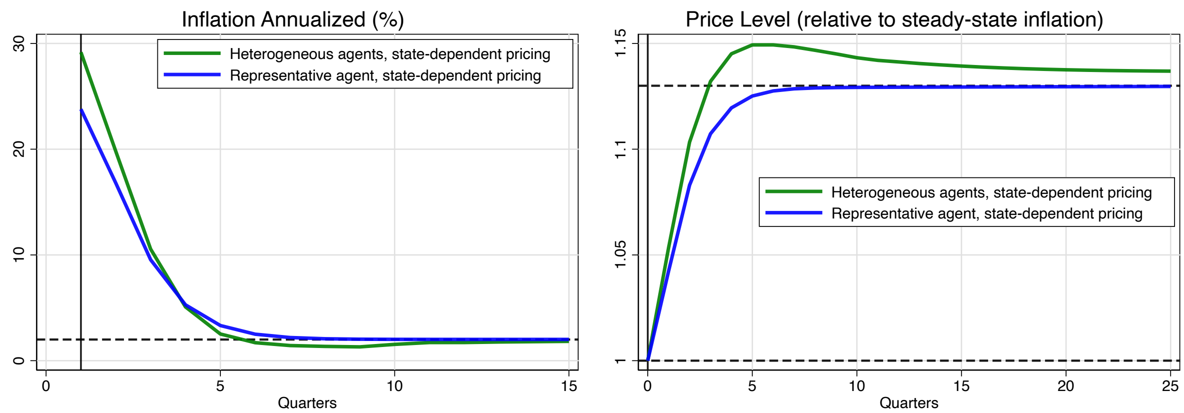
However, in a HANK model this would result in real redistribution from high-wealth households to low-wealth households. Moreover, because low-wealth households have higher MPCs than high-wealth households, overall spending would increase, putting additional upward pressure on the price level. For the goods market to clear, a period of higher real interest rates is required to offset this additional spending pressure. With no change in the nominal rate, the higher real rate comes about via lower future inflation, implying that the price level jumps higher on impact than in the representative agent economy.

With sticky prices, this higher initial price jump manifests as an overshooting of inflation in the immediate wake of the stimulus, followed by lower subsequent inflation. Figure 1, from Kaplan and Miyahara (2025), illustrates these different dynamics in response to a temporary increase in uniform lump-sum transfers roughly the size of that implemented in the US during Covid, in an economy with state-dependent pricing. The left panel shows that inflation is initially substantially higher in the HANK economy but then drops below the RANK economy. The right panel shows that the price level overshoots its long-run level. For a stimulus this size, the formula in equation (9) is not a good approximation to the long-run effect. The corresponding formula for large shocks is

$$1 + \Delta = \int_{t=0}^{\infty} \omega(t) \frac{P_t}{P_0} dt. \tag{11}$$

Equation (11) shows that a weighted average of cumulative price increases at all horizons equals the size of the stimulus Δ. The non-monotonic path of prices means that the the lower future inflation is not enough to offset the higher inflation early on, and the cumulative increase in the price level is larger than Δ.

Redistributive Fiscal Stimulus is Even More inflationary One implication of the real redistribution that arises with unfunded fiscal stimulus is that the specifics of how unfunded fiscal



(a) GDP, Heterogeneous Agents

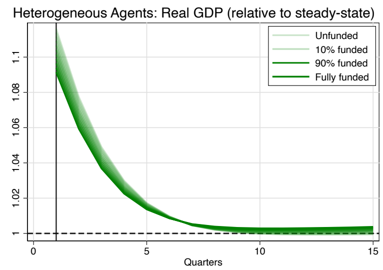
(b) Inflation, Heterogeneous Agents

Figure 1: From Kaplan and Miyahara (2025). Impulse response to an increase in uniform lump-sum transfers, equivalent to 13% of outstanding government debt. Model includes state-dependent pricing. .

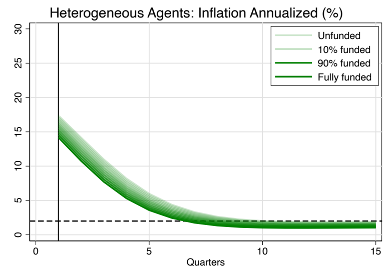
stimulus is targeted matters for the short-run inflation (and hence output) response in HANK. The more targeted are the transfers to households with high MPCs, the stronger is the additional upward pressure on spending and the more inflation and output rise in the short term. For the same reasons, even purely redistributive shocks that entail no change in debt or surpluses affect inflation.

Even Fully Funded Fiscal Stimulus is Inflationary In RANK models, fiscal stimulus payments that the government commits to eventually repay with higher non-distortionary taxes or lower transfers have no effect on either inflation or the real economy. But in HANK models the same policy can have substantial short-run effects on both inflation and the real economy. In plausibly calibrated versions, departures from Ricardian equivalence are large. The further in the future are the required fiscal adjustments, the stronger are the short-run effects on output and inflation, and for a fiscal rule with a sufficiently delayed increase in taxes, the short run effects of fully-funded stimulus approach those of unfunded stimulus. It follows that in HANK economies, very little can be learned from the short run response of output and inflation about the extent to which households and firms expect the government to eventually raise future surpluses versus allowing the additional debt to be inflated away.

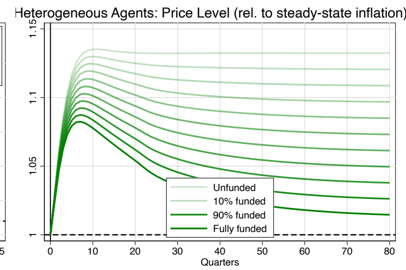
Figure 2, taken from Kaplan and Miyahara (2025), shows the output and inflation response to a uniform increase in lump-sum transfers equivalent to 13% of steady-state debt under different assumptions about the fraction of the stimulus that the fiscal authority intends to repay. The funded component is repaid by a reduction in lump-sum transfers that starts 5 years after the initial shock, and follows the surplus rule in equation (5). The figures show that even for fully funded stimulus programs there is a large short run effect on output and inflation in the HANK



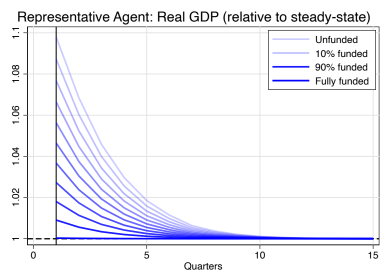
(a) GDP, Heterogeneous Agents



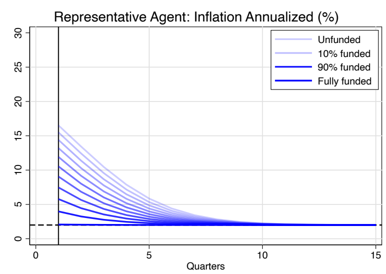
(b) Inflation, Heterogeneous Agents



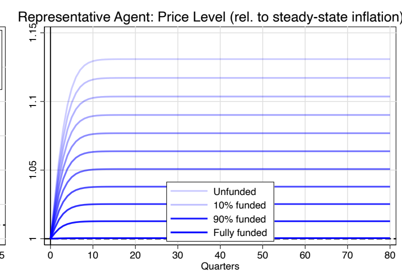
(c) Price level, Heterogeneous Agents



(d) GDP, Representative Agent



(e) Inflation, Representative Agent



(f) Price level, Representative agent

Figure 2: From Kaplan and Miyahara (2025). Impulse response to an increase in uniform lump-sum transfers, equivalent to 13% of outstanding government debt, for different degrees of funding in 10% increments from unfunded to fully funding. Funding is implemented by reductions in lump-sum transfers commencing after 5 years.

model, whereas there is no effect at all in the RANK model. However, the figures also reveal that the effect of the stimulus is temporary and is followed by a prolonged period of disinflation, as well as a recession when the debt starts being repaid. Although there is a permanent effect on prices, the long run effect on the price level is much smaller than the initial surge in inflation. It remains the case that the most important factor determining the long run impact of the fiscal stimulus on the price level is the extent to which it is funded.

4 Lessons About Monetary Policy

In this section I discuss the effects of a temporary increase in the nominal interest rate. If the increase in the nominal interest rate succeeds in raising the real interest rate, then it also leads to higher required interest payments on outstanding government debt. The fiscal authority must finance these payments through higher taxes, lower transfers or inflation. These are the fiscal footprints of monetary policy. I first consider a government that responds by raising its primary surplus, followed by a government that keeps its primary surplus unchanged.

4.1 Fiscal Footprints Matter for the Effects of Monetary Policy

Consider first a fiscal authority that follows a passive fiscal rule such as in equation (5) and therefore meets these higher interest payments by raising current or future lump sum taxes.[7] In a RANK economy with this fiscal rule, the fiscal footprints have no consequences and can be safely ignored. The higher future taxes that households pay are exactly offset by the higher interest rate. The present value of their net income is unaffected by the fiscal adjustment, and because of Ricardian equivalence, there is no change in their consumption. As long as the fiscal rule is passive, the consequences of a monetary contraction can be studied without reference to the specifics of the fiscal response.

In HANK models, these fiscal footprints cannot be ignored. Both the timing and distribution of the fiscal authority's response to the higher interest payments matter significantly for the overall effect of monetary policy. The timing matters because of the failure of Ricardian equivalence. A fiscal response that pushes the required tax increase further in the future would lead to a smaller drop in spending from the rate hike. On the other hand, a fiscal response that immediately raises taxes would lead households to cut spending by more, exacerbating the effects of the rate hike. The distribution matters because of MPC heterogeneity. Even if the government were to perfectly stabilize its debt ($\phi \to \infty$) by immediately raising lump sum taxes or lowering transfers by the amount of the additional interest payments, the incidence of the higher taxes matters for the overall effect. The more it is targeted towards low-wealth, high-MPC households, the larger the fall in aggregate consumption from the increase in real rates.

The size of these fiscal footprints depends on the size and duration of the government balance sheet. As long as the government has some debt ($b^* > 0$) and its duration is finite, some change in current or future transfers is required to satisfy a passive fiscal rule like (5). But the longer the duration of the debt, the smaller are the required fiscal adjustments. The government effectively has a very long duration asset: a commitment to collect an infinite stream of primary surpluses. So if it is matched with an equally long duration debt, a change in the real interest rate would have no effect on the fiscal authority's net equity and no change in taxes or transfers would be required. But even in this case, the transmission of monetary policy is still complex in HANK models, because a change in interest rates redistributes wealth between the subset of households who hold different amounts of the debt. An unexpected rate hike is a capital loss for the households who hold that debt (either directly or via ownership of financial institutions that hold those claims) and so the effect of the policy depends on the MPCs of those households.[8]

[7] I use the term passive in the sense of Leeper (1991). Alternatively, one could consider the broader class of Ricardian fiscal rules as defined by Woodford (1995).

[8] Auclert (2019) derive sufficient statistics for the extent of this exposure and applies them to microeconomic data. Kaplan et al. (2018) and Kaplan and Violante (2018) report simulations for the effects of monetary shocks under different assumptions of the size and distribution of fiscal footprints.

4.2 Raising Nominal Rates Without a Fiscal Contraction Raises Inflation

What if the fiscal authority does not respond to the fiscal footprints by raising taxes? In other words, what are the effects of an interest rate hike without a corresponding commitment by the fiscal authority to raise its current or future primary surplus?

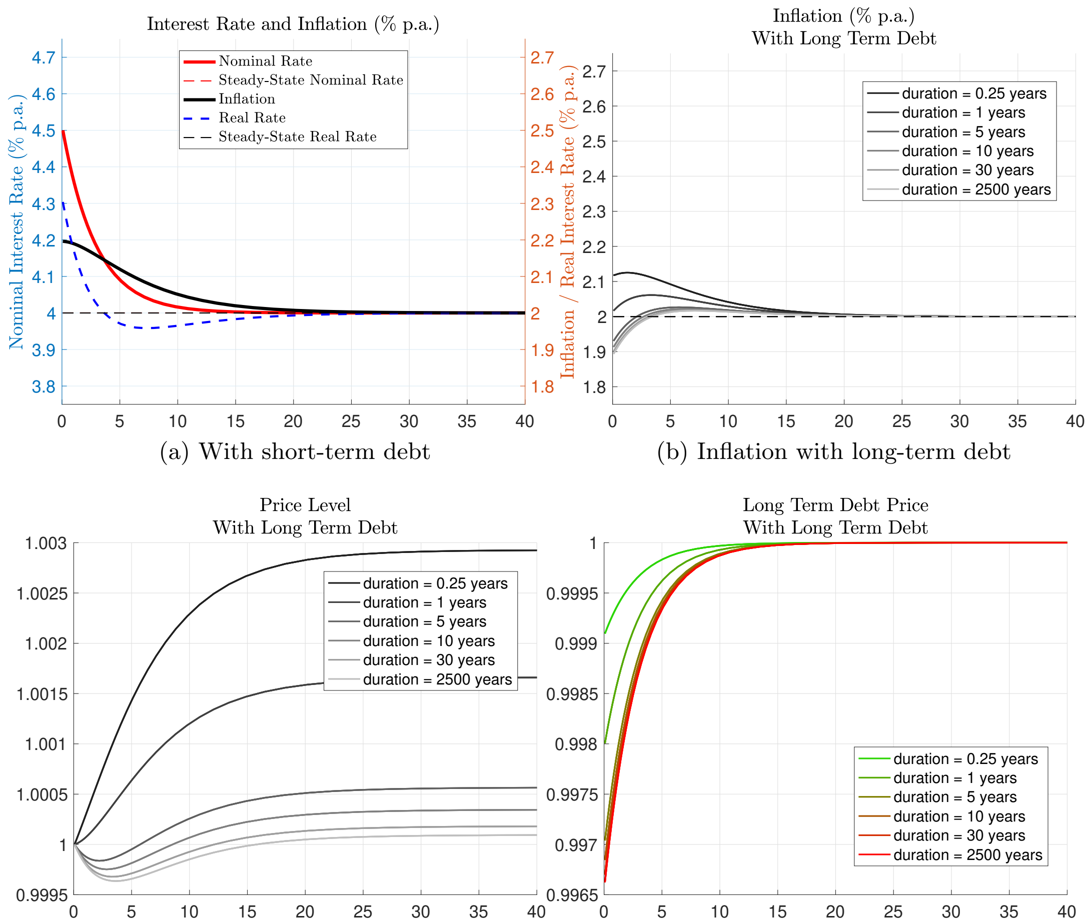
Short-term debt Figure 3 shows the impulse response to a temporary 50 basis point interest rate hike leaving fiscal surpluses unchanged from a standard one-asset HANK model. On impact, the real rate rises by around 30 basis points and inflation rises by around 20 basis points. The fact that inflation rises on impact and that the cumulative price impact is positive is an extremely robust feature of both HANK and RANK models with short-term debt. In the absence of a fiscal contraction, a temporary increase in the nominal interest rate cannot persistently lower inflation, and when the government issues short-term debt it cannot even temporarily lower inflation.

This point is not about HANK models *per se*. It holds also in RANK models and has been clearly articulated by Sims (2011) and Cochrane (2024). However, the argument is even more difficult to avoid in a heterogeneous agent economy than in a representative agent economy because it relies on a non-zero level of steady-state government debt $b^* > 0$, and a unique steady-state equilibrium to which the economy returns after a temporary shock. The result follows from the integral restriction implied by the government budget constraint. Starting with equation (7) and imposing that the economy starts and returns at the same real steady-state, with no change in surpluses, the paths of inflation and nominal rates are related by

$$0 = \int_{t=0}^{\infty} \omega\left(t\right)\left(\hat{\pi}_t - \hat{i}_t\right) dt. \tag{12}$$

This equation holds in *any* equilibrium in which the economy starts at a steady-state with a non-zero level of real government debt and returns to the same steady-state, regardless of what type of fiscal and monetary rules are used to implement the equilibrium. Since the weighting function $\omega\left(t\right)$ declines exponentially fast, and since $\hat{i}_t$ is positive and declining, a negative inflation deviation early on would need to be offset by even larger and more persistent positive inflation deviations later on. The simplest way for this restriction to hold is for inflation to rise on impact, but less than the increase in nominal rates, so that the real rate initially rises, and then inflatoin returns to steady-state more slowly than the nominal rate so that the real rate then falls below steady-state. Indeed, this is what happens in every simulation I have encountered and I am not aware of any simulations from a RANK or HANK model with (non-zero) short-term debt in which inflation falls on impact of a temporary nominal rate hike, absent a fiscal contraction.

What goes wrong with the usual intuition from New Keynesian models that a temporary rate hike lowers inflation by raising real rates and depressing household spending? That intuition comes from a thought experiment involving an innovation to a Taylor rule for monetary policy and a passive fiscal policy rule of the type in equation (5). On impact of the shock, the real interest



(a) With short-term debt

(b) Inflation with long-term debt

(c) Price level with long-term debt

(d) Long-term debt price

Figure 3: Example of 50bp p.a. increase in nominal rate with no change in surpluses in HANK model. From Cochrane et al. (2025).

rate indeed rises, but that causes real debt to rise above its steady-state level. The fiscal authority responds to this increase in debt by raising primary surpluses. It is this fiscal contraction that causes inflation to fall, not the rise in nominal rates. Moreover, the fiscal contraction needed for inflation to fall is large, much more than is needed to meet the additional interest payments on outstanding debt from higher rates. In the presence of such a fiscal contraction, the rate hike itself does nothing to lower inflation, and inflation would be lower without the rate hike.

Long-term debt Sims (2011) and Cochrane (2023, 2024) point out that if the government issues long-term debt then it may be possible for a rate hike to lower inflation without a fiscal contraction, but only temporarily and only at the expense of higher inflation later on, such that eventually the price level is permanently higher than it would otherwise be. This is the phenomenon that Sims (2011) calls “stepping on a rake” and Cochrane (2024) calls “unpleasant interest rate arithmetic”.

To see how this works, assume that the government issues a long-term nominal bond, rather than a short term bond, with a geometric maturity structure whose rate of maturity is δ. I continue to denote the real value of outstanding government debt by b_t but now denote the real price of these bonds (i.e. the price in terms of goods) as Q_t^δ and the quantity of outstanding bonds as B_t^δ. It is easiest to consider a flexible price representative agent model. The present value of government debt is

$$\frac{Q_0^\delta B_0^\delta}{P_0} = \frac{\bar{s}}{\rho}.$$

With no change in surpluses, this value is unchanged by a period of higher nominal rates. With short-term debt, there is no change in Q_0^δ and so no change in the initial price level P_0, but subsequent inflation is higher since $\pi_t = i_t - \rho$. With long-term debt, the price of bonds Q_0^δ falls on impact and so the price level P_0 must also fall on impact to keep the real value of debt unchanged.

With sticky prices, this initial fall in the price level manifests as a period of disinflation before which higher inflation eventually takes over. But even with long-term debt, eventually inflation must rise back above steady-state and the ultimate rise in the price level will take it above, not below steady-state. To see why this must happen, consider the analogous integral restriction to (7) for the case with long-term debt,

$$\log \frac{Q_0^\delta}{Q^*} = \int_{t=0}^{\infty} \omega(t) \left(\hat{i}_t - \hat{\pi}_t\right) dt. \tag{13}$$

An increase in the nominal rate as described above leads to an immediate fall in the price of long-term bonds Q_0^δ, the size of which depends only on the path of nominal rate. Because the left-hand side of (13) is negative, the argument given above for short term debt does not hold. It is possible that inflation may fall on impact, and indeed it typically does for long maturity debt. To see why the long-run effect on prices must be positive, substitute for the implied price of debt, given the interest rate innovations (see Cochrane (2024) for a derivation), to get

$$0 = \int_{t=0}^{\infty} \omega(t) \left(\left(1 - e^{-\delta t}\right) \hat{i}_t - \hat{\pi}_t\right) dt. \tag{14}$$

With short term debt ($\delta \to \infty$), this collapses to (12). With perpetual debt ($\delta = 0$), the restriction imposes that the weighted average inflation deviations must be zero $\int_{t=0}^{\infty} \omega(t)\, \hat{\pi}_t dt = 0$. Therefore in both cases, and any in between, lower inflation early on must be compensated for with higher inflation later.

The remaining panels of Figure 3 illustrate these effects. They show impulse responses to the same path of nominal rates under different assumptions about the duration of government debt. With durations of a year or more, inflation falls on impact, but then rises above its steady-state level and the cumulative effect on the price level leaves it higher than before the rate hike. The insights from Sims (2011) and Cochrane (2024) on the effects of nominal interest rates on inflation are a robust feature of any model with non-zero government debt. Without a fiscal contraction, interest rate policy can at best change the timing of inflation, via its effects on the market value of government bonds, and a rate hike cannot persistently lower inflation.

5 US Fiscal Stimulus and Interest Rate Policy in the 2020's

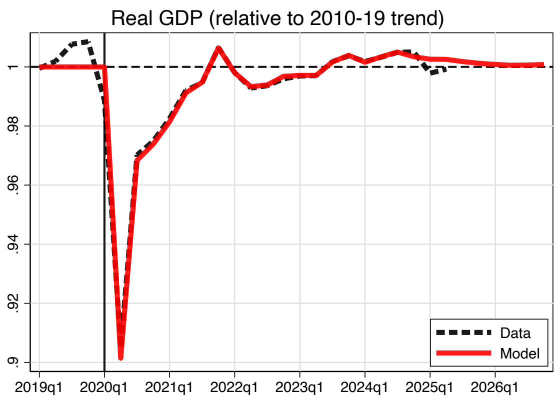
In this section, I summarize some preliminary findings from Kaplan and Miyahara (2025) to illustrate how these effects of fiscal and monetary policy played out in the United States in the wake of the Covid pandemic.

5.1 A Quantitative HANK Model with State-Dependent Pricing

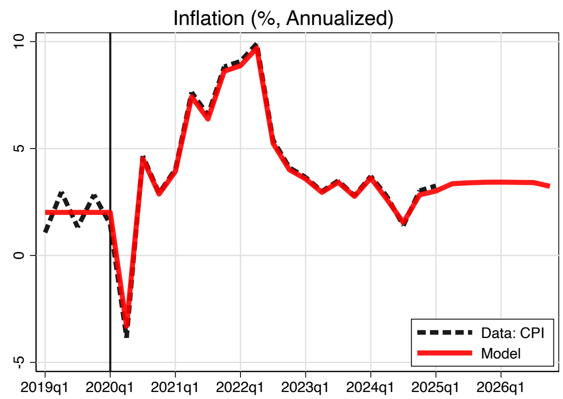
I refer readers to Kaplan and Miyahara (2025) for a detailed description of the model, and summarize only the most important features here. The model is a one-asset HANK model in which heterogeneous firms can exert effort to affect the hazard rate of receiving opportunities to adjust their prices. The parameters of the effort cost function are chosen to match key features of the micro data on firm pricing that include the frequency of price adjustment, the average absolute size of price changes and the kurtosis of price changes. The household labor income process is calibrated to match data on US earnings. Fiscal variable are set to match key macro aggregates in the years leading up to the pandemic. In particular, the model is calibrated so that the US government runs a steady-state primary deficit of 2.2% of GDP and issues debt of 88% of GDP, sustained by a real interest rate of -0.1% and a growth rate of 2.4%.

The model incorporates two types of aggregate shocks that hit the economy at quarterly intervals, starting in 2020Q1. Both shocks have AR(1) dynamics with a half-life of two quarters. The first is a shock to households' marginal utility of consumption and is intended to capture features of the pandemic period that affected the demand side of the economy, such as isolation and lockdowns. The second is a shock to the technology for producing intermediate goods and is intended to capture disruptions to production chains and other effects on the supply side of the economy. Given the baseline settings for fiscal and monetary policy described below, the realizations for the two shocks are chosen to match the realized paths for GDP and inflation over this period. These paths, together with the estimated paths for the two series of shocks, are displayed in Figure 4.

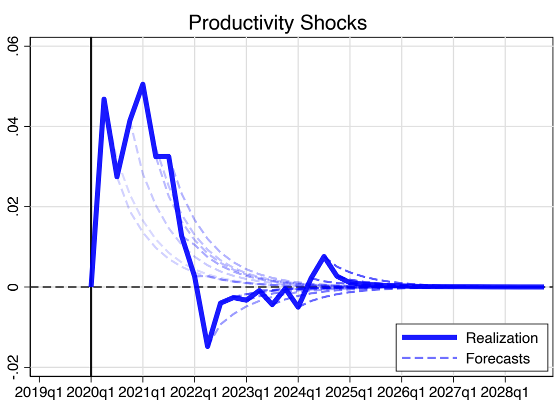
The top row of Figure 4 shows that the model matches the time series for inflation and GDP. The collapse in GDP through 2020 and 2021, and associated deflation, was driven primarily by the demand shock, which recovers slowly through the first half of 2023. Productivity jumps at the start of the pandemic, consistent with data on measured labor productivity in this period, but rapidly declines in 2021 as supply chain disruptions take effect. This accounts for the rise in inflation and below-trend GDP in 2022.



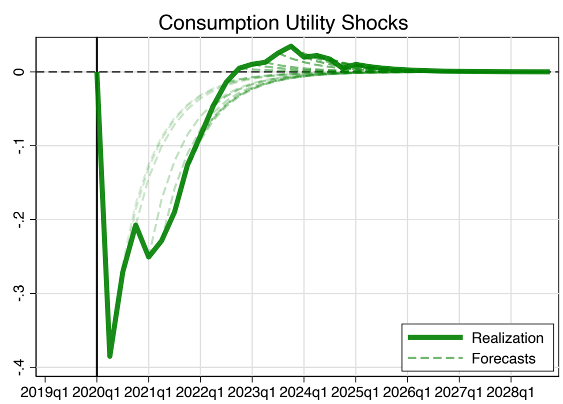
(a) Real GDP



(b) Inflation



(c) Estimated current and forecasted shocks to productivity in intermediate goods sector



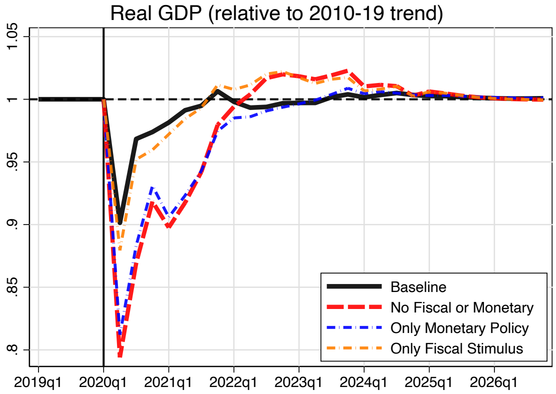
(d) Estimated current and forecasted shocks to marginal utility of consumption

Figure 4: Model fit and estimated shocks from Kaplan and Miyahara (2025)

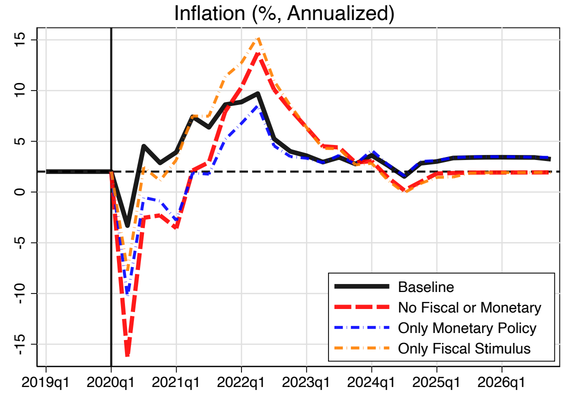
5.2 The Role of Fiscal and Monetary Policy

Baseline Policy Responses To implement the fiscal stimulus programs, we assume that at the beginning of each quarter the government announces a new round of targeted fiscal transfers and government spending. The size of these programs match measured outlays and hence the paths of primary surpluses and accumulated government debt match those in the data. In our baseline exercise, we assume that the fiscal stimulus program is unfunded.

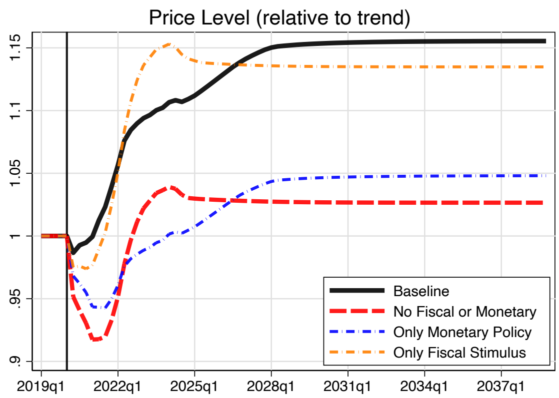
To implement the monetary response, we feed into the model the actual realized federal funds rate in each quarter, together with median consensus forecasts for the future path of the federal funds rate at each date. For the purposes of interpreting realized aggregate dynamics, this approach of feeding in directly the realized path of nominal rates and past forecasts avoids us having to take a stand on the monetary rule, since for any rule we could ex-post back out the relevant sequence of monetary shocks that rationalizes the observed sequence of nominal rates.



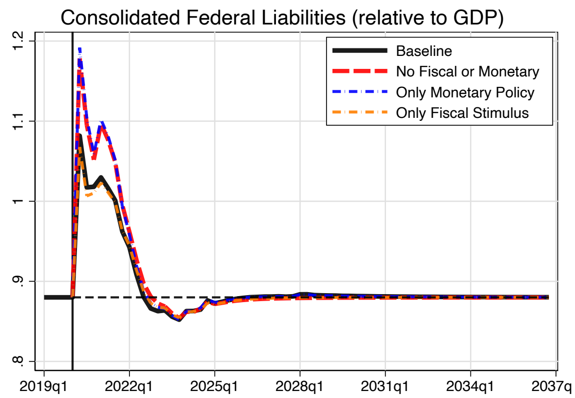
(a) Real GDP



(b) Inflation



(c) Price level (relative to trend)



(d) Government debt to GDP

Figure 5: Counterfactual model dynamics from Kaplan and Miyahara (2025)

Aggregate Dynamics without a Policy Response Figure 5 displays paths for GDP, inflation, the price level and government debt, under four scenarios. The black line, labeled "Baseline" is the baseline scenario that includes the actual fiscal and monetary responses, and matches the data for GDP and inflation. The dashed red line labeled "No Fiscal or Monetary" shows the counterfactual paths had there been no fiscal stimulus and had the Federal Reserve kept the federal funds rate constant throughout the period. The blue and yellow dash-dot lines show the counterfactual paths had there only been a fiscal or monetary response, respectively.

The first observation is that fiscal and monetary policy had a big effect on the economy over this period. Comparing the red and black lines in panel (a) reveals that absent a policy response, GDP would have fallen by twice as much in 2020 and recovered much more slowly. Inflation would have been much more volatile, with more severe and protracted deflation and a much larger spike in inflation, peaking at 15% rather 10% (panel (b)). However, the cost of higher GDP and smoother inflation is permanently higher prices. Prices in 2028 would be around 12% lower in the absence of the fiscal and monetary responses, than in reality.

Effects of Fiscal Stimulus Fiscal and monetary policy both contributed to these effects, although in different ways. Comparing the red dashed line and orange dash-dot lines in Figure 5 reveals the effects of the fiscal stimulus program in isolation. The fiscal stimulus was almost solely responsible for supporting GDP throughout 2020 and 2021, and accounted for preventing about half of the deflation. However, it had little effect on the size and timing of the inflation spike in 2022, which would have occurred irrespective of the stimulus program. In this sense, those who attributed the inflation surge to supply side shocks were correct. However, those who attribute the rise in the price level to the large unfunded fiscal stimulus program are also correct, because the stimulus program accounts for almost all of the large cumulative increase in the price level. The stimulus program supported prices during the demand slump in the early stages of the pandemic, thereby preventing deflation and shifting the timing of the subsequent inflation spike earlier without affecting its magnitude but at the cost of permanently higher prices. In Kaplan and Miyahara (2025) we also consider the counterfactual if the government had committed to repay the costs of the stimulus by raising primary surpluses starting in 2030. We find that a funded fiscal stimulus of this type could have achieved very similar support of GDP and prices in 2020 and 2021 without the permanent effect on prices.

Effects of Monetary Policy Comparing the red dashed line and blue dash-dot lines in Figure 5 reveals the effects of the monetary policy response in isolation. The loose monetary policy throughout 2020 and 2021 had very little effect on GDP, which would have been similar if nominal rates had been held constant through this period. However, it did help in preventing some deflation at the start of the pandemic. The monetary tightening starting in 2022 lowered GDP moderately in 2022 and 2023. But the most important effects of monetary policy were in smoothing out the surge in inflation. Consistent with the "stepping on a rake" effects discussed above, the higher nominal rate substantially lowered the spike in inflation, which peaked below 10%, compared with the counterfactual of 15%. The cost of this smoothing was persistently higher inflation, which remained above trend for much longer than otherwise, as well as the aforementioned lower output in 2022 and 2023. So there is a sense in which, the monetary tightening did achieve the so-called "soft landing", but at the cost of persistent above-trend inflation.

In Kaplan and Miyahara (2025) we supplement these aggregate counterfactuals with an analysis of the welfare consequences of supporting individual household consumption, redistributing real resources and shifting the burden of taxation over time. I refer interested readers to that paper for more details.

6 Conclusion

Monetary and fiscal policy are inescapably interconnected. These interconnections are especially important when households have heterogeneous MPCs and Ricardian equivalence does not hold – as in reality, and as in HANK models. I have explained how some of these forces manifest in the contest of fiscal stimulus policy and nominal interest rate changes. I have illustrated how HANK models can be used to construct counterfactuals from which we can quantify these effects and thereby assess the effects of fiscal and monetary interventions. The large shocks and policy responses of the first half of the 2020's offer a prime example of the ways that fiscal stimulus and interest rate policy influence the economy.

References

Aguiar, Mark A, Manuel Amador, and Cristina Arellano, "Pareto improving fiscal and monetary policies: Samuelson in the new keynesian model," Technical Report, National Bureau of Economic Research 2023.

Aiyagari, S Rao, "Uninsured idiosyncratic risk and aggregate saving," *The Quarterly Journal of Economics*, 1994, *109* (3), 659–684.

Angeletos, George-Marios, Chen Lian, and Christian K Wolf, "Can Deficits Finance Themselves?," *Econometrica*, 2024, *92* (5), 1351–1390.

Auclert, Adrien, "Monetary policy and the redistribution channel," *American Economic Review*, 2019, *109* (6), 2333–2367.

Bassetto, Marco and Wei Cui, "The fiscal theory of the price level in a world of low interest rates," *Journal of Economic Dynamics and Control*, 2018, *89*, 5–22.

Bewley, Truman, "Stationary monetary equilibrium with a continuum of independently fluctuating consumers," *Contributions to mathematical economics in honor of Gérard Debreu*, 1986, *79.*

Bilbiie, Florin O, "Limited asset markets participation, monetary policy and (inverted) aggregate demand logic," *Journal of economic theory*, 2008, *140* (1), 162–196.

Cochrane, John, "The fiscal theory of the price level," 2023.

_ , Greg Kaplan, and Ken Miyahara, "Some Illustrations of the Effects of Raising Nominal Interest Rates on Inflation," Technical Report, University of Chicago (In Progress) 2025.

Cochrane, John H, "A frictionless view of US inflation," *NBER macroeconomics annual*, 1998, *13*, 323–384.

_ , "Understanding policy in the great recession: Some unpleasant fiscal arithmetic," *European economic review*, 2011, *55* (1), 2–30.

_ , "Expectations and the neutrality of interest rates," *Review of Economic Dynamics*, 2024, *53*, 194–223.

Davig, Troy and Eric M Leeper, "Generalizing the Taylor principle," *American Economic Review*, 2007, *97* (3), 607–635.

Eusepi, Stefano and Bruce Preston, "Fiscal foundations of inflation: imperfect knowledge," *American Economic Review*, 2018, *108* (9), 2551–2589.

Galí, Jordi, *Monetary policy, inflation, and the business cycle: an introduction to the new Keynesian framework and its applications*, Princeton University Press, 2008.

_ , **J David López-Salido, and Javier Vallés**, "Understanding the effects of government spending on consumption," *Journal of the european economic association*, 2007, *5* (1), 227–270.

Havranek, Tomas and Anna Sokolova, "Do consumers really follow a rule of thumb? Three thousand estimates from 144 studies say probably not," *Review of Economic Dynamics*, 2020, *35*, 97–122.

Huggett, Mark, "The risk-free rate in heterogeneous-agent incomplete-insurance economies," *Journal of economic Dynamics and Control*, 1993, *17* (5-6), 953–969.

Imrohoroğlu, Ayşe, "Cost of business cycles with indivisibilities and liquidity constraints," *Journal of Political economy*, 1989, *97* (6), 1364–1383.

Kaplan, Greg, "HANK Models: What Are They? And What Have We Learned?," Technical Report, University of Chicago 2024.

_ , "Implications of Fiscal-Monetary Interaction from HANK Models," *Proceedings of the Econometric Society World Congress*, 2025, *forthcoming.*

_ **and Giovanni L Violante**, "Microeconomic heterogeneity and macroeconomic shocks," *Journal of Economic Perspectives*, 2018, *32* (3), 167–194.

_ **and** _ , "The marginal propensity to consume in heterogeneous agent models," *Annual Review of Economics*, 2022, *14* (1), 747–775.

_ **and Ken Miyahara**, "How Does Monetary and Fiscal Policy Shape Macroeconomic Dynamics in the Face of Large Shocks?," Technical Report, University of Chicago 2025.

_ , **Benjamin Moll, and Giovanni L Violante**, "Monetary policy according to HANK," *American Economic Review*, 2018, *108* (3), 697–743.

_ , **Georgios Nikolakoudis, and Giovanni L Violante**, "Price level and inflation dynamics in heterogeneous agent economies," Technical Report, National Bureau of Economic Research 2023.

Leeper, Eric M, "Equilibria under active and passive monetary and fiscal policies," *Journal of monetary Economics*, 1991, *27* (1), 129–147.

_ **and Campbell Leith**, "Understanding inflation as a joint monetary–fiscal phenomenon," in "Handbook of macroeconomics," Vol. 2, Elsevier, 2016, pp. 2305–2415.

Sargent, Thomas J, *The ends of four big inflations*, Federal Reserve Bank of Minneapolis, 1981.

_ **and Neil Wallace**, "Some unpleasant monetarist arithmetic," *Federal reserve bank of minneapolis quarterly review*, 1981, *5* (3), 1–17.

_ **and** _ , "The real-bills doctrine versus the quantity theory: A reconsideration," *Journal of Political economy*, 1982, *90* (6), 1212–1236.

Sims, Christopher A, "A simple model for study of the determination of the price level and the interaction of monetary and fiscal policy," *Economic theory*, 1994, *4*, 381–399.

_ , "Stepping on a rake: The role of fiscal policy in the inflation of the 1970s," *European Economic Review*, 2011, *55* (1), 48–56.

Wallace, Neil, "A Modigliani-Miller theorem for open-market operations," *The American Economic Review*, 1981, *71* (3), 267–274.

Woodford, Michael, "Price-level determinacy without control of a monetary aggregate," in "Carnegie-Rochester conference series on public policy," Vol. 43 Elsevier 1995, pp. 1–46.

_ , "Interest and prices: Foundations of a theory of monetary policy," 2003.