"Leaning Against the Wind" Leads to a Higher (Not Lower) Household Debt-to-GDP Ratio[*]

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Abstract

"Leaning against the wind" – a tighter monetary policy than necessary for stabilizing inflation around the inflation target and unemployment around a long-run sustainable rate – has been justified as a way of reducing household indebtedness. But, under realistic assumptions, it actually has the opposite effect; it leads to higher real household debt and a higher household debt-to-GDP ratio. The reason is that a tighter policy than a baseline induces a relatively slow fall below the baseline of total nominal (mortgage) debt but a faster fall in the nominal price level and nominal GDP. There is then first a rise in real debt and the debt-to-GDP ratio relative to the baseline, a rise that is almost as large and as fast as the fall in the price level and nominal GDP. Then, real debt and the debt-to-GDP ratio slowly fall back to the baseline during a few additional years. Therefore, "leaning against the wind" as a way of reducing the household debt-to-GDP ratio is counterproductive.

1   Introduction

"Leaning against the wind" – a tighter monetary policy than necessary for stabilizing inflation around an inflation target and unemployment around a long-run sustainable rate – has been advocated as a policy to counter rapid credit growth and rising asset prices (for instance, by Borio and

White (2003) and Cecchetti, Genberg, and Wadhwani (2002)). More specifically, it has been justified as a way of reducing household indebtedness relative to what it would be without the tighter policy. But this paper shows that "leaning" actually has the opposite effect; it leads to higher real household debt and a higher household debt-to-GDP ratio. The reason is that a tighter policy than a baseline induces a quite slow fall relative to the baseline of total nominal (mortgage) debt but a faster fall in the nominal price level and nominal GDP. There is then first a rise during a few years in real debt and the debt-to-GDP ratio relative to the baseline, a rise that is almost as large and as fast as the fall in the price level and nominal GDP. Then, real debt and the debt-to-GDP ratio quite slowly fall back to the baseline during a few additional years. Therefore, "leaning against the wind" as a way of reducing the debt-to-GDP ratio is counterproductive.

A temporarily higher policy rate than a baseline *temporarily* reduces inflation and (real) GDP below the baseline. Via temporarily higher mortgage rates, it also *temporarily* reduces real housing prices below the baseline. The temporary fall in inflation leads to a *permanent* fall in the price level below the baseline. This, in turn, leads to a permanent fall in nominal GDP and in nominal housing prices relative to the baseline. The fall in nominal housing prices means that, for a given loan-to-value ratio, new mortgages issued each year are smaller than the baseline. But the new mortgages issued each year are a relatively small share of total mortgages. Therefore, total nominal (mortgage) debt falls only quite slowly below the baseline.

That total nominal debt falls quite slowly means that movements in real debt and the debt-to-GDP ratio are dominated by the faster movements in the price level and nominal GDP. Therefore, real debt and the debt-to-GDP ratio rise above the baseline almost as fast and as much as the permanent fall in the price level and nominal GDP. Once the price level and nominal GDP have reached their new permanent level below the baseline, real debt and the debt-to-GDP ratio start to slowly fall back to the baseline over a period of a few additional years.

For parameters that seem approximately consistent with the Swedish economy and mortgage market, a 1 percentage point increase above the baseline in the policy rate for four quarters will then increase real debt to about 0.5 percent above the baseline and the debt-to-GDP ratio to about 1 percentage points above the baseline in about four years. Then, real debt and the debt-to-GDP ratio will fall back and reach the baseline in about another 4 years. The result that a higher policy rate increase the debt-to-GDP ratio seems quite robust to alternative assumptions about a quicker turnover of mortgages, a stronger housing price response to the policy rate, and weaker response of inflation and GDP to the policy rate. For these alternative assumptions, however, the response

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of real debt becomes weaker and it does not move much.

In order to show this, this paper develops a quite simple model of household debt dynamics. For a given time path of nominal housing prices and the loan-to-value ratio of new mortgages, together with assumptions about the turnover of the mortgage stock (more precisely, the average length of time, the refinancing period, before mortgages are refinanced to the loan-to-value ratio for new mortgages) and the rate of amortization of the debt, the time path of total mortgage debt and the average loan-to-value ratio can be calculated. In particular, given the responses of inflation and GDP to the policy rate and the response of real housing prices to mortgage rates, the responses of total real debt and the debt-to-GDP ratio can be calculated.

Some models of the housing market and debt dynamics, such as the one of Iacoviello and Neri (2010) and Walentin and Sellin (2010), rely on the unrealistic assumption that mortgages are refinanced each quarter at a maximum LTV ratio given by a collateral constraint, in which case nominal debt varies directly with housing prices. For a realistic model of mortgage debt dynamics, it is important to take into account the fact that only a relatively small share of the total mortgage stock is refinanced each year, as is done in the models of Chambers, Garriga, and Schlagenhauf (2009) and Sterk (2012).

The result of the present paper is reminiscent of the discussion of "debt deflation,", the fact that deflation increases the value of existing nominal debt. Naturally, any lower price level than anticipated will reduce the real value of existing nominal debt below what was anticipated (Bank of England (2013, p. 53), Fisher (1933), Eggertson and Krugman (2012)). They are also reminiscent of the recent debate on "fiscal austerity." Fiscal austerity may reduce budget deficits and the growth of nominal public debt, but if it reduces nominal GDP faster due to high multipliers, the debt-to-GDP ratio may rise rather than fall. For "monetary austerity", it seems that the debt-to-GDP ratio will almost always rise.

The result of this paper are of some particular relevance for current and past monetary policy in Sweden. Over several years, the Swedish Riksbank has conducted an arguably quite aggressive leaning-against-the-wind policy, which has led to inflation substantially below the inflation target and unemployment substantially above any reasonable estimate of a long-run sustainable rate (see Svensson (2013b) for details). It has recently justified this policy by arguing that an alternative more expansionary policy would increase household debt-to-GDP and debt-to-disposable income ratios and thereby any risks associated with household debt (see, for instance, Sveriges Riksbank (2013b)). But the Riksbank has not presented any analysis of debt dynamics that supports its case.

It seems that the Riksbank has simply taken as given that a higher policy rate reduces household debt ratios. The simple and rather robust analysis that I present here shows that the it seems that the Riksbank has got the sign of the effects of its policy wrong. Its policy has actually increased the debt-to-GDP and debt-to-disposable income ratios. Thus, it is difficult to find any justification for the Riksbank policy.

2 Debt dynamics and housing prices

Let P_t denote the nominal housing price in (the beginning of) year t. Assume, for simplicity, that the housing stock is constant and normalized to equal unity. Then, P_t is also the nominal value of the housing stock in year t. Assume also that all housing ownership is financed by mortgages. Furthermore, there is no amortization so each mortgages is constant in nominal terms until it is refinanced after a fixed period of T years, the refinancing period. This means that each year $1/T$ of the mortgages are refinanced.

For simplicity, refinancing of mortgages as assumed to consist of repaying the old mortgage and replacing it with a new mortgage. Some of the refinanced mortgages are assumed to arise from sales of old and purchases of new housing, but some of the refinancing may, realistically, be done by housing owners who are not selling and moving to a new house. The average holding period of housing may be longer than the refinancing period. In the analysis that follows, it is the refinancing period, not the holding period of housing, that matters.

Some borrowers may amortize their debt in nominal terms. Others may increase their mortgage when housing prices increase. Assuming no amortization is a compromise between these two alternatives. The extension to a given positive rate of nominal amortization is easy and is shown in appendix A. The results of the paper does not depend on zero or positive amortization.

Importantly, no amortization in nominal terms nevertheless implies some amortization in real terms, when CPI inflation is positive. Furthermore, when nominal housing prices increase, it implies amortization relative to the value of housing, that is, a fall in the loan-to-value ratio. When nominal disposable income grows, it also means amortization relative to disposable income. A nominal growth rate of 4 percent per year of nominal housing prices and nominal disposable income is a reasonable assumption (real income growth of 2 percent and 2 percent CPI inflation, together with housing prices rising in line with disposable income). Then, nominal housing prices and nominal disposable income double in 18 years, so without nominal amortization, the loan-to-

value ratio and the loan-to-disposable income ratio is halved in 18 years, implying a substantial rate of amortization.

Let m_v denote the new mortgage issued in (the beginning of) year v.[1] Assume that it satisfies

$$m_v = \alpha P_v / T. \tag{2.1}$$

Here $1/T$ is the fraction of mortgages that are refinanced in any year, P_v/T is the value of the housing for which new mortgages are issued, and α is a constant loan-to-value (LTV) ratio for new mortgages. It can be interpreted as a binding LTV cap for new mortgages or just a stable average LTV ratio for new mortgages following from the behavior of borrowers and lenders. In in year t, there is then a mortgage vintage structure $\{m_v\}_{v=t-T+1}^{t}$ consisting of T vintages of mortgages issued in the last T years, where the mortgage of vintage v is given by (2.1) for $v = t-T+1, t-T+2, ..., t$.

The total (mortgage) debt in (the beginning of) year t, denoted D_t, will then be the sum over the existing vintages of mortgages and is given by

$$D_t \equiv \sum_{v=t-T+1}^{t} m_v = \frac{\alpha}{T} \sum_{v=t-T+1}^{t} P_v. \tag{2.2}$$

Thus, total debt depends on the sequence of housing prices during the last T years, $\{P_v\}_{v=t-T+1}^{t}$. Let A_t denote the average loan-to-value ratio, given by

$$A_t \equiv \frac{D_t}{P_t}. \tag{2.3}$$

It follows that, for any given sequence of housing prices $\{P_t\}_{t=-\infty}^{\infty}$, we get a corresponding sequence of total debt $\{D_t\}_{t=-\infty}^{\infty}$ and average LTV ratios $\{A_t\}_{t=-\infty}^{\infty}$ given by, respectively, (2.2) and (2.3).[2]

Consider now a baseline case with nominal housing prices $\bar{P}_t$ that grow with a constant nominal growth rate, g, and hence satisfy

$$\bar{P}_t = \bar{P}_0 (1+g)^t.$$

Let $\bar{m}_t$ and $\bar{D}_t$ denote the new mortgage and the total debt in year t in the baseline case. The total debt will be given by

$$\bar{D}_t \equiv \sum_{v=t-T+1}^{t} \bar{m}_v = \frac{\alpha}{T} \sum_{v=t-T+1}^{t} \bar{P}_v = \frac{\alpha}{T} \bar{P}_t \sum_{v=0}^{T-1} (1+g)^{-v} = \frac{\alpha}{T} \bar{P}_t \frac{1+g-(1+g)^{-T+1}}{g},$$

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[1] For simplicity, mortgages are refinanced and new mortgages issues only at the beginning of each year.
[2] It is easy to extend the analysis to a sequence of time-varying LTV ratios, $\{\alpha_t\}_{t=-\infty}^{\infty}$. Then, the new mortgage issued in year t satisfies $m_t = \alpha_t P_t / T$ and the total debt in year t is given by $D_t = \sum_{v=t-T+1}^{t} m_v = \sum_{v=t-T+1}^{t} \alpha_v P_v / T$.

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Figure 2.1: Baseline for housing prices, total debt and the average LTV ratio
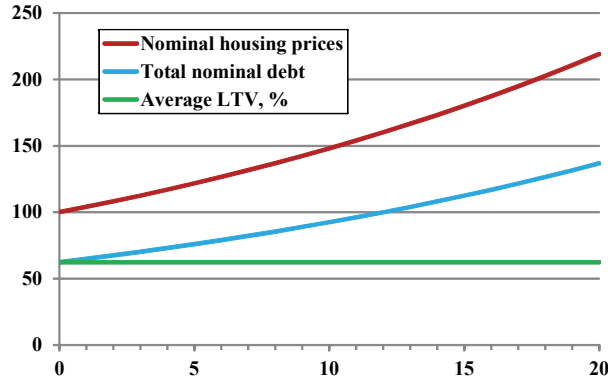
where I have used the expression for the sum of a finite geometric series. The average loan-to-value ratio in the baseline case, $\bar{A}_t$, is then given by

$$\bar{A}_t \equiv \frac{\bar{D}_t}{\bar{P}_t} = \frac{\alpha}{T} \frac{1 + g - (1 + g)^{-T+1}}{g}.$$

The loan-to-value ratio in year t for mortgages issued in a given year v, $v \leq t \leq v + T - 1$, the ratio of the mortgage $\bar{m}_v = \alpha \bar{P}_v / T$ to the value $\bar{P}_t / T$ in year t of the $1/T$th of the housing stock for which the mortgage applies, will decrease with t according to

$$\frac{\bar{m}_v}{\bar{P}_t / T} = \alpha \frac{\bar{P}_v}{\bar{P}_t} = \frac{\alpha}{(1 + g)^{t-v}}. \tag{2.4}$$

2.1 Parameters

Assume that the baseline case has the LTV ratio for new mortgages $\alpha = 70$ percent, the holding period $T = 7$ years, and the nominal growth rate of housing prices $g = 4$ percent. Then, $1/7 = 14$ percent of the housing stock gets a new mortgage each year, and the average LTV ratio $\bar{A}_t = 62.4$ percent; in the rest of the paper this is rounded to 62 percent. For Sweden, the LTV ratio for new mortgages is 68 percent, and the average LTV ratio for the total housing stock with mortgages is about 65 percent, similar to these baseline numbers.[3] The assumed refinancing period of 7 years is substantially shorter than the average holding period of housing, which may be as long as 18 years.[4]

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[3] For the LTV ratio for new mortgages, see Finansinspektionen (2013, figure 2). For the average LTV ratio for housing with mortgages, see (Finansinspektionen (2013)). The average LTV ratio for households, given by the ratio of household debt to household real wealth (single-family dwellings, condominiums, and second homes) is about 55 percent, see Sveriges Riksbank (2013a, figure A3).

[4] According to Statistics Sweden, during 2000-2012, the average number of owner-occupied houses and second homes sold each year as a share of the total stock was 3.5 percent. For condominiums, the share was 9.7 percent. The total share was 5.6 percent, making the average holding period equal to 18 years.

Figure 2.2: The loan-to-value ratio in percent for an individual mortgage as a function of age of the mortgage in the baseline case
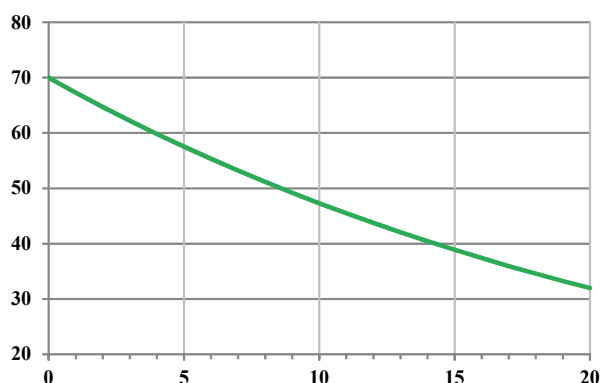

Figure 2.3: The response of total nominal debt and the average LTV ratio to higher nominal housing prices in year 1 – deviations from baseline

The assumed refinancing period seems realistic to me, but it should be possible to calibrate more precisely if data about the refinancing period for mortgages become available from the Swedish banks.

Figure 2.1 shows housing prices, total debt and the average LTV ratio for the baseline. We note that housing prices double in 18 years.

Figure 2.2 shows the LTV ratio for a given mortgage in the baseline case, as a function of the age in years of the mortgage. It falls from the initial 70 percent to 35 percent in 18 years. After 7 years, in the beginning of year 8, when the mortgage is refinanced, it has fallen to 54 percent. The volume-weighted average of the LTV ratios for years 1–8 is 62 percent, the average aggregate LTV

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ratio in the baseline case.

2.2 The response to a temporary housing price increase

It is easy to calculate how total debt and the average loan-to-value ratio changes if housing prices change. Suppose that housing prices increase by 1 percent relative to the baseline in (the beginning of) year 1 and then return back to the baseline in (the beginning of) year 2. Figure 2.3 shows the deviation from the baseline for housing prices, total debt, and the average LTV ratio.

Total debt increases to 0.16 percent in year 1 and then falls slowly to reach the baseline in year 8. To see why, note that since housing prices increase by 1 percent relative to the baseline in year 1, so do new mortgages in year 1. New mortgages are $70/62 = 1.12$ times larger than average mortgages. They concern 1/7th of the mortgages each year. Then, total debt increases by $1.12/7 = 0.16$ percent in year 1. New mortgages have returned to the baseline from year 2 and onwards. The share in total debt of the addition to total debt in year 1 falls over time as total debt grows by 4 percent per year. In year 8, the new higher mortgage in year 1 is refinanced, and total debt again is equal to the baseline.

The average LTV ratio falls by 0.5 percentage points in year 1. The numerator in the average LTV ratio, total debt, has increased by 0.16 percent in year 1, whereas the denominator has increased by 1 percent, so the average LTV ratio falls by 0.84 percent. 0.84 percent of 62 is 0.5 percentage points, so the average LTV ratio falls from 62 to 61.5. In year 2, the average LTV ratio rises to 0.1 percentage points above the baseline and then slowly falls back to the baseline. These changes are so small that they do not show in figure 2.1.

3 "Leaning against the wind"

As a way of examining the effects of "leaning against the wind," I will simply examine the effect of a 1 percentage point increase relative to the baseline of the policy rate during year 1. From year 2 onwards, the policy rate has returned to the baseline. The policy rate will reduce inflation, GDP and, through mortgage rates, real housing prices.

I will assume that impulse responses to inflation and GDP are approximately equal to the responses of the Riksbank's standard DSGE model, Ramses. (In section 4 I examine the consequences of a weaker response of inflation and GDP than Ramses.) Regarding the response of inflation, I assume that a 1 percentage point higher policy rate during year 1 reduces CPIF inflation relative

Figure 3.1: Responses of inflation, GDP, and real housing prices to a 1 percentage point higher policy rate during year 1
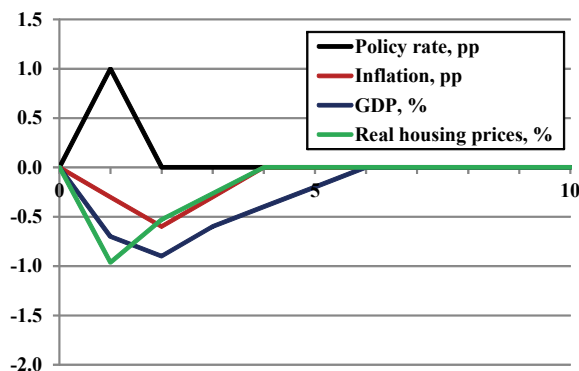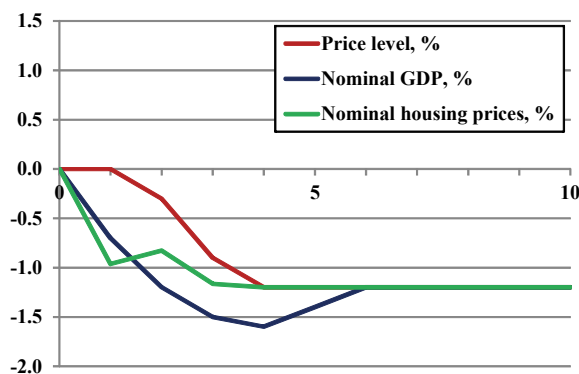

Figure 3.2: The response of the price level, nominal GDP, and nominal housing prices

to the baseline by 0.3 percentage points during year 1, 0.6 percentage points during year 2, 0.3 percentage points during year 3, and 0 percentage points from year 4 onwards. This is a somewhat slower response of CPIF inflation than in Ramses.

Regarding the response of (real) GDP, I assume that a 1 percentage point higher policy rate during year 1 reduces GDP relative to the baseline by 0.7 percent during year 1, 0.9 percent during year 2, 0.6 percent during year 3, 0.4 percent during year 4, and 0.2 percent during year 5. This is similar to the response of GDP in Ramses. The responses of inflation and GDP to the higher policy rate are shown in figure 3.1.

It remains to determine the response of housing prices through the response of mortgage rates.

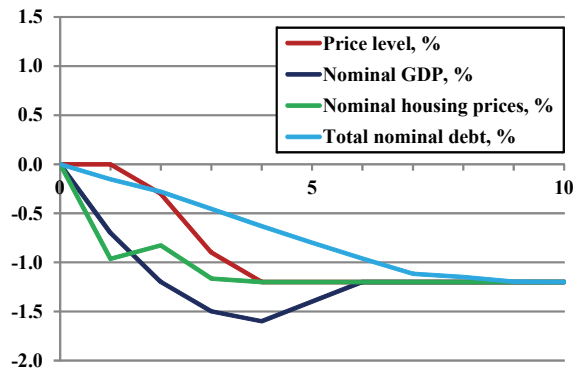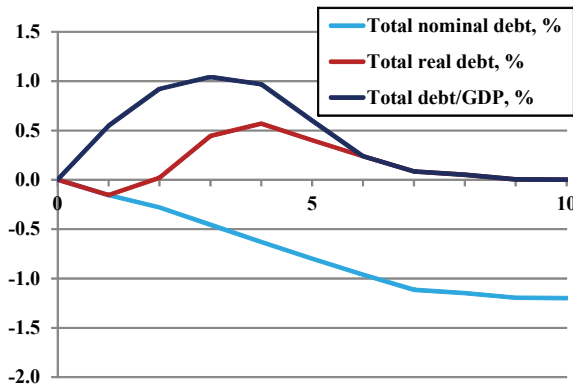Figure 3.3: The response of total nominal debt

Figure 3.4: Response of total real debt, the debt-to-GDP ratio, and total nominal debt

Assume that the variable mortgage rate varies one-to-one with the policy rate, that is, that mortgage issuers maintain a constant margin between the variable mortgage rate and the policy rate. Then, a temporarily higher policy rate during year 1 will cause a temporarily higher variable mortgage rate by 1 percentage point during year 1. This will increase the 1-year mortgage rate at the beginning of year 1 by 1 percentage point. It will not affect 1-year mortgage rates from year 2 and onwards. The issue is thus how a temporarily higher 1-year mortgage rate by 1 percentage point at the beginning of year 1 will affect housing prices.

Svensson (2013a) uses the user-cost approach of Englund (2011) and Sørensen (2013) to calculate the semi-elasticity of *real* Swedish housing prices with respect to the 1-year mortgage rate. Taking into account the tax deductibility of mortgage-rate payments, the semi-elasticity is estimated to

Figure 3.5: The response of the average LTV ratio
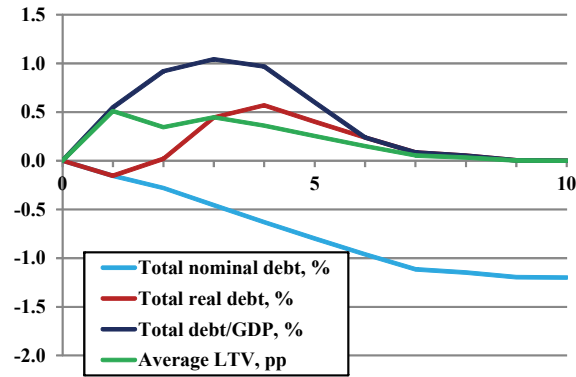
be between -0.6 and -0.8. The former estimate applies if the capital-gains on housing are disregarded; the latter if the capital-gains tax is fully internalized by housing owners and furthermore paid every year even if the housing is not sold. In reality, the capital-gains tax is postponed until it is realized when the housing is sold, and it may be further postponed if new housing is bought. Therefore, the best estimate of the semi-elasticity is probably somewhere between -0.6 and -0.8. I will use -0.7 as an estimate.[5] That is, a 1 percentage point higher 1-year mortgage rate at the beginning of year 1 reduces real housing prices by 0.7 percent at the beginning of that year. At the beginning of year 2 they will be back to the baseline level. Thus, the increase in real housing prices relative to the baseline is temporary.

Furthermore, the inflation expectations of housing buyers matter for the housing price, since, for a given nominal mortgage rate, higher expected inflation reduces the real after-tax mortgage rate. Svensson (2013a) estimates the semi-elasticity of housing prices with respect to inflation expectations to be 0.87 or 0.90 depending on whether the capital-gains tax is fully internalized and paid each year or disregarded. Thus, the semi-elasticity is not so sensitive to the capital-gains tax. I will use 0.88 as an estimate. That is, if housing buyers expect inflation over the next year to fall by 1 percentage point, real housing prices will fall by 0.88 percent, everything else equal. If housing buyers' inflation expectations adjust so that they correctly anticipate inflation over the next year, real housing prices will fall – because of both the rise in the 1-year mortgage rate and the fall in

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[5] A quick back-of-the-envelope calculation explains why the semi-elasticity would be somewhere around -0.7. Assume that a potential housing buyer considers buying a house, financing 100 percent of the purchase with a mortgage. If the mortgage rate for the first year falls by 1 percentage point, the potential buyer saves 1 percent of the price of the house. After tax (assuming a 30 percent deductible capital-income tax) he or she saves 0.7 percent. He or she is thus prepared to pay 0.7 percent more for the house.

inflation expectations by 0.3 percentage points – by a total of 0.96 percent at the beginning of year 1. Because of the fall in inflation expectations relative to the baseline of 0.6 percentage points in year 2 and 0.3 percentage points in year 3, real housing prices will also fall by 0.53 and 0.26 percent relative to the baseline in years 2 and 3, respectively.[6] Figure 3.1 also shows the response of real housing prices from the 1 percentage point increase in the policy rate. We note that the fall in inflation, GDP, and real housing prices relative to the baseline is *temporary*.

In order to calculate the response of *nominal* housing prices, we need to know the response of the price level. Figure 3.2 shows the response of the price level that follows from the response of inflation in figure 3.1. It also shows the response of nominal GDP and nominal housing prices that follows when the deviation of the price level from the baseline in figure 3.2 is added to the deviations of real GDP and real housing prices in figure 3.1.[7] We see that the price level and nominal housing prices fall to 1.2 percent below the price level in year 4. Nominal GDP falls to 1.6 percent below the baseline in year 4 and then rises to 1.2 percent below the price level in year 6. Thus, the increase in the policy rate by 1 percentage point leads to a *permanent* fall of 1.2 percent relative to the baseline in the price level, nominal GDP and nominal housing prices.

The fall in nominal housing prices implies that new mortgages fall correspondingly relative to the baseline. Since new mortgages are a relatively small share of the total nominal debt, this will lead to a quite slow fall in total nominal debt, shown in figure 3.3. Total nominal debt reaches 1.2 percent below the baseline in year 9.

Since we know the response of total nominal debt and the price level, we can calculate the response of total real debt by subtracting the deviation of the price level from the deviation of total nominal debt. Since we know the response of nominal GDP, we can calculate the response of the debt-to-GDP ratio by subtracting the deviation from the baseline of nominal GDP from the deviation of total nominal debt, or by subtracting the deviation of (real) GDP in figure 3.1 from the deviation of real debt in figure 3.4.[8] The responses of total real debt and the debt-to-GDP ratio are shown in figure 3.4. Since the price level falls to 1.2 percent below the baseline faster than total nominal debt, real debt rises to 0.56 percent above the baseline in year 4 and then slowly falls back to the baseline. Since nominal GDP falls even faster and overshoots the permanent fall of 1.2 percent below the baseline, the debt-to-GDP ratio rises to 1 percent above the baseline before it

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[6] For simplicity, housing buyers are assumed to consistently expect 2 percent inflation two years ahead and onwards.

[7] Here I do not distinguish between the CPI price level, the CPIF price level, and the GDP deflator.

[8] The debt-to-GDP ratio in year t is here defined as real debt at the beginning of year t divided by real GDP during year t.

Figure 4.1: Response of total nominal and real debt, the debt-to-GDP ratio, and the average LTV ratio when mortgages are renewed every 4 years
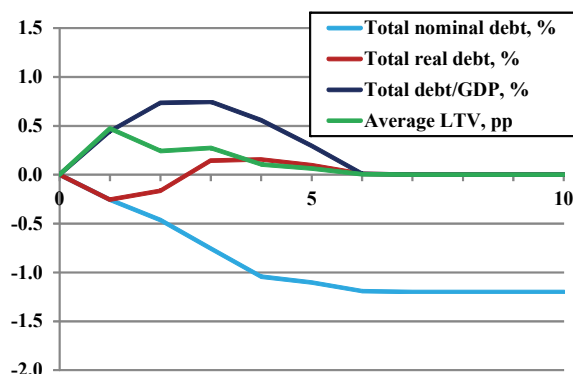
falls back to the baseline. Figure 3.5 also shows the response of the average LTV ratio. It rises to about almost 0.5 percentage points above the baseline in year 1–3 and then falls back to the baseline. That is, it increases from 62 percent to 62.5 percent before it slowly falls back to 62 percent.

4   Robustness

How robust is the result of this paper – that a higher policy rate increases household real debt and the household debt-to-GDP ratio? This is examined in this section. We will see that the result the household debt-to-GDP ratio increases is quite robust to alternative assumptions of a shorter financing period, a stronger response of housing prices, and a weaker response of inflation and GDP to the policy rate. For these alternative assumptions, the real debt becomes much less responsive to the policy rate and even falls initially.

For instance, suppose that mortgages are renewed after a holding period of only 4 years instead of 7, so $T = 4$. This means that $1/T = 25$ percent of the mortgages are refinanced each year instead of 14 percent.[9] The response of total nominal debt, total real debt, the debt-to-GDP ratio, and the average LTV ratio is shown in figure 4.1. Now total real debt becomes less responsive and falls below the baseline a little the first two years and then rises a little above the baseline in year 2 before it falls back to the baseline in year 6. The debt-to-GDP ratio rises to about 0.75 percent

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[9] For a given LTV ratio of 70 percent for new mortgages, the baseline average LTV ratio will be 66 percent rather than 62 percent.

Figure 4.2: The response of nominal housing prices and total nominal debt for double semi-elasticites with respect to the mortgage rate and inflation expectations
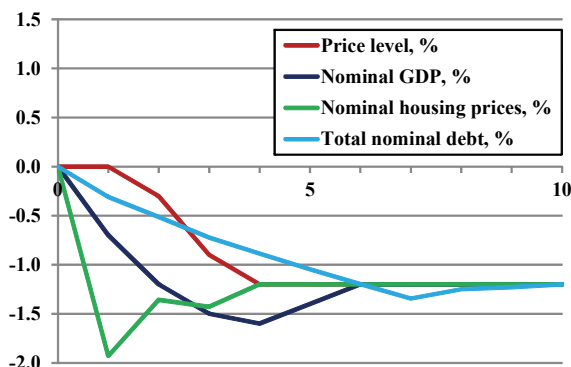

above the baseline in year 2 and 2 before it falls back and reach the baseline in year 6. The average LTV ratio rises to 0.5 percent above the baseline in year 1 and then falls back to the baselined. The response of the debt-to-GDP and the LTV ratios to the policy rate is thus not very sensitive to a shortening to a much shorter refinancing period.

Furthermore, doubling the semi-elasticity of real housing prices with respect to the mortgage rate and inflation expectations does not change the result for the debt-to-GDP ratio, as seen in figures 4.2 and 4.3. Nominal housing prices fall more in year 1 than in figure 3.3, and this shifts down the path of total nominal debt, but it does not materially change the dynamics of the debt-to-GDP ratio. Real debt becomes less responsive, falls initially below the baseline and then rises above the baseline.

A somewhat extreme sensitivity test is to assume that the impulse responses of inflation and GDP is only half that of Ramses, the Riksbank's standard DSGE model, and also that the refinancing period is so short as 4 years. We see in figure 4.4 that then nominal debt falls faster than the price level but slower than nominal GDP. In figure 4.5 we see that, as a result, total real debt actually falls a little and then comes back to baseline, whereas the debt-to-GDP ratio still rises, but only to 0.3 percent above the baseline. The result that "leaning against the wind" increases the debt-to-GDP ratio thus seems robust to quite dramatic parameter changes, whereas real debt need not increase if the response of total nominal debt is weak enough and the response of inflation is small and sluggish enough.

Importantly, the result that a higher policy rate increases real debt and the debt-to-GDP ratio

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Figure 4.3: The response of total nominal and real debt and the debt-to-GDP ratio for double semi-elasticites with respect to the mortgage rate and inflation expectations
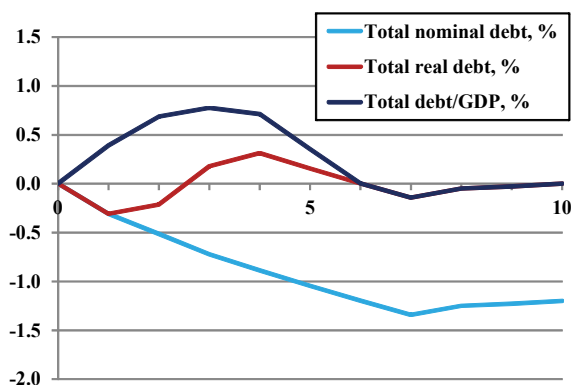

is in terms of deviations from a baseline. It is hardly very sensitive to the precise baseline chosen. For instance, whether nominal housing prices in the baseline grow by 2 percent or 0 percent per year instead of 4 will not affect the result. The crucial property driving the result is that the total nominal debt falls relatively slowly and that the price level and, in particular, nominal GDP fall faster. That property hardly depends on the precise baseline.

5   Conclusions

The explanation for the result of this paper is actually quite simple and intuitive. A higher policy and mortgage rate for a year than the baseline leads to *temporarily* lower inflation, GDP, and real housing prices relative to the baseline. It leads to a *permanently* lower a price level, nominal GDP, and nominal housing prices relative to the baseline. Since a relatively small share of mortgages are refinanced each year, the somewhat lower new mortgages slowly reduce total nominal debt relative to the baseline. But the price level and, in particular, nominal GDP fall faster. Total real debt therefore rises relative to the baseline almost as fast and as much as the price level falls, and the debt-to-GDP ratio rises almost as much and as fast as nominal GDP falls. Since nominal GDP overshoots the permanent fall, the debt-to-GDP ratio increases more than real debt. The crucial property for the result is that the total nominal debt falls relatively slowly and that the price level and, in particular, nominal GDP falls faster. This property that a higher policy rate increase the debt-to-GDP ratio seems quite robust to alternative assumptions about a shorter refinancing period,

Figure 4.4: The response of nominal housing prices and total nominal debt with shorter refinancing period and weaker response of inflation and GDP
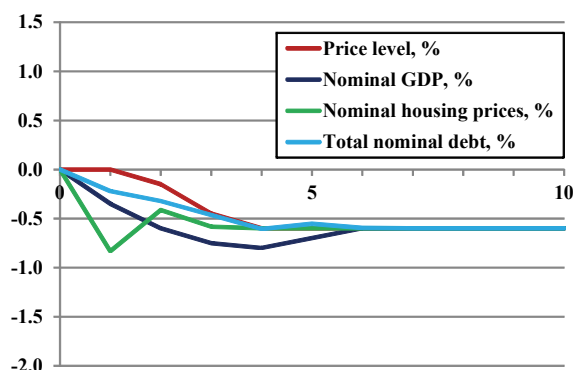

stronger housing price response, and weaker response of inflation and GDP. For these alternative assumptions, the response of real debt is much weaker and it may fall a little initially.

The result is reminiscent of the discussion of "debt deflation,", the fact that deflation increases the value of existing nominal debt. Naturally, any lower price level than anticipated will lower the real value of existing nominal debt below what was anticipated (Bank of England (2013, p. 53), Fisher (1933), Eggertson and Krugman (2012)). They are also reminiscent of the recent debate on fiscal austerity. Fiscal austerity may reduce budget deficits and the growth of nominal public debt, but if it reduces nominal GDP faster due to high multipliers, the debt-to-GDP ratio will rise. For "monetary austerity" in the form of "leaning against the wind," it thus seems that the debt-to-GDP ratio will almost always rise. "Leaning" as a way of reducing the household debt-to-GDP ratio is counterproductive.

The Riksbank has conducted an arguably quite aggressive leaning-against-the-wind policy over several years , which has led to inflation substantially below the inflation target and unemployment substantially above any reasonable estimate of a long-run sustainable rate (see Svensson (2013b) for details). It has justified this policy by arguing that an alternative more expansionary policy would increase household debt-to-GDP and household debt-to-disposable income ratios and thereby any risks associated with household debt (see, for instance, Sveriges Riksbank (2013b)). But the Riksbank has not presented any analysis of debt dynamics that supports its case. It seems that the Riksbank has simply taken as given that a higher policy rate reduces household debt ratios. Some simple and robust analysis presented here shows that the Riksbank seems to have got the sign of the

Figure 4.5: The response of total real debt and the debt-to-GDP ratio with shorter refinancing period and weaker response of inflation and GDP
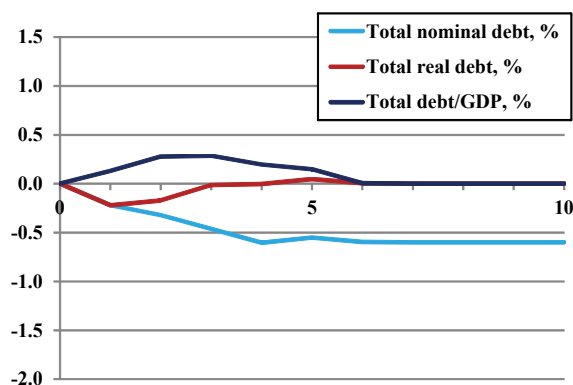
effects of its policy wrong. Its policy has actually increased the debt-to-GDP and debt-to-disposable income ratios. Thus, it is difficult to find any justification for the Riksbank policy.

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Appendix

A   Amortization in nominal terms

Above it is assumed that there is no amortization in nominal terms until the mortgage is refinanced in year T. There is still amortization in real terms and in relation to housing prices and disposable income. But suppose that borrowers amortize also in nominal terms at the annual rate β ($0 \leq \beta <$

1). That is, a housing owner that bought housing in year v at the nominal price P_v and got the mortgage $m_v = \alpha P_v / T$ repays a share β of the remaining mortgage each year. Then, in year t, $v \leq t \leq v + T - 1$, the mortgage of vintage v is

$$m_v = (1 - \beta)^{t-v} \alpha P_v.$$

It follows that the total debt in year t is given by

$$D_t = \frac{\alpha}{T} \sum_{v=t-T+1}^{t} (1 - \beta)^{t-v} P_v.$$

It is obviously easy to incorporate nominal amortization of this kind.