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Claire Boeing-Reicher and David Pinto

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THE EFFECTS OF THE SUPPLY OF CREDIT ON REAL ESTATE PRICES: VENEZUELA AS A POLICY LABORATORY

Claire Boeing-Reicher [1] and David Pinto[2]

ABSTRACT

We identify the effects of the supply of mortgage credit on house prices, using the politically-directed credit-targeting regime of Venezuela as quasi-natural experiment. We find a large effect of the supply of housing credit on time path of house prices (or housing markups), with an elasticity of housing markups with respect to credit of about 0.23 under our baseline specification, and similar results under a set of alternative specifications. These estimates are close to previous panel estimates for the United States, which suggests that these estimates capture similar phenomena.

Keywords: House prices, credit supply, Venezuela, credit targeting

JEL classification: E51, E65, R31

Claire Boeing-Reicher
Kiel Institute for the World Economy
Kiellinie 66, D-24105 Kiel, Germany
phone: +49-431-8814-300
Email: claire.reicher@ifw-kiel.de

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[1]Institute for the World Economy, Kiellinie 66, 24105 Kiel, Germany
[2]Institute for the World Economy: Advance Studies Program, 2013-214

1 Introduction

The nationwide expansion of mortgage credit and the increase in house prices during the 2000s, and the subsequent crash, have provoked a wave of research on the causal nexus between the supply of credit and asset prices. However, it is difficult to clearly state in econometric terms that the expansion in mortgage credit caused the increase in house prices, since it is conceivable that the increase in house prices may have caused the expansion in credit, or something else caused both the increase in house prices and the expansion in credit. In fact, it is only recently that two panel studies on U.S. metropolitan areas have managed to identify the causal effect of the supply of credit on house prices. To add to our knowledge on this subject, we offer some evidence on this effect based on Venezuelan time-series data. We use Venezuelan data because in Venezuela, the supply of mortgage credit is politically determined, to such an extent that shocks to the supply of credit provide a quasi-natural experiment. This allows us to treat Venezuela under the administration of former president Hugo Chávez as a policy laboratory. After doing this, we find similar results to the panel studies–we find a large and persistent effect of the supply of mortgage credit on the housing markup (our preferred measure of house prices), with a medium-run (12-quarter) elasticity of about 0.23.

Our results add to a growing set of findings which suggest that changes to the supply of housing credit have an important causal effect on house prices. To that end, there are two panel studies which look at the effects of the supply of credit on regional house prices in the United States, and these studies also rely on a political identification strategy. The first panel study in question is that of Favara and Imbs (2015), who use changes in branch banking regulations to identify exogenous movements in the supply of housing credit at the MSA level. Favara and Imbs find a large, economically significant effect of the supply of credit on house prices. The medium-run elasticity that they estimate, holding income constant, is somewhat below 0.25, which is close to our estimate of 0.23.[1] The second panel study to examine this issue is that of Adelino et al. (2012), who estimate the effects of regional changes in the conforming loan limit of the Federal Housing Finance Agency

[1] We derive this figure from Favara and Imbs (2015), Table 5, second column. An elasticity of 0.25 is obtained by taking $0.134/(1-0.457)$.

(FHFA), which the authors take to represent a exogenous policy-driven shock to credit, on house prices at the metro area level. Adelino et al. find that an increase in the conforming loan limit leads to a substantial increase in house prices, which in turn suggests that the supply of credit causally affects house prices. In light of this panel evidence for the United States, our results find that the aggregate time-series evidence for Venezuela produces a similar set of patterns, which suggests that both sets of estimates capture basically similar phenomena.

Apart from the two politically-identified panel studies, most other studies on the link between the supply of credit and house prices take an observational approach. However, these studies also find a correlation between the supply of credit and house prices, with some possibility of causation. One such study is the panel study of Agnello and Schuknecht (2009). Agnello and Schuknecht estimate a panel probit model in order to see which variables can help to forecast boom and bust episodes in the housing market for 18 major industrialized economies. In their findings, they observe that lagged credit growth helps to forecast booms and busts. Another such study is that of Goodhart and Hofmann (2008), who estimate a panel VAR model with fixed effects, to estimate the degree of comovement among house prices, credit and money, using data for the 17 major industrialized economies. Based on these estimates, they conclude that money, credit, and house prices are linked to each other. Exploring this link with respect to the recent crisis, Mian and Sufi (2009) also present results that provide evidence for such a relationship. This evidence comes from the fact that the US house price boom from 2001 to 2005 coincided with an unusual increase in subprime lending which affected ZIP codes asymmetrically. It turns out that those ZIP codes which experienced a larger increase in subprime lending also experienced larger increases in mortgage credit and also in house prices, with some hint of causality.[2] Finally, based more on a descriptive approach, Borio and Lowe (2002) observe that asset price cycles seem to comove with the credit cycle. Taken together, the literature suggests that there is a statistical relationship between the supply of credit and house prices, and in conjunction with the identified panel studies,

[2] We refer to results from the working paper version, since the published version omits this finding. Also note that Glaeser et al. (2010) find that none of this cross-sectional correlation seems to come through changes in approval rates or loan-to-value ratios.

our work helps to further establish that this relationship also appears to be a causal one.

This set of empirical results also has implications for ongoing theoretical work which has sought to explain the 2000s boom and crash in house prices. To cite one example of such work, Justiniano et al. (2014) set up a model of real estate prices which features a credit channel. Based on this model, Justiniano et al. argue that credit supply shocks may be a major driver of the boom and crash in U.S. house prices. On the credit supply side, their model features a lending constraint following Kiyotaki and Moore (1997), and on the demand side, their model features a collateral constraint. A credit supply shock works in the following manner. First, a loosening of the lending constraint leads to an expansion in the supply of housing credit, which then leads to an expansion in the demand for housing. This expansion in demand drives house prices up, which further loosens the collateral constraint on the credit demand side. In fact, based on this feedback mechanism, this model generates a stark prediction: a house price elasticity with respect to credit of about one, which in comparison with the data, overexplains the original runup in house prices. Nonetheless, the basic qualitative predictions of their model are compatible with our esults, which suggests that changes in lending constraints may help to explain some of the empirical patterns that we see.

2 Identification: the economic and political environment in Venezuela during the credit targeting regime

Our results are based on an identification strategy that takes the supply of credit in Venezuela as an exogenous variable, which then affects the housing markup (our proxy for real estate prices). As Figure 1 shows, between 1999 and 2008, the housing markup and the nominal supply of housing credit tended to move together. The housing markup serves as a proxy for the value of land, and this markup is equal to a nominal house price index of the capital city Caracas, divided by a construction input price index.[3] The nom-

[3] The nominal house price index is the "Indicador Inmobiliario Consolidado (Inpi)", which was calculated by the Central Bank of Venezuela for research and internal purposes until the first quarter of 2008. The construction input price index is the "Índice de Precios de Insumos de la Construcción", which is published on a monthly basis by the Central Bank of Venezuela.

inal supply of housing credit is equal to the aggregate supply of residential mortgages within the Venezuelan banking system.[4] Examining these series, several episodes are worth noting. First of all, during the 2002-2003 period of political instability, both the housing markup and the supply of housing credit fell together. Then, during the second half of 2003, both variables began to recover from their depressed levels, and from 2005 onward (marked by the vertical line), both variables began to show a sustained sharp increase. Altogether, the visual evidence indicates that both variables tended to fall and rise together. Based on our identification strategy, which takes credit as exogenous, we argue that the increase in the housing markup alongside the increase in credit supports the idea that an increase in credit causes the housing markup to rise.

To support this identification strategy, we argue that the documentary evidence suggests that the supply of housing credit in Venezuela during the 2000s was driven by political decisions rather than economic decisions and is hence exogenous to the housing markup. We argue that these conditions especially hold after 2005. After 2005, the sharp increase in the supply of housing credit results directly from the Venezuelan government's implementation of an expanded credit targeting regime. Under this credit targeting regime, the government forced private and public banks to direct ten percent of their respective loan portfolios to housing credit in the form of mortgages, with an objective toward expanding home ownership among workers. Since banks on average had initially directed only two percent of their loan portfolios to housing credit, in order to avoid shrinking their portfolios in other sectors, banks were forced to progressively increase their overall supply of credit.[5] In fact, the Central Bank of Venezuela points out in its 2005 Annual Economic Report that real credit supply for the purchase of houses increased by 157.5 percent in 2005 due to the implementation of this credit target.[6] The imposition of this credit target also coincided with the imposition of a lower interest rate for housing credit (shown in Figure 2), with an objective toward limiting "usury".[7] Im-

[4] These data were obtained from the Central Bank of Venezuela.

[5] For further information about these changes and other changes to the Venezuelan banking system, see Levy-Carciente et al. (2014).

[6] For further information, see Banco Central de Venezuela, Informe Económico 2005, page 179.

[7] See Gaceta Oficial No. 38.098: Ley Especial de Protección al Deudor Hipotecario de Vivienda (2005), for which a rough translation would be, "The special law for the protection of residential mortgages".

portantly, the credit targeting law itself states that its objectives mainly lie in expanding homeownership and in limiting usury, while that law does not make any reference to then-current economic conditions. These stated objectives suggest that the credit targeting regime and its associated expansion of housing credit were implemented for exogenous, political reasons rather than as an endogenous response to macroeconomic conditions.

There is more evidence that points toward a uniquely strong role for shocks to housing credit in driving the housing markup. Although Venezuela experienced a number of other shocks during the 1999-2008 period, none of these shocks seems to have coincided closely with the rise in housing markups. One set of shocks involves shocks to exchange rate policy. Venezuelan exchange rate policy may conceivably have an effect on housing markups, since house prices in Venezuela are often tied to the US dollar to avoid issues associated with a high and variable inflation rate. To address this possibility, Figure 3 displays the housing markup and the shadow and official exchange rates between the Venezuelan Bolivar (VEB) and the US dollar.[8] The Venezuelan government implemented controls on these exchange rates beginning in 2003, after which the official and shadow exchange rates diverged. The official exchange rate increased only gradually after 2003, while the shadow exchange rate increased sharply beginning in late 2006, nearly two years after the sharp increase in the housing markup was well underway. The timing of this increase suggests that the rise in the housing markup may have been driven by something other than shocks to exchange rate policy.

In addition to oil price shocks, another set of shocks to affect Venezuela during this period would be shocks to oil prices. Given that oil forms more than 90 percent of Venezuelan exports, changes in oil prices may have affected the relative price of nontrad-

The discussion about expanding home ownership could be found in Articles 8 and 9 of this law, while the discussion about usury could be found in Article 11.

[8] Both exchange rate indicators are in nominal terms. While the official exchange rate was published by the Central Bank of Venezuela, the shadow market exchange rate was published on private websites which were not officially recognized by the Venezuelan government. Until 2010 the shadow market exchange rate was published on a daily basis at http://www.dolarparalelo.blogspot.com, while until February 2015 the shadow market exchange rate was published on a daily basis at http://dolartoday.com. In February 2015 the shadow foreign exchange market was finally legalized by the government, and since then foreign exchange can be traded freely at the Sistema Marginal de Divisas (SIMADI).

ables in general and the price of real estate in particular.[9] To address this possibility, Figure 4 displays the housing markup and the real price of the Venezuelan oil basket in US dollars.[10] A look at this figure shows that the real price of the Venezuelan oil basket began to rise from 2001 onward–four years before the sharp increase in the real estate markup. The timing of the oil price shocks, as with the exchange rate shocks, does not seem to coincide closely with the rise in housing markups.

Altogether, it appears that the timing of exchange rate shocks and oil price shocks does not coincide with the timing of the sharp increase in the housing markup, while the sharp increase in the housing markup does seem to coincide with a sharp increase in the supply of housing credit and with a fall in interest rates, both of which are driven by the credit targeting regime. Furthermore, this credit targeting regime appears to be driven by political events rather than by economic events, which suggests that it is reasonable to assume that the nominal supply of housing credit is exogenous to the rest of the system. Using this exogeneity as an identifying assumption in a VAR, we go on to show that there does in fact seem to be a close relationship between the supply of housing credit and the housing markup, and this relationship is robust to including these other confounding factors.

3 Housing credit and the housing markup: Evidence from a VAR

3.1 The VAR specification

The institutional setup of the credit targeting regime–in particular, the exogenous imposition of that regime for political reasons–makes it possible to identify the effects of credit supply shocks. This identification scheme implies that a VAR model would capture

[9] Given this reliance on oil, an increase in oil prices could result in the "Dutch Disease", following the terminology of Corden and Neary (1982).

[10] The real oil price is obtained by dividing the nominal price of the Venezuelan oil basket in US dollars, which is published by the Venezuelan Ministry of Energy and Oil, by the US CPI, which is published by the US Bureau of Labor Statistics.

the effects of an exogenous shock to growth in the nominal supply of housing credit, or nominal credit growth, under the assumption that nominal credit growth in the current period is exogenous to all of the other variables in the system. To estimate such a VAR, we use a Bayesian MCMC estimation procedure in order to generate exact credible intervals (analogous to confidence intervals) given the data. Furthermore, the credit supply shock may have persistent–or even unit-root or explosive–effects on observables, which renders the use of asymptotic reasoning problematic.

In the baseline VAR setup, the observables y_t are given by the two-by-one matrix:

$$y_t = \begin{pmatrix} \text{nominal housing credit growth}_t \\ \text{housing markup growth}_t \end{pmatrix}. \tag{1}$$

The elements of y_t are equal to the change in log total nominal housing credit (nominal housing credit growth) and the change in the log housing markup (housing markup growth). The aggregates y_t evolve according to a VAR. The VAR specification itself takes the reduced form:

$$y_t = c + \sum_{p=1}^{P} A_p y_{t-p} + \varepsilon_t. \tag{2}$$

On the right-hand side of the VAR, c equals a 2 by 1 matrix containing a set of intercepts; A_p equals a 2 by 2 matrix comprising the coefficients on lagged endogenous variables at lag p; and the residuals ε_t are a 2 by 1 vector of innovations which is i.i.d across time and multivariate normal with a mean of zero and a covariance matrix of Σ. There are T observations in total. Taking the inclusion of P lagged endogenous variables on the right-hand side into account, there remain $T - P$ usable observations in calculating the VAR coefficients.

3.2 The estimation procedure

To estimate the VAR, it is necessary to first set the lag length P. In the baseline setup, the Akaike and Schwarz information criteria both point toward a value of P equal to one, and so the estimated VAR contains one lag. We estimate this VAR using an MCMC algorithm, where each MCMC draw is indexed by (i). For notational simplicity, the matrix A denotes all of the coefficients in the VAR stacked into a column matrix; X denotes the stacked right-hand side variables of the VAR (including a column of ones); and Y denotes the stacked left-hand side variables of the VAR. Furthermore, we set our priors such that the matrix A is multivariate normal with a zero mean and zero precision, and Σ is Inverse Wishart, equivalent to having observed zero observations, with a product of residuals equal to a matrix of zeroes.

To initialize the MCMC, we first set $A^{(1)}$ and $\Sigma^{(1)}$ to the observed coefficients and to the observed covariance matrix of VAR residuals, which are calculated using the usual OLS formulae. Then, for each iteration (i) from 2 through 50,001, we draw a set of coefficients $A^{(i)}$ given Y, X, and $\Sigma^{(i-1)}$, from a posterior distribution given by $A^{(i)} \sim N((X'X)^{-1}(X'Y), \Sigma^{(i-1)} \otimes (X'X)^{-1})$. Next, we generate a set of VAR residuals $\varepsilon^{(i)}$ of dimension 2 by $T-P$, given $A^{(i)}$, Y, and X. Based on these residuals, we draw a covariance matrix $\Sigma^{(i)}$, from a posterior distribution given by $\Sigma^{(i)} \sim IW(\varepsilon^{(i)}(\varepsilon^{(i)})', T-P)$.[11]

Once the VAR coefficients for iteration (i) are recovered, we then apply a set of Cholesky identifying assumptions in order to recover impulse responses. We generate these impulse responses for iteration (i) by shocking the first element of ε_t and tracing through its contemporaneous and dynamic effects. We accomplish this by representing the innovations to equation (2) as $\varepsilon_t = C^{(i)}\eta_t$, where η_t is a matrix of shocks with an identity covariance matrix. By assuming that the credit supply shock can affect the other variables contemporaneously but not vice versa, we equivalently assume that $C^{(i)}$ is given by a lower-triangular matrix which we in turn derive using the Cholesky decomposition of $\Sigma^{(i)}$. By setting the first element of η_t to one at the initial period (which represents a one-standard-deviation credit supply shock), premultiplying by $C^{(i)}$ gives $\varepsilon_t^{(i)}$ conditional on that shock, which allows us to iterate through equation (2) to map out the impulse response for later periods.

After engaging in these steps for a given iteration (i), we store the impulse responses in memory, and then we move on to the next iteration $(i+1)$ and repeat the whole process.

[11] The notation used here for the Inverse Wishart distribution takes as arguments the sum of squared residuals and number of observations.

After the final iteration, we discard the first 10,000 iterations as burn-in, which leaves the remaining 40,001 iterations to calculate exact posterior medians, credible intervals, and the posterior distributions of impulse responses.

3.3 Baseline VAR results: The increase in housing markups after a housing credit supply shock

3.3.1 Baseline results: the effects of a nominal credit supply shock

Figure 5 shows a set of posterior median impulse responses of y_t to a one standard deviation housing credit supply shock, along with a set of credible intervals. The left-hand panels of Figure 5 display the quarterly responses of the nominal housing credit growth rate and the housing markup growth rate to a one-standard-deviation nominal housing credit supply shock, while the right-hand panels show the cumulative responses of housing credit and the housing markup. Table 1, part A, displays some posterior statistics with respect to these impulse responses. Altogether, these impulse responses show that housing credit supply shocks appear to drive up the housing markup, which is directly in line with the visual evidence from Figure 1. A nominal housing credit supply shock on impact triggers a 5.40 percent posterior median increase in the nominal housing credit supply and a 0.63 percent posterior median increase in the housing markup growth rate (both in log terms), with a 92.52 percent probability that the latter increase is above zero. After twelve quarters the housing credit supply shock leads on average to a 12.34 percent posterior median cumulative increase in the total housing credit supply and a 2.82 percent posterior median cumulative increase in the housing markup growth rate, with a 97.82 percent probability that the latter effect is above zero. This response is economically significant. These numbers imply that the medium-run elasticity of the housing markup with respect to the supply of housing credit is equal to approximately 0.23. Furthermore, a variance decomposition (using OLS estimates of the VAR system) suggests that within a horizon of 12 quarters, between 18 and 19 percent of the variance in the housing markup growth rate can be explained by the housing credit supply shock. Altogether, it appears that credit supply shocks are an economically significant factor behind fluctuations in the housing markup in Venezuela.

3.3.2 An overidentifying restriction: the effects of a residual housing markup shock

Under the identifying assumptions used to identify the effects of a credit supply shock, the supply of credit should be driven by the credit supply shock alone, and residual shocks to the housing markup (shocks to the second element of η_t) should therefore have no effect on the supply of credit. A nonzero effect of such a shock on the credit supply would mean that there is some feedback process running from the housing markup to the housing credit supply, which would put the identifying assumptions underlying the VAR into doubt. To check that the housing markup does not drive future changes to the housing credit supply, Figure 6 and Table 1, part B, display impulse response paths and posterior statistics with respect to the housing credit growth rate and housing markup growth rate after a residual shock to the housing markup. It turns out that a residual shock to the housing markup in fact has little effect on the supply of housing credit. The posterior credible intervals for these responses encompass zero, and furthermore, the estimated responses of the housing credit supply to a housing markup shock are small and economically insignificant. Furthermore, a variance decomposition shows that shocks to the housing markup only explain about 6 percent of the variance of housing credit growth. Taken together, this evidence is in line with the narrative evidence and with the identifying assumption that a residual shock to the housing markup has no effect on the supply of housing credit in later periods.

3.4 Robustness: results based on alternative observables

3.4.1 Real instead of nominal housing credit supply shocks

One possible objection to our analysis might take the form that we combine real and nominal variables in an unusual way. To address this objection, we show that the baseline VAR results are robust to looking at real housing credit growth instead of nominal housing credit growth. To do this, we replace nominal housing credit growth in equation (2) with real housing credit growth, such that:

$$y_t = \begin{pmatrix} \text{real housing credit growth}_t \\ \text{housing markup growth}_t \end{pmatrix}, \tag{3}$$

and then proceed as before. Here, we obtain real credit by deflating nominal housing credit by the Venezuelan (Caracas) consumer price index, which serves as a proxy for the level of consumer prices in all of Venezuela.

As seen in Figure 7 and Table 2, part A, a real housing credit supply shock on impact triggers a 14.12 percent posterior median increase in the real housing credit growth rate and a 0.67 percent posterior median increase in the housing markup growth rate, with a 93.78 percent probability that this increase is above zero. After twelve quarters the real housing credit supply shock leads to a 34.58 percent cumulative increase in the real housing credit supply and a 3.03 percent posterior cumulative increase in the housing markup growth rate, with a 98.37 percent probability that this effect is above zero. As with a nominal credit supply shock, the effects of a real credit supply shock are statistically distinguishable from zero and economically significant. Furthermore, within a horizon of 12 quarters, between 20 and 21 percent of the variance in housing markup growth can be explained by the housing credit supply shock. Altogether, these results show that the baseline results are not sensitive to taking nominal as opposed to real housing credit, and in fact, the baseline results could be viewed as somewhat conservative.

3.4.2 Real house prices instead of housing markups

The baseline VAR results are also robust to looking at an alternative measure of house prices, which involves replacing the housing markup in equation (2) with real house price growth, such that:

$$y_t = \begin{pmatrix} \text{nominal housing credit growth}_t \\ \text{real house price growth}_t \end{pmatrix}, \tag{4}$$

and then proceeding as before. Here, real house prices are obtained by deflating nominal house prices by the Venezuelan (Caracas) consumer price index.

As seen in Figure 8 and Table 2, part B, a nominal housing credit supply shock on impact triggers a 5.47 percent posterior median increase in nominal housing credit growth and a 0.33 percent posterior median increase in real house price growth, with an 81.11 percent probability that this increase is above zero. After twelve quarters the nominal housing credit supply shock leads to a 12.36 percent cumulative increase in the nominal credit supply and a 1.65 percent posterior cumulative increase in the real house price, with a 94.48 percent probability that this effect is above zero. These effects are (borderline) statistically distinguishable from zero and economically significant, though less significant than under the housing markup measure. After 12 quarters, about 10.5 percent of the variance in house price growth can be explained by the housing credit supply shock. Based on these results, it appears our results are robust to choosing a different indicator of house prices.

3.5 Robustness: results based on expanded specifications

3.5.1 Taking the interest rate into account

As discussed in Section 2, the imposition of the credit targeting regime coincided with the imposition of a preferential interest rate for housing credit; and in fact, it is conceivable that this is one mechanism through which the credit targeting regime operated. To investigate the sensitivity of our results to movements in interest rates, we also estimate a specification which includes the interest rate on housing credit into the VAR, ordered second. In this setup, the vector y_t consists of the following observables, such that:

$$y_t = \begin{pmatrix} \text{nominal housing credit growth}_t \\ \text{change in nominal interest rate}_t \\ \text{housing markup growth}_t \end{pmatrix}, \tag{5}$$

where the change in the nominal interest rate is given by changes to the quarterly nominal lending rate until 2004 and the preferential nominal interest rate for residential mortgages from 2005 onward. As before, we utilize a one-lag specification based on the Akaike and Schwarz Information Criteria.

The impulse response functions in Figure 9 and the results in Table 3, part A, show that adding the change in the nominal interest rate to the system does not significantly alter the results of the baseline model specification. On impact, a nominal housing credit shock triggers a 5.49 percent median increase in the housing credit growth rate, a fall in the nominal interest rate of about 0.90 percent, and a 0.54 percent posterior median increase in the housing markup growth rate, with an 88.45 percent probability that this increase is above zero. After twelve quarters, the nominal housing credit supply shock leads on average to an 11.47 percent posterior median cumulative increase in the total housing credit supply, a 2.71 percent posterior cumulative increase in the nominal interest rate, and a 2.24 percent posterior cumulative increase in the housing markup growth rate, with a 94.00 percent probability that this effect is above zero. Over a 12 quarter horizon, between 22 and 23 percent of the variance in changes in interest rates and between 16 and 17 percent of the variance in the housing markup growth rate can be explained by the nominal housing credit supply shock. These results are broadly in line with those obtained in the baseline model, and these results suggest that the nominal housing credit supply shock may reduce interest rates at the outset, with an ambiguous effect in later periods.

Turning to the issue of identification, under the identifying assumptions used to identify the effects of a nominal housing credit supply shock, the supply of housing credit should be driven by the housing credit supply shock alone, and residual shocks to the absolute change in the nominal interest rate (shocks to the second element of η_t) should therefore have no effect either on the nominal supply of housing credit or on the housing markup. Nonzero effects of such a shock on the housing credit supply or on the housing markup would put the identifying assumptions underlying the three-variable VAR into doubt.

To check that the absolute change in the nominal interest rate does not drive future changes in the credit supply, Figure 10 and Table 3, part B, display paths and statistics with respect to the impulse responses to the nominal housing credit growth rate, housing markup growth rate, and the absolute change in the nominal interest rate after a residual shock to the nominal interest rate. It turns out that a residual shock to the nominal interest rate in fact has little effect on the nominal supply of housing credit, and only a small effect on the housing markup. The posterior credible intervals for these responses encompass zero, and furthermore, the estimated responses of the nominal housing credit supply to an interest rate shock are small and negative over the course of 12 quarters, and economically insignificant. In addition, a variance decomposition shows that shocks to the nominal interest rate only explain between 2 and 3 percent of the variance of nominal housing credit growth. Taken together, this evidence is in line with the narrative evidence and with the identifying assumption that a residual shock to the interest rate has no effect on the supply of housing credit in later periods.

3.5.2 Taking oil prices and exchange rates into account

Finally, we see what happens when we add real oil price growth and exchange rate growth to our system. Given the narrative evidence in Section 2, we do not expect much to happen to the effects of credit supply shocks when we include these two variables. This is indeed the case. To see this, in the expanded system, the vector y_t now consists of the following observables, such that:

$$y_t = \begin{pmatrix} \text{nominal housing credit growth}_t \\ \text{oil price growth}_t \\ \text{exchange rate growth}_t \\ \text{housing markup growth}_t \end{pmatrix}, \tag{6}$$

As before, we utilize a one-lag specification based on the Akaike and Schwarz Information Criteria.

The impulse response functions in Figure 11 and the statistics in Table 4, part A, show that adding these auxiliary variables does not significantly change the results relative to the baseline model specification. On impact, a nominal housing credit shock now triggers a 5.51 percent median increase in housing credit growth, a 2.05 percent median decrease in oil prices, a 1.48 percent decrease in the nominal exchange rate, and a 0.60 percent posterior median increase in the housing markup growth rate, with an 88.74 percent probability that this last increase is above zero. After twelve quarters, the nominal housing credit supply shock leads on average to a 12.17 percent posterior cumulative increase in the total housing credit supply, a 1.82 percent posterior cumulative decrease in oil prices, a 1.79 percent posterior decrease in the nominal exchange rate, and a 2.49 percent posterior cumulative increase in the housing markup, with a 94.18 percent probability that this last effect is above zero. Over a 12 quarter horizon, between 14 and 15 percent of the variance in the housing markup growth rate can be explained by the nominal housing credit supply shock. These results indicate that the results from the baseline model are not affected by taking oil prices and exchange rates into account, which is also in line with the narrative evidence presented in Section 2.

Interestingly, these results also point toward a moderate probability (100 percent minus 3.66 percent, or 96.34 percent) of a negative relationship between innovations to credit growth and oil price growth in the very short run, while the probability of this relationship falls in the long run. While the probability of this relationship in the very short run does not quite reach the 97.5 percent threshold that would be applied in a two-sided hypothesis test, and such a test would in any case require a Bonferroni-like correction for multiple comparisons, these results point toward that possibility that political authorities in Venezuela tended to slightly increase the supply of credit whenever the oil price fell. To the extent that this is a true pattern in the data, and not an artifact of multiple comparisons, it turns out that this pattern would result in this robustness check yielding somewhat too conservative of a result in the short run.

To investigate this issue and other issues related to the identification of this model, it is useful to look at the effects of the other shocks. Under the identifying assumptions used to identify the effects of a nominal housing credit supply shock, the supply of housing credit should be driven by the housing credit supply shock alone, and residual shocks to the real oil price growth rate (shocks to the second element of η_t) as well as residual shocks to the exchange rate (shocks to the third element of η_t) should therefore have no effect either on the nominal supply of housing credit or on the housing markup. Furthermore, looking at the effects of these shocks is likely to reveal the extent and direction of any bias that might result from a correlation between credit supply shocks and oil price shocks.

First, to check that the real oil price growth rate does not drive future changes in the supply of housing credit, Figure 12 and Table 4, part B, display median impulse response paths and statistics with respect to the impulse responses after a residual shock to the real oil price growth rate. It turns out that a residual shock to the real oil price growth rate has at most a minor effect on the nominal supply of housing credit, and only a small positive effect on the housing markup. After twelve quarters, the residual real oil price shock leads on average to a 4.29 percent posterior cumulative increase in the total housing credit supply, with a 91.28 percent probability that this effect is above zero. Over the course of twelve quarters, a residual real oil price shock triggers a 1.14 percent median increase in the housing markup, with an 79.68 percent probability that this increase is above zero. Furthermore, the variance decomposition shows that shocks to the real oil price growth rate only explain about 8 percent of the variance of nominal housing credit growth and between 2 and 3 percent of the variance of housing markup growth over a 12-quarter horizon. Taken together, this evidence is in line with the narrative evidence and with the identifying assumption that a residual shock to the real oil price growth rate has only a negligible effect on the supply of housing credit in later periods. Furthermore, this set of impulse responses suggests that the estimates of the very short-run effects of a housing credit supply shock are somewhat conservative, to the extent that these shocks are actually related to decreases in oil prices.

Then, to check that the shadow exchange rate does not drive future changes in the supply of housing credit, Figure 13 and Table 4, part C, display median paths and statistics with respect to the impulse responses after a residual shock to the shadow exchange rate. It turns out that a residual shock to the shadow exchange rate growth in fact has little effect on the nominal supply of housing credit, and only a small effect on the housing markup. The posterior credible intervals for these responses encompass zero, and furthermore, the estimated responses of the nominal supply of housing credit to a shadow exchange rate growth shock are small and economically insignificant. In addition, a variance decomposition shows that shocks to the shadow exchange rate only explain less than 5 percent of the variance of nominal housing credit growth. Taken together, this evidence is in line with the narrative evidence and with the identifying assumption that a residual shock to the shadow exchange rate has no effect on the supply of housing credit in later periods.

4 Conclusion

Altogether, the narrative evidence and quantitative evidence from a VAR for Venezuela both point toward a strong effect of the supply of housing credit on real estate markups, or on real estate prices more generally. Based on exogenous, politically-driven movements in the supply of housing credit that were implemented through a credit-targeting regime, we find that increases in the supply of housing credit appear to have resulted in large, robust increases in the housing markup, with a medium-run elasticity of the housing markup with respect to the supply of credit of about 0.23. Furthermore, we argue that these credit supply shocks have effects which are broadly compatible with the theoretical literature on the credit channel. The key to these results lies in the fact that the supply of credit in Venezuela is politically determined, which allows us to treat Venezuela as a policy laboratory and to conduct a quasi-natural experiment to see what happens after a shock to the supply of housing credit.

These results suggest that the findings reported by observational studies on this topic might represent, in large part, a causal relationship, rather than mere correlation. In interpreting these results in such a manner, it is worth pointing out that the fact that Venezuela can serve as a policy laboratory in the first place implies that Venezuela is not completely representative with respect to the experiences of other countries. Much of the Venezuelan economy is subject to state intervention, and the economy itself relies heavily on oil and natural resources. In these respects, Venezuela is different from a large, diversified economy such as the United States or most of Europe. As a result of these differences, our exact estimates should be treated with a degree of caution. Nonetheless, we believe that some of the same mechanisms that operate within the Venezuelan economy might operate within other economies, particularly with respect to the demand for real estate by the household sector. Furthermore, our aggregate time-series results are very close to those from the panel study of Favara and Imbs (2015). This similarity suggests that both sets of results seem to possibly capture a similar set of phenomena.

Taking into account these considerations, we believe that our results may help to shape ongoing work on the effects of changes in the supply of credit, and to provide a quantitative target for researchers to match. Additionally, within the macro literature, future work might help to examine the spillovers between the channels identified by Justiniano et al. (2014) and the real economy, particularly within credit-sensitive sectors such as the construction sector. Given the basic similarities between our empricial results and the theoretical results of Justiniano et al., our results also suggest that future work might further uncover the degree to which monetary, fiscal, and regulatory policymakers might wish to directly monitor, or respond to, shocks to the supply of credit. Altogether, the evidence points toward exogenous fluctuations in the supply of credit as having important effects on real estate prices, and given recent experience, these effects are are of substantial interest to policymakers and researchers.

References

Adelino, M., A. Schoar, and F. Severino (2012), “Credit Supply and House Prices: Evidence from Mortgage Market Segmentation”, *NBER Working Paper* 17832.

Agnello, L., and L. Schuknecht (2009), “Booms and Busts in Housing Markets: Determinants and Implications”, *ECB Working Paper* 1071.

Banco Central de Venezuela (2005), *Informe Económico 2005.*

Borio, C., and P. Lowe (2002), “Asset Prices, Financial and Monetary Stability: Exploring the Nexus”, *BIS Working Paper Series* 114.

Corden, W., and P. Neary (1982), “Booming Sector and De-Industrialization in a Small Open Economy”, *The Economic Journal* 92(268), pp. 825-848.

Favara, G., and J. Imbs (2015), “Credit Supply and the Price of Housing”, *The American Economic Review* 105(3), pp. 958-992.

Goodhart, C., and B. Hofmann (2008), “House Prices, Money, Credit and the Macroeconomy”, *ECB Working Paper* 888.

Glaeser, E., J. Gottlieb, and J. Gyourko (2010), “Can Cheap Credit Explain the Housing Boom?”, *NBER Working Paper* 16230.

Justiniano A., G. Primiceri G., and A. Tambalotti (2014), “Credit Supply and the Housing Boom”, *Federal Reserve Bank of Chicago Working Paper* 2014-21.

Kiyotaki N., and J. Moore (1997), “Credit Chains”, *Journal of Political Economy* 105(2), pp. 211-248.

Levy-Carciente S., D. Kennet, A. Avakian, H. Stanley, and H. Shlomo (2014), "Dynamical Macro-Prudential Stress Testing Using Network Theory", Working Paper.

Mian A., and A. Sufi (2009), "The Consequences of Mortgage Credit Expansion: Evidence from the 2007 Mortgage Default Crisis", *Quarterly Journal of Economics* 124(4), pp. 1449-1496.

República Bolivariana de Venezuela: "Ley Especial de Protección al Deudor Hipotecario de Vivienda" (2005), *Gaceta Oficial* 38.098.

Table 1: Two-variable baseline model: Cumulative responses to shocks: Results on impact (t=0) and after three years (t=12)

	Credit Growth Median [P>0] (Var. Decomp. %)	Housing Markup Growth Median [P>0] (Var. Decomp. %)
A. Nominal credit supply shock (Baseline)		
t=0	0.0540	0.0063 [92.52]
t=12	0.1234	0.0282 [97.82] (18.46)
B. Residual markup shock (Baseline)		
t=0	0	0.0242
t=12	0.0342 [89.10] (6.12)	0.0384

Part A displays the quarterly posterior median responses of nominal housing credit growth and housing markup growth to a one-standard-deviation nominal housing credit supply shock. The values in square brackets below the median response outcomes show the probability of the shock's effect being above zero. The values in parentheses display how much of the variance in the housing markup growth rate can be explained by the nominal housing credit supply shock (variance decomposition). Part B displays the same statistics as described above, but for the responses to a one-standard-deviation residual housing markup shock.

Table 2: Two-variable model with alternative indicators: Cumulative responses to shocks: Results on impact (t=0) and after three years (t=12)

	Credit Growth Median [P>0] (Var. Decomp. %)	Housing Markup / House Price Growth Median [P>0] (Var. Decomp. %)
A. Real credit supply shock (Alternative credit indicator: real credit)		
t=0	0.1412	0.0067 [93.78]
t=12	0.3458	0.0303 [98.37] (20.60)
B. Nominal credit supply shock (Alternative house price indicator: real house prices)		
t=0	0.0547	0.0033 [81.11]
t=12	0.1236	0.0165 [94.48] (10.45)

Part A displays the quarterly posterior median responses of real housing credit growth and housing markup growth to a one-standard-deviation real housing credit supply shock. Real housing credit is obtained by deflating nominal housing credit with the consumer price index (cpi) of the Venezuelan capital city Caracas. The values in square brackets below the median response outcomes show the probability of the shock's effect being above zero. The values in parentheses display how much of the variance in the housing markup growth rate can be explained by the real housing credit supply shock (variance decomposition). Part B displays the same statistics described as above, but for the nominal housing credit and house price growth responses to a one-standard-deviation nominal housing credit supply shock.

Table 3: Larger system with interest rate: Cumulative responses to shocks: Results on impact (t=0) and after three years (t=12)

	Credit Growth Median [P>0] (Var. Decomp.%)	Markup Growth Median [P>0] (Var. Decomp. %)	Change in Interest Rate Median [P>0] (Var. Decomp. %)
A. Nominal credit supply shock (System with interest rate)			
t=0	0.0549	0.0054 [88.45]	-0.0090 [12.88]
t=12	0.1147	0.0224 [94.00] (16.24)	0.0271 [97.20] (22.55)
B. Residual interest rate shock (System with interest rate)			
t=0	0	0.0425 [55.52]	0.0006
t=12	-0.0213 [13.48] (2.79)	-0.0093 [16.82] (4.64)	0.0320

Part A displays the quarterly posterior median responses of nominal housing credit growth, housing markup growth, and the change in the nominal interest rate to a one-standard-deviation nominal housing credit supply shock. The values in square brackets below the median response outcomes show the probability of the shock's effect being above zero. The values in parentheses display how much of the variance in the housing markup growth rate can be explained by the nominal housing credit supply shock (variance decomposition). Part B displays the same statistics described as above, but for the responses to a one-standard-deviation residual nominal interest rate shock.

Table 4: Larger system with oil prices and exchange rate: Cumulative responses to shocks: Results on impact (t=0) and after three years (t=12)

	Credit Growth Median [P>0] (Var. Decomp.%)	Markup Growth Median [P>0] (Var. Decomp. %)	Oil P. Growth Median [P>0] (Var. Decomp. %)	FX Rate Growth Median [P>0] (Var. Decomp. %)
A. Nominal credit supply shock				
(System with oil price, FX rate)				
t=0	0.0551	0.0060	-0.0205	-0.0148
		[88.74]	[3.66]	[7.47]
t=12	0.1217	0.0249	-0.0182	-0.0179
		[94.18]	[27.83]	[25.92]
		(14.33)	(10.71)	(6.65)
B. Residual oil price shock				
(System with oil price, FX rate)				
t=0	0	0.0029	0.0568	-0.0011
	[0]	[73.40]		[45.42]
t=12	0.0429	0.0114	0.0663	-0.0197
	[91.28]	[79.68]		[18.73]
	(8.10)	(2.61)		(4.57)

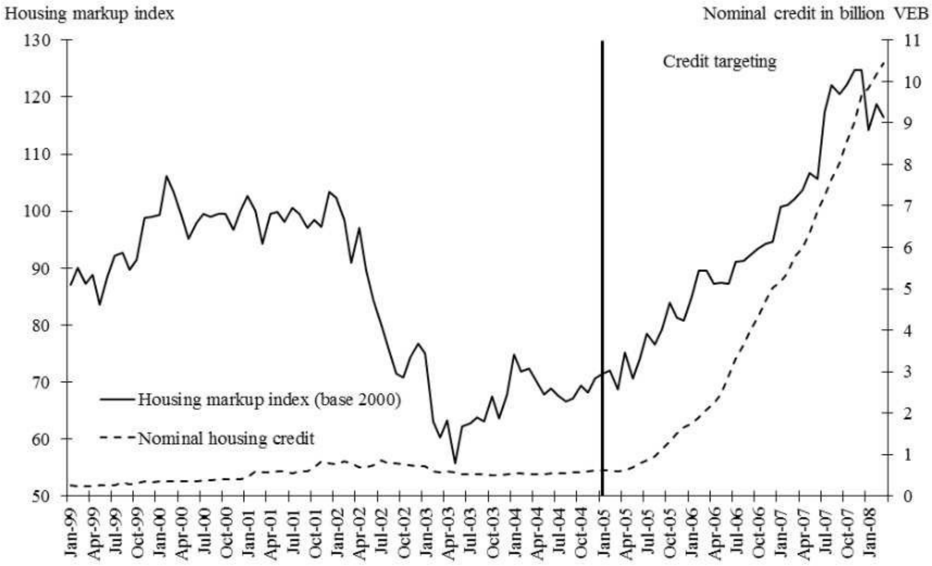
The table displays the quarterly posterior median responses of nominal housing credit growth, housing markup growth, real oil price growth, and the FX rate growth rate to a one-standard-deviation nominal housing credit supply shock (Part A) and to a one-standard-deviation residual oil price shock (Part B). The values in square brackets below the median response outcomes show the probability of the shocks' effect being above zero. The values in parentheses display how much of the variance in the housing credit growth rate, the housing markup growth rate, the real oil price growth rate, and the FX rate growth rate can be explained by the shocks.

Table 4 (continued): Larger system with oil prices and exchange rate: Cumulative responses to the shocks: Results on impact (t=0) and after three years (t=12)

	Credit Growth	Markup Growth	Oil P. Growth	FX Rate Growth
	Median	Median	Median	Median
	[P>0]	[P>0]	[P>0]	[P>0]
	(Var. Decomp.%)	(Var. Decomp. %)	(Var. Decomp. %)	(Var. Decomp. %)
C. Residual exchange rate shock				
(System with oil price, FX rate)				
t=0	0	0.0022	0	0.0521
	[0]	[69.21]	[0]	
t=12	-0.0333	-0.0142	0.0025	0.0678
	[16.75]	[14.91]	[55.10]	
	(4.14)	(9.23)	(1.67)	

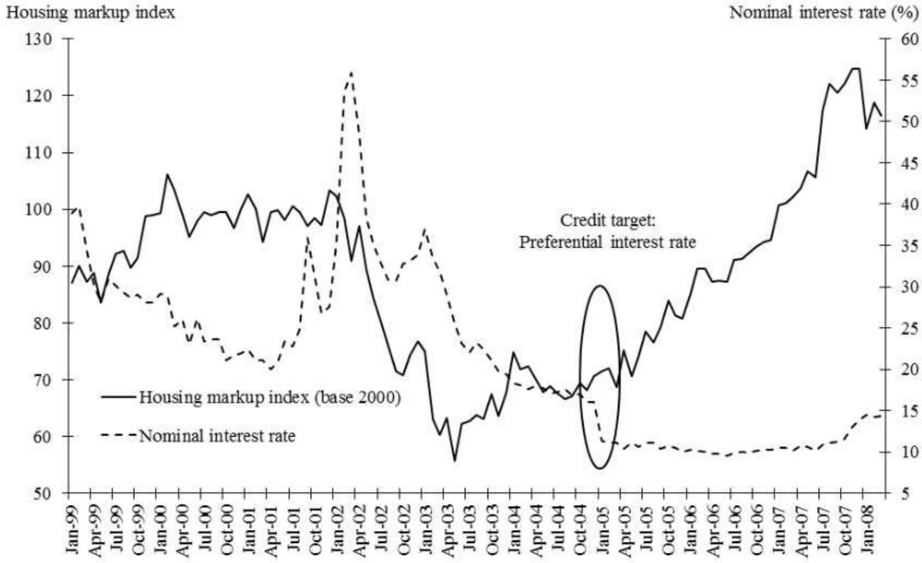
The table displays the quarterly posterior median responses of nominal housing credit growth, housing markup growth, oil price growth, and the FX rate growth rate to a one-standard-deviation shadow FX rate shock. The values in square brackets below the median response outcomes show the probability of the shock's effect being above zero. The values in parentheses display how much of the variance in the housing credit growth rate, the housing markup growth rate, the real oil price growth rate, and the FX rate growth rate can be explained by the shock.

Figure 1: Housing markup and nominal supply of housing credit



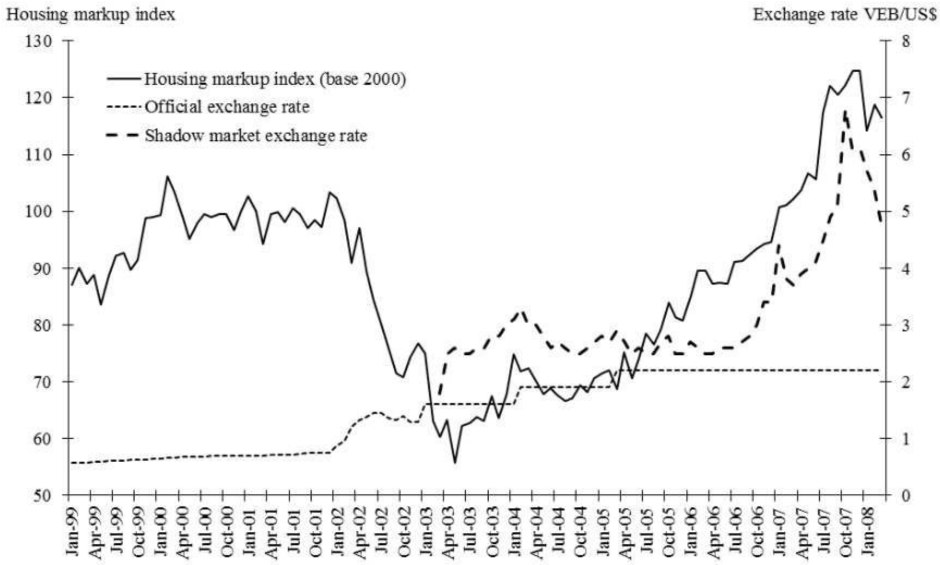
The housing markup index (continuous line) serves as a proxy for the value of land. This index is obtained by dividing a nominal house price index by a construction input price index. The nominal house price index is called "Indicador Inmobilirario Consolidado (Inpi)" and is estimated by the Central Bank of Venezuela. The construction input price index is called Índice de Precios de Insumos de la Construcción and is published on a monthly basis by the Central Bank of Venezuela. The dotted line shows data published by the Central Bank of Venezuela on the aggregate nominal credit supply for housing mortgages. The vertical line highlights the implementation of a credit target for housing mortgages during the first quarter of 2005. Source: Central Bank of Venezuela, and authors' calculations.

Figure 2: Housing markup and interest rate to be charged on housing credit



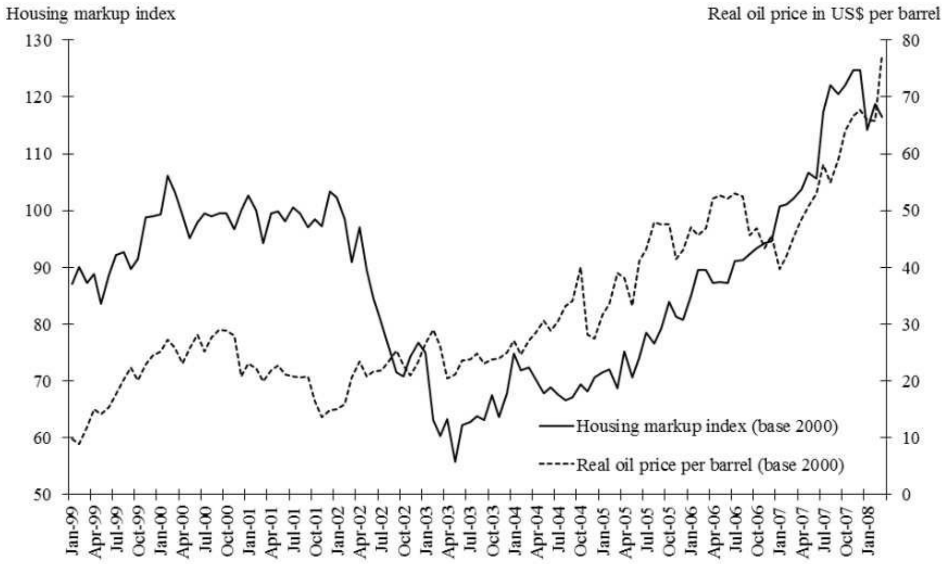
The housing markup index (continuous line) serves as a proxy for the value of land. This index is obtained by dividing a nominal house price index by a construction input price index. The nominal house price index is called "Indicador Inmobilirario Consolidado (Inpi)" and is estimated by the Central Bank of Venezuela. The construction input price index is called Índice de Precios de Insumos de la Construcción and is published on a monthly basis by the Central Bank of Venezuela. The dotted line shows the nominal market interest rate for housing mortgages until 2004. From the first quarter of 2005 onward, the dotted line shows the preferential interest rate for housing mortgages within the credit targeting framework. This preferential interest rate is obtained by applying a predefined haircut to the average nominal market interest rate. Source: Central Bank of Venezuela, Venezuelan Bank Supervision Authority (Sudeban), and authors' calculations.

Figure 3: Housing markup and shadow and official exchange rates between the Venezuelan Bolivar (VEB) and the US dollar



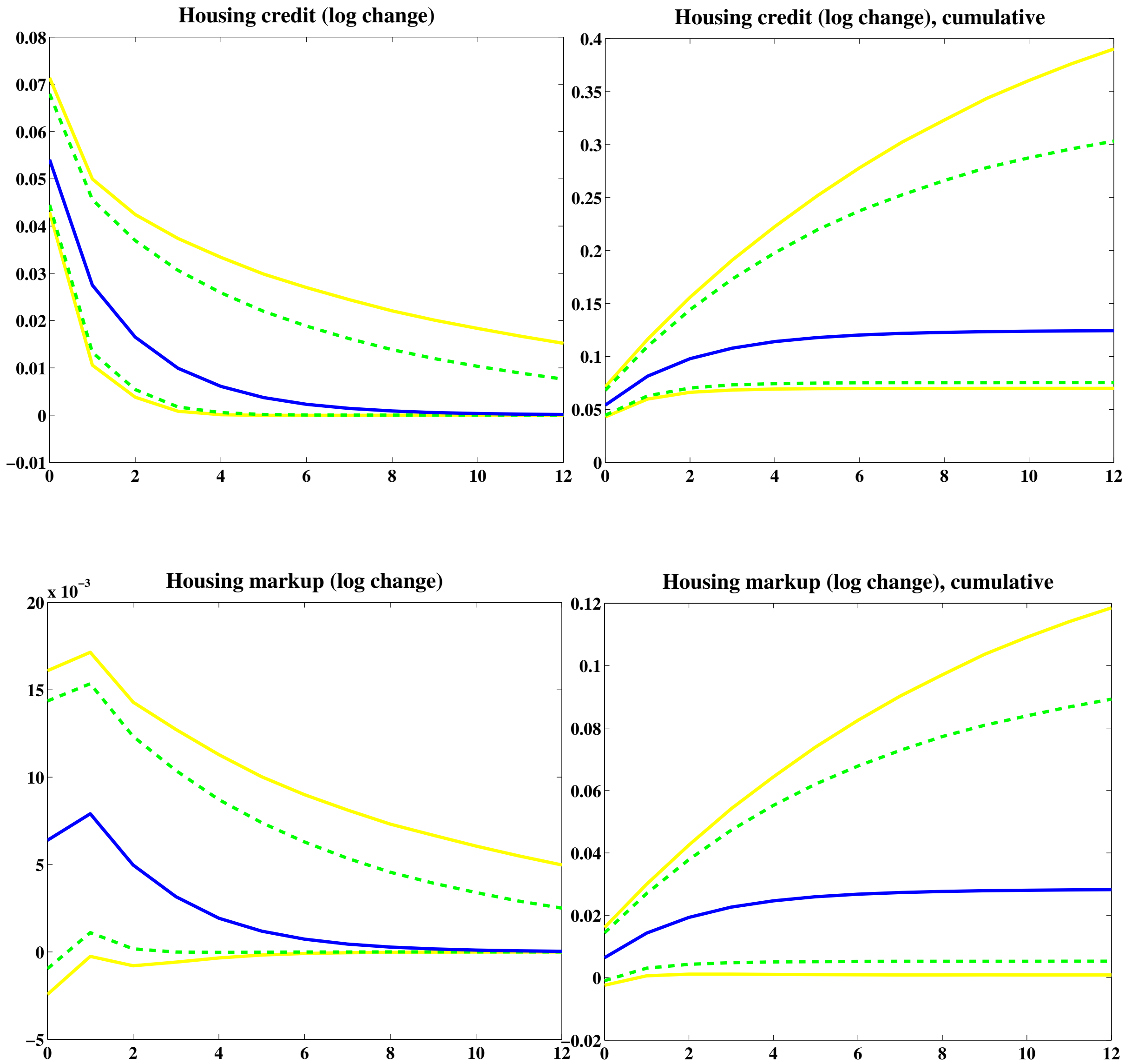
The housing markup index (continuous line) serves as a proxy for the value of land. This index is obtained by dividing a nominal house price index by a construction input price index. The nominal house price index is called "Indicador Inmobilirario Consolidado (Inpi)" and is estimated by the Central Bank of Venezuela. The construction input price index is called "Índice de Precios de Insumos de la Construcción" and is published on a monthly basis by the Central Bank of Venezuela. The fine dotted line shows the evolution of the official exchange rate and the bold dotted line shows the evolution of the shadow exchange rate. Since 2003 an exchange rate control has been implemented in Venezuela. Under these controls, the shadow market exchange rate could be seen as a proxy to the free market rate. The official exchange rate is published by the Central Bank of Venezuela. For the shadow exchange rate there are specialized websites which publish the shadow exchange rate on a daily basis, based on information from the shadow market. Source: Central Bank of Venezuela, http://www.dolarparalelo.blogspot.com, http://dolartoday.com, and authors' calculations.

Figure 4: Housing markup and real price of the Venezuelan oil basket in US dollars



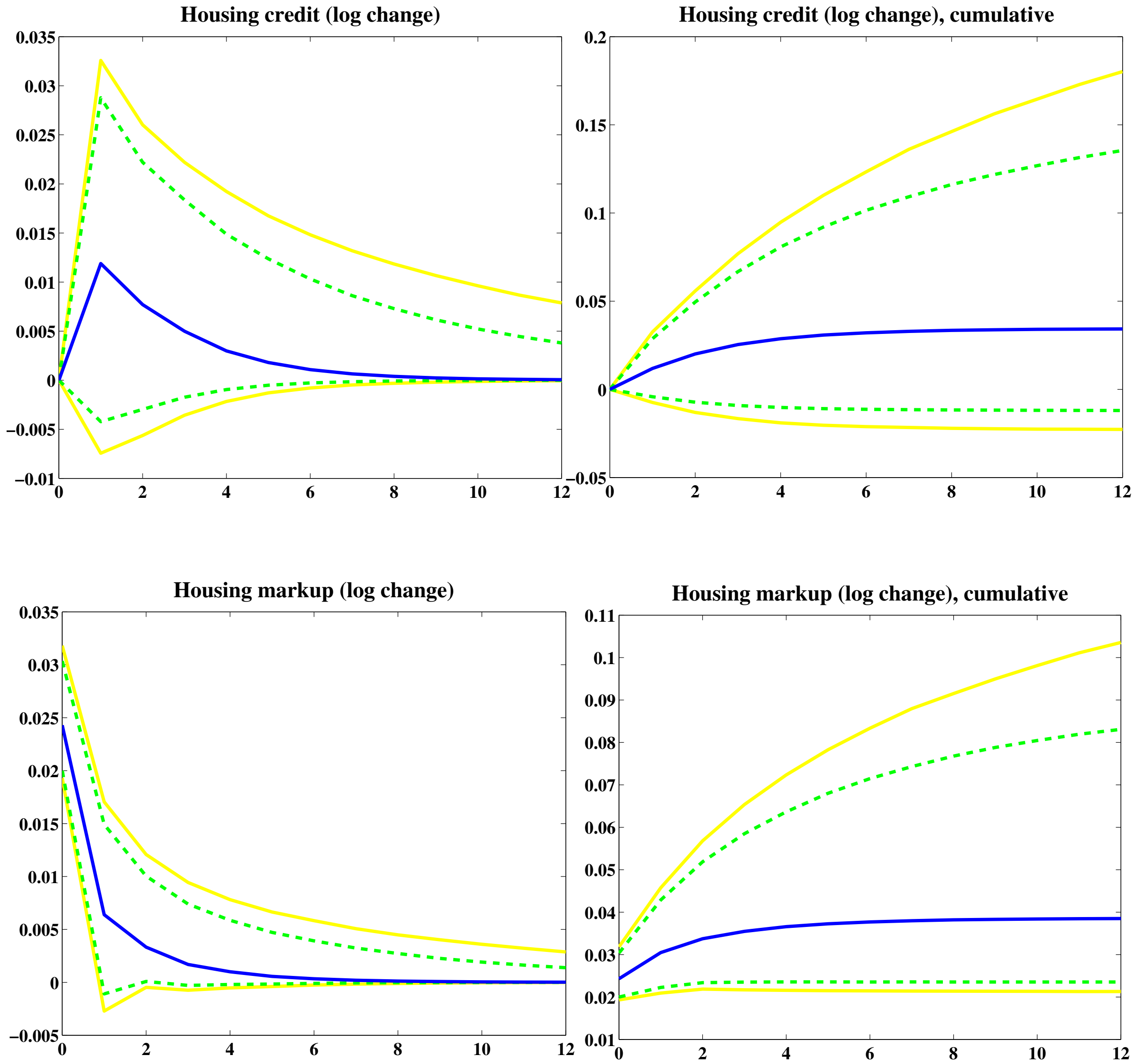
The housing markup index (continuous line) serves as a proxy for the value of land. This index is obtained by dividing a nominal house price index by a construction input price index. The nominal house price index is called "Indicador Inmobilirario Consolidado (Inpi)" and is estimated by the Central Bank of Venezuela. The construction input price index is called Índice de Precios de Insumos de la Construcción and is published on a monthly basis by the Central Bank of Venezuela. The dotted line shows the evolution of the real oil price. The real oil price is obtained by deflating the nominal price of the Venezuelan oil basket in US dollars, which is published by the Venezuelan Ministry of Energy and Oil on a monthly basis, by the US consumer price index. The US consumer price index is obtained from the US Bureau of Labor Statistics (BLS). Source: Central Bank of Venezuela, US Bureau of Labor Statistics, Venezuelan Ministry of Energy and Oil, and authors' calculations.

Figure 5: Baseline model: Responses to a nominal housing credit supply shock



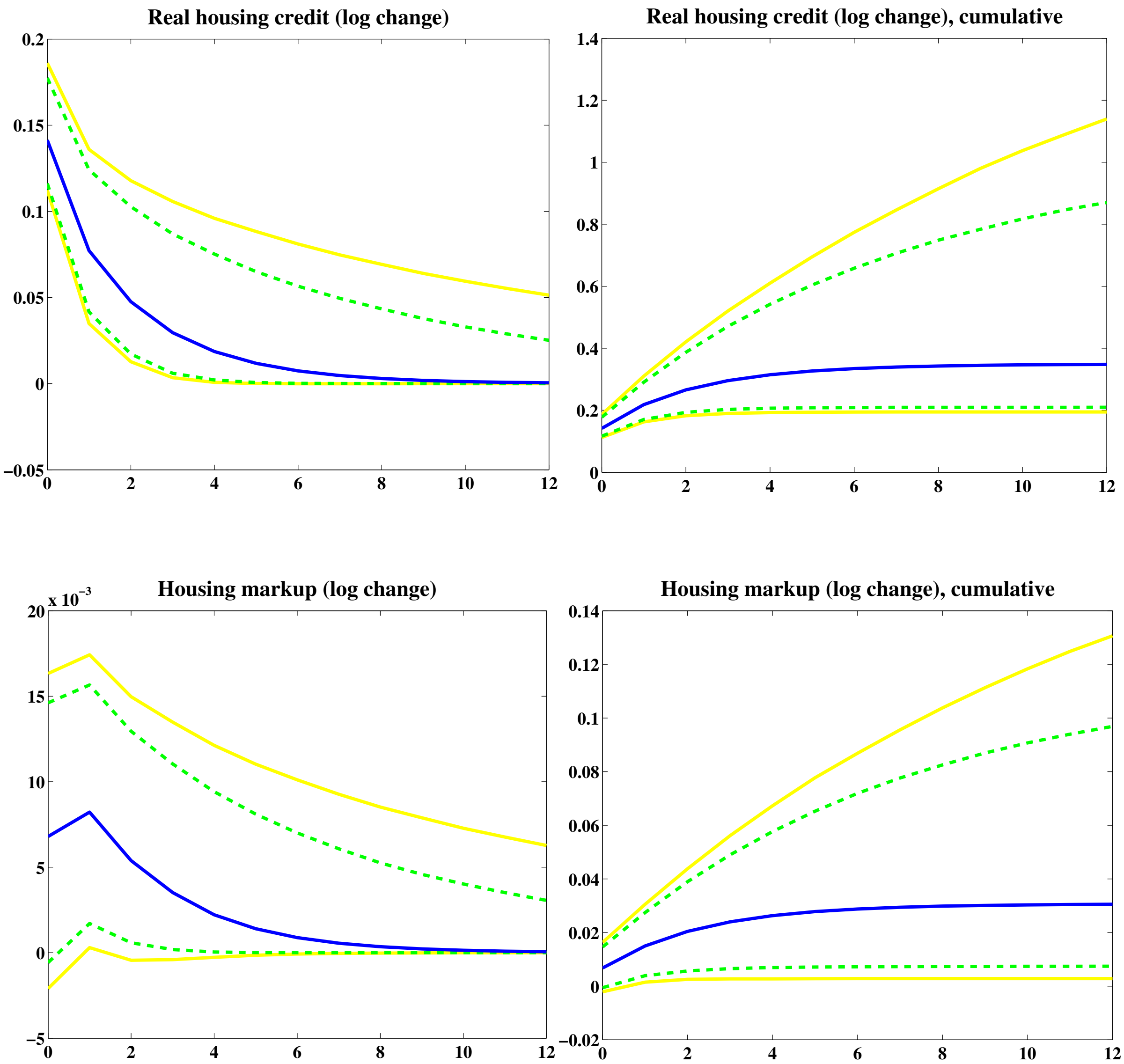
The left-hand panels display the quarterly responses of the nominal housing credit growth rate and the housing markup growth rate to a one-standard-deviation nominal credit supply shock, while the right-hand panels show the cumulative responses of the nominal housing credit growth rate and the housing markup growth rate.

Figure 6: Baseline model: Responses to a residual housing markup shock



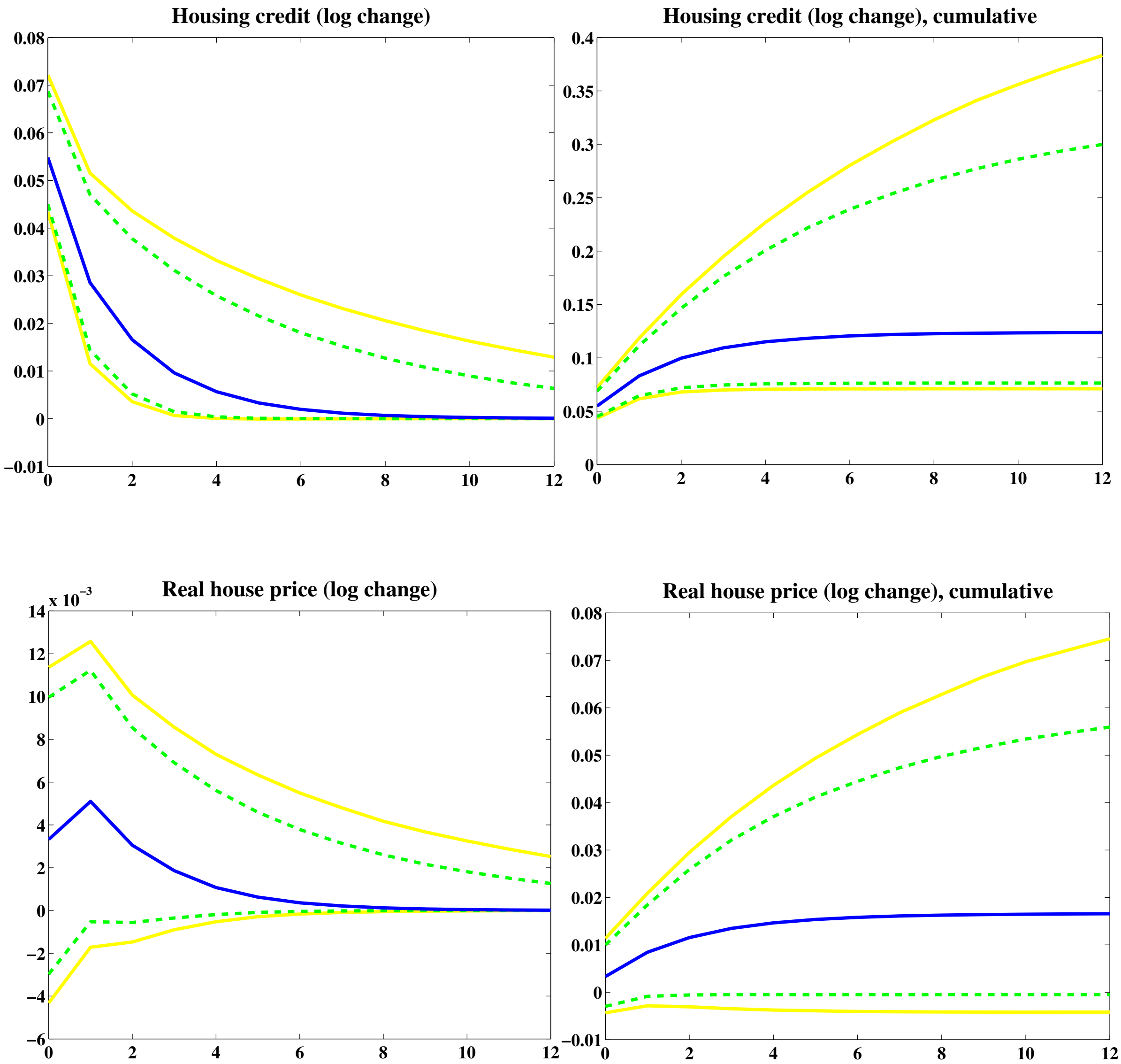
The left-hand panels display the quarterly responses of the housing markup growth rate and the nominal housing credit growth rate to a one-standard-deviation residual housing markup shock, while the right-hand panels show the cumulative responses of the housing markup growth rate and the nominal housing credit growth rate.

Figure 7: Alternative observables (real housing credit): Responses to a real housing credit supply shock



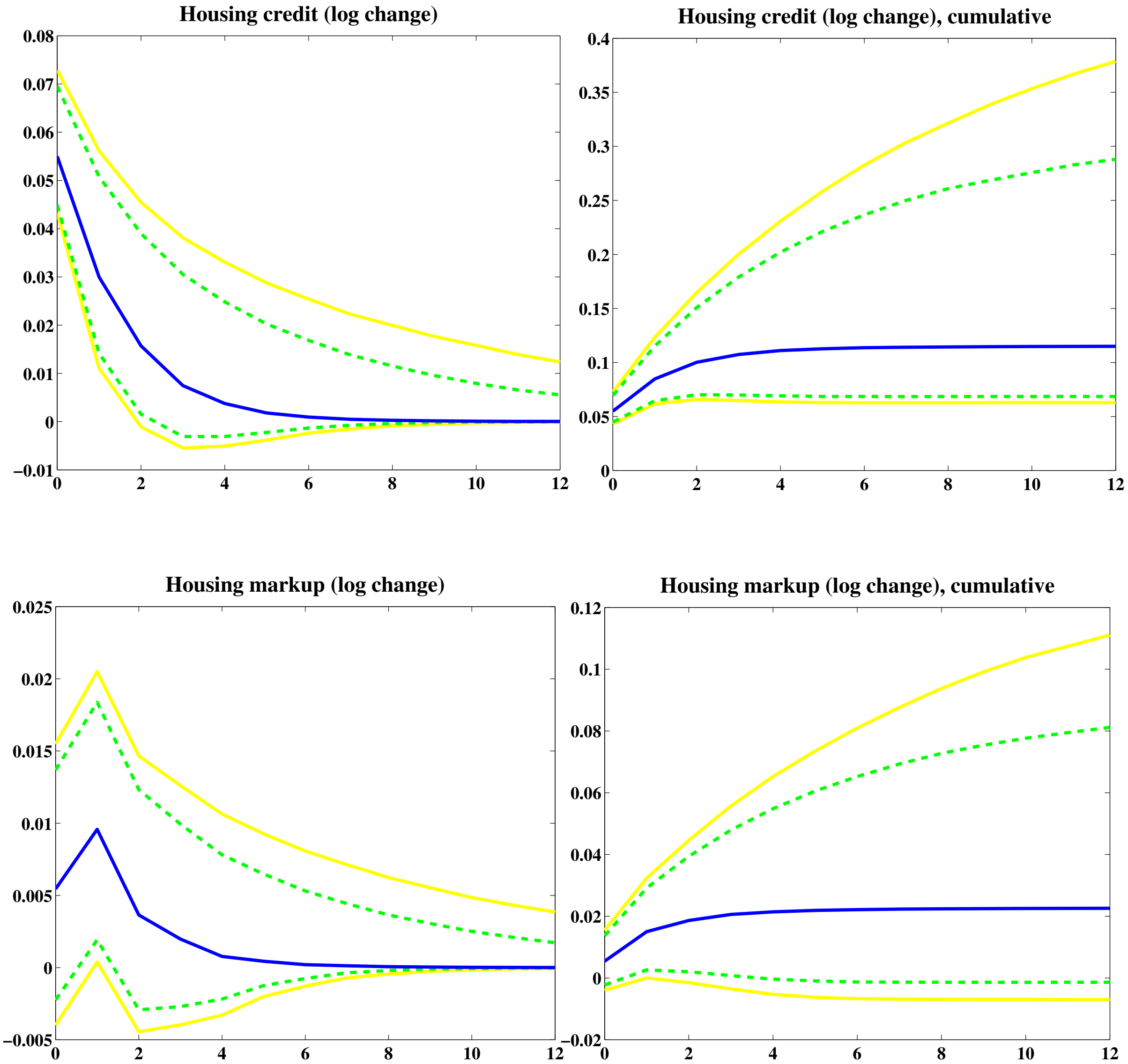
The left-hand panels display the quarterly responses of the real housing credit growth rate and housing markup growth rate to a one-standard-deviation housing credit shock, while the right-hand panels show the cumulative responses. Real housing credit is obtained by the deflating nominal housing credit by the consumer price index of the capital city of Caracas.

Figure 8: Alternative observables (real house prices): Responses to a nominal housing credit supply shock



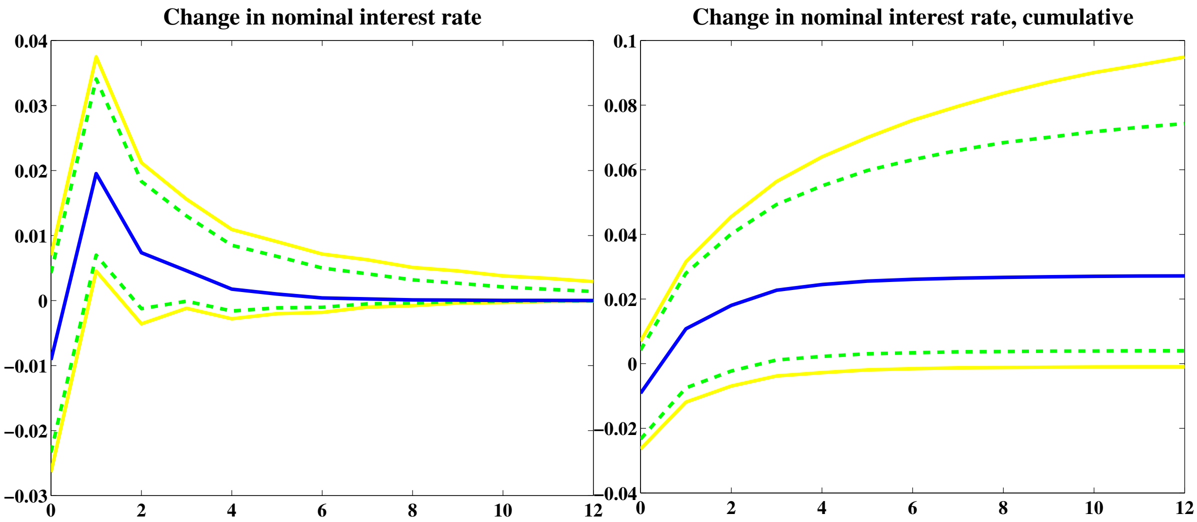
The left-hand panels display the quarterly responses of the nominal housing credit growth rate and real house price index growth rate to a one-standard-deviation housing credit shock, while the right-hand panels show the cumulative responses. The real house price index is obtained by the deflating the nominal house price index with the consumer price index of the capital city of Caracas.

Figure 9: System with interest rates (absolute change): Responses to a nominal housing credit supply shock



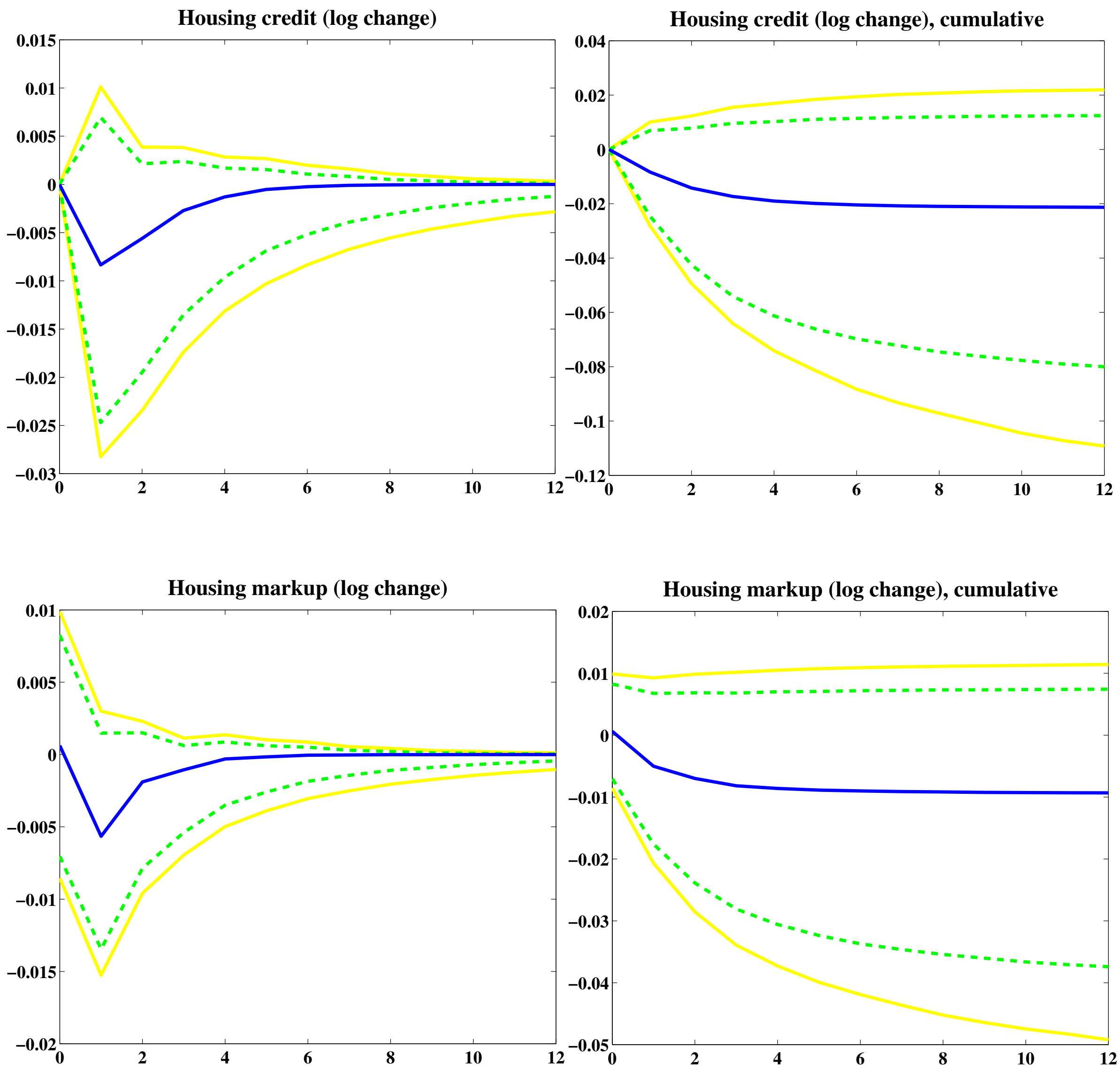
The left-hand panels display the quarterly responses of the nominal housing credit growth rate and the housing markup growth rate to a one-standard-deviation nominal credit supply shock, while the right-hand panels show the cumulative responses of these objects.

Figure 9 (continued): System with interest rates (absolute change): Response to a nominal housing credit supply shock



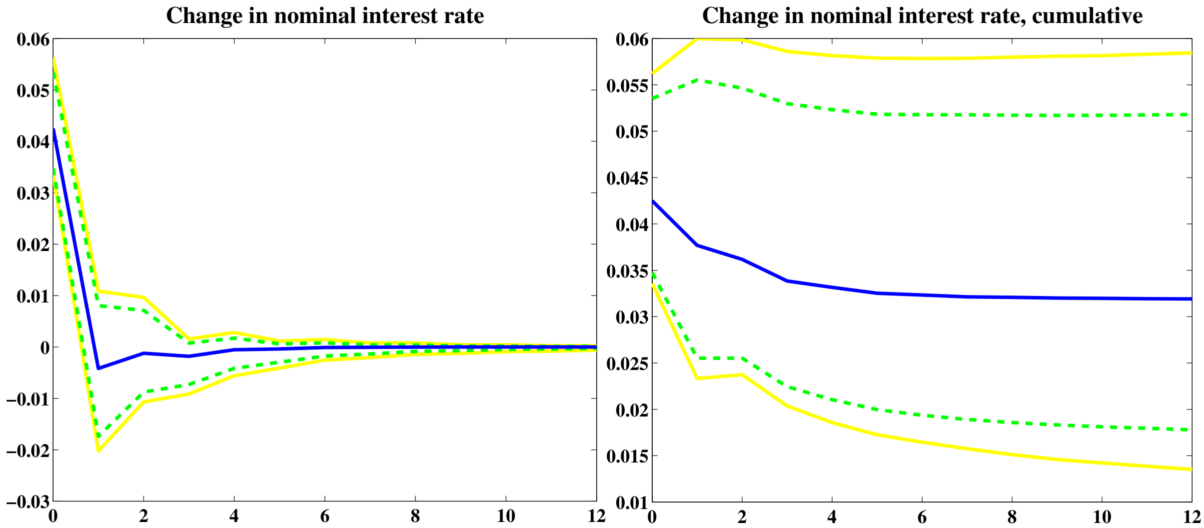
The left-hand panel displays the quarterly response of the nominal interest rate to a one-standard-deviation nominal credit supply shock, while the right-hand panel shows the cumulative response of this object. The nominal interest rate is the market rate through 2004 and the preferential interest rate beginning in 2005.

Figure 10: System with interest rates (absolute change): Responses to a residual interest rate shock



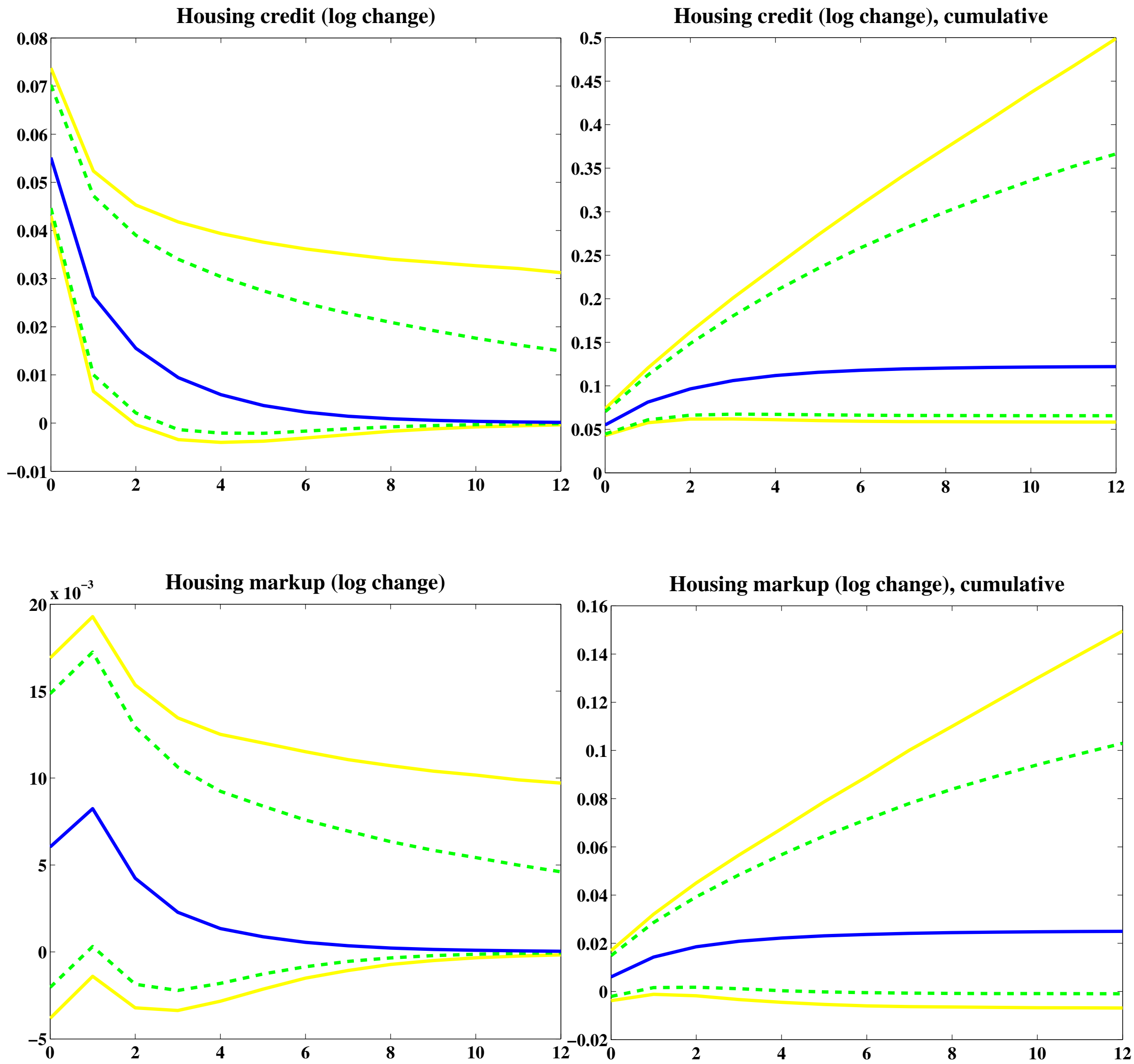
The left-hand panels display the quarterly responses of the nominal housing credit growth rate and the housing markup growth rate to a one-standard-deviation residual nominal interest rate shock, while the right-hand panels show the cumulative responses of these objects. The nominal interest rate is the market rate through 2004 and the preferential interest rate beginning in 2005.

Figure 10 (continued): System with interest rates (absolute change): Responses to a residual interest rate shock



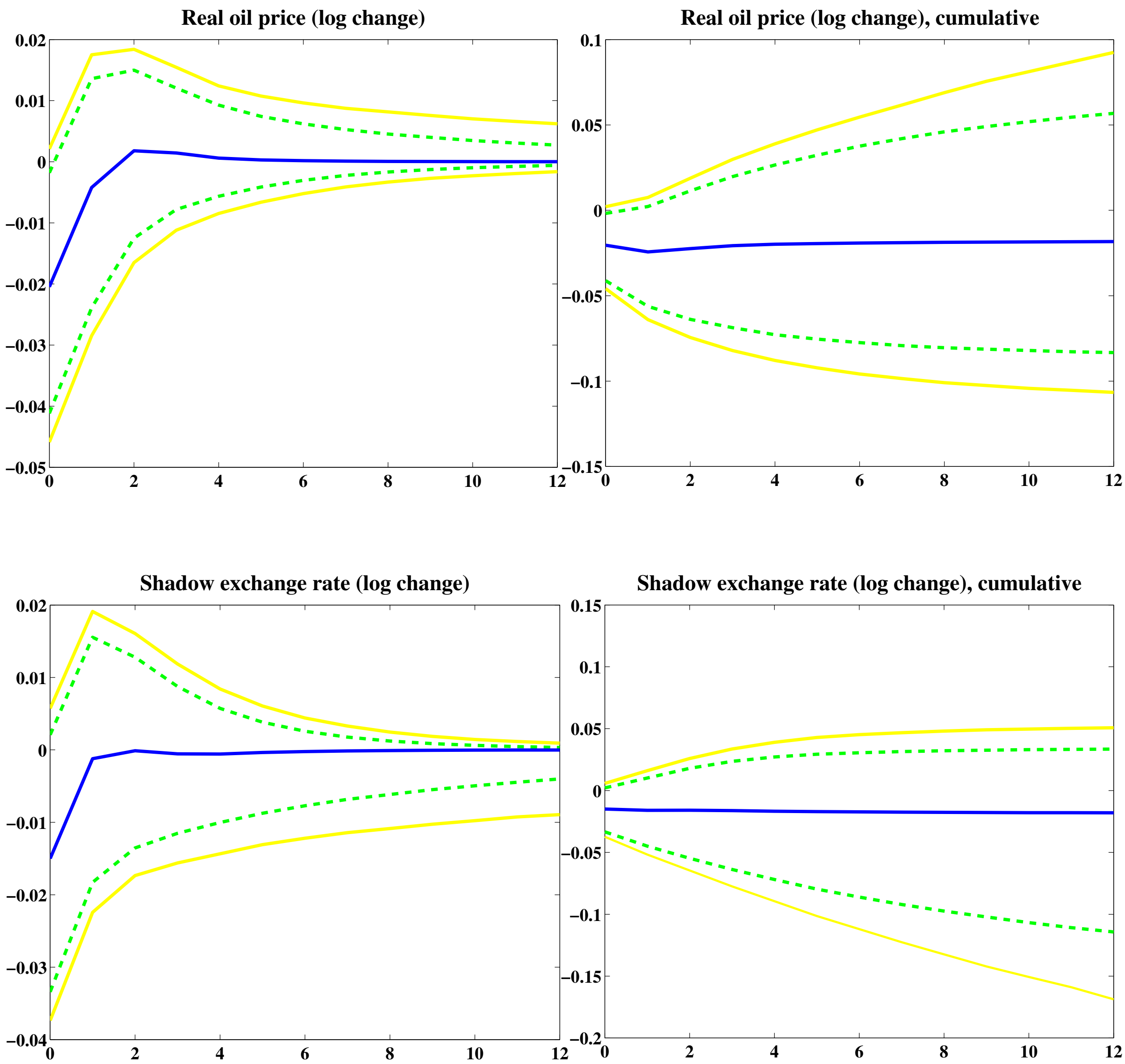
The left-hand panel displays the quarterly response of the nominal interest rate to a one-standard-deviation residual nominal interest rate shock, while the right-hand panel shows the cumulative response of this object. The nominal interest rate is the market rate through 2004 and the preferential interest rate beginning in 2005.

Figure 11: System with exchange rates and oil prices: Responses to a nominal housing credit supply shock



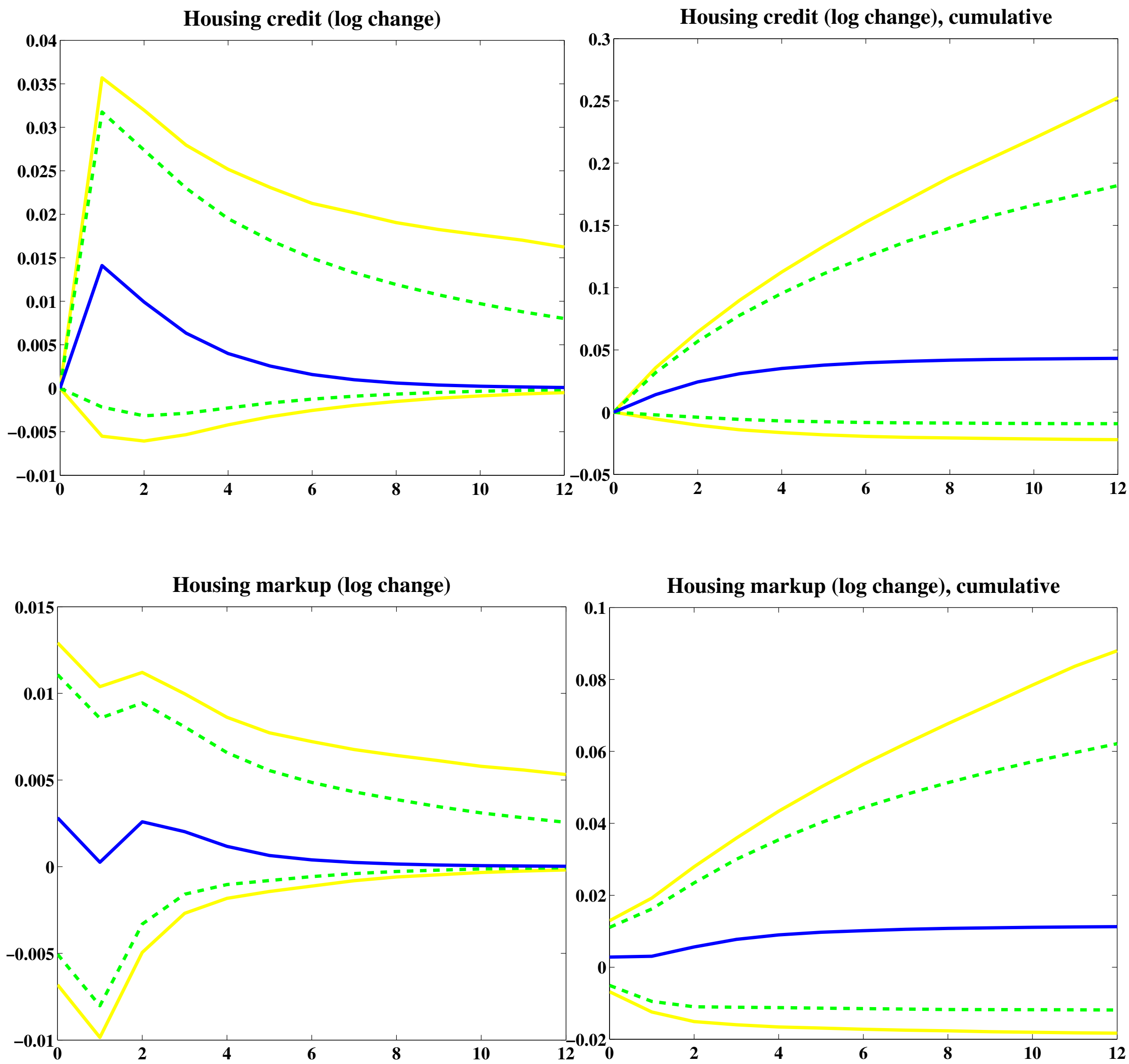
The left-hand panels display the quarterly responses of the nominal housing credit growth rate and the housing markup growth rate to a one-standard-deviation nominal credit supply shock, while the right-hand panels show the cumulative responses of the nominal housing credit growth rate and the housing markup growth rate.

Figure 11 (continued): System with exchange rates and oil prices: Responses to a nominal housing credit supply shock



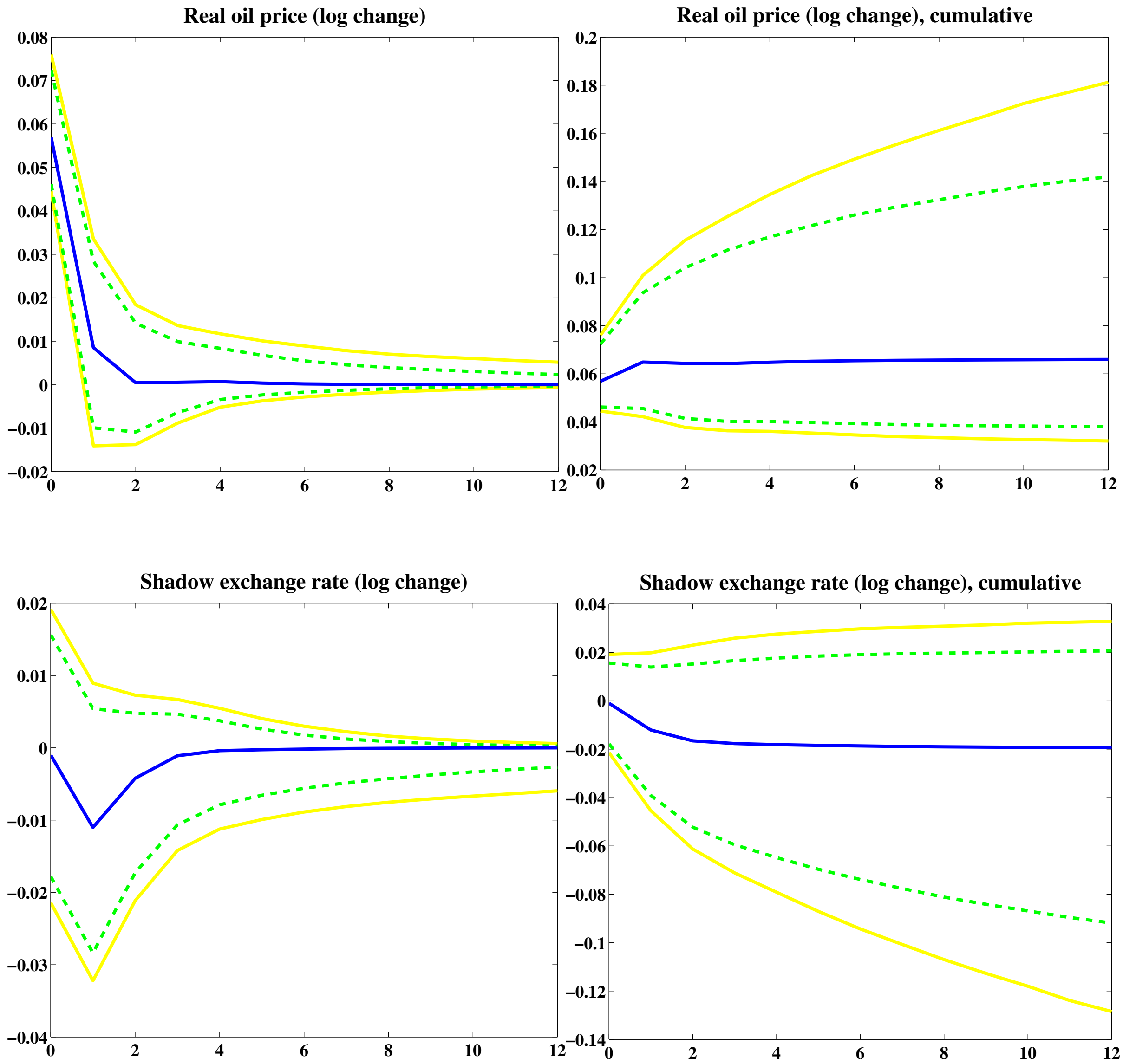
The left-hand panels display the quarterly responses of the real oil price growth rate and the shadow exchange rate growth rate to a one-standard-deviation nominal credit supply shock, while the right-hand panels show the cumulative responses of the real oil price growth rate and the shadow exchange rate growth rate.

Figure 12: System with exchange rates and oil prices: Responses to a residual oil price shock



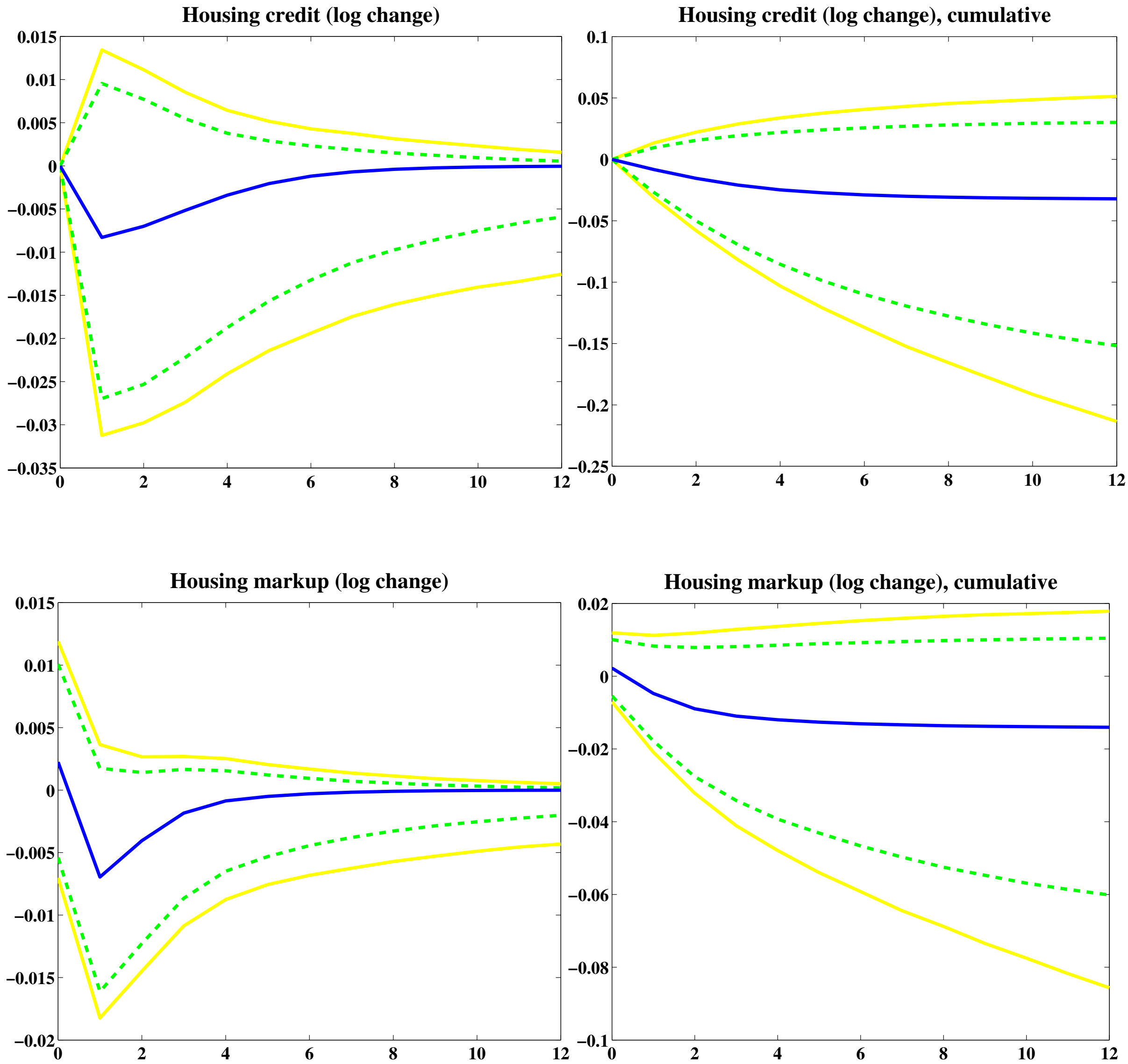
The left-hand panels display the quarterly responses of the nominal housing credit growth rate and the housing markup growth rate to a one-standard-deviation residual real oil price shock, while the right-hand panels show the cumulative responses of the nominal housing credit growth rate and the housing markup growth rate.

Figure 12 (continued): System with exchange rates and oil prices: Responses to a residual oil price shock



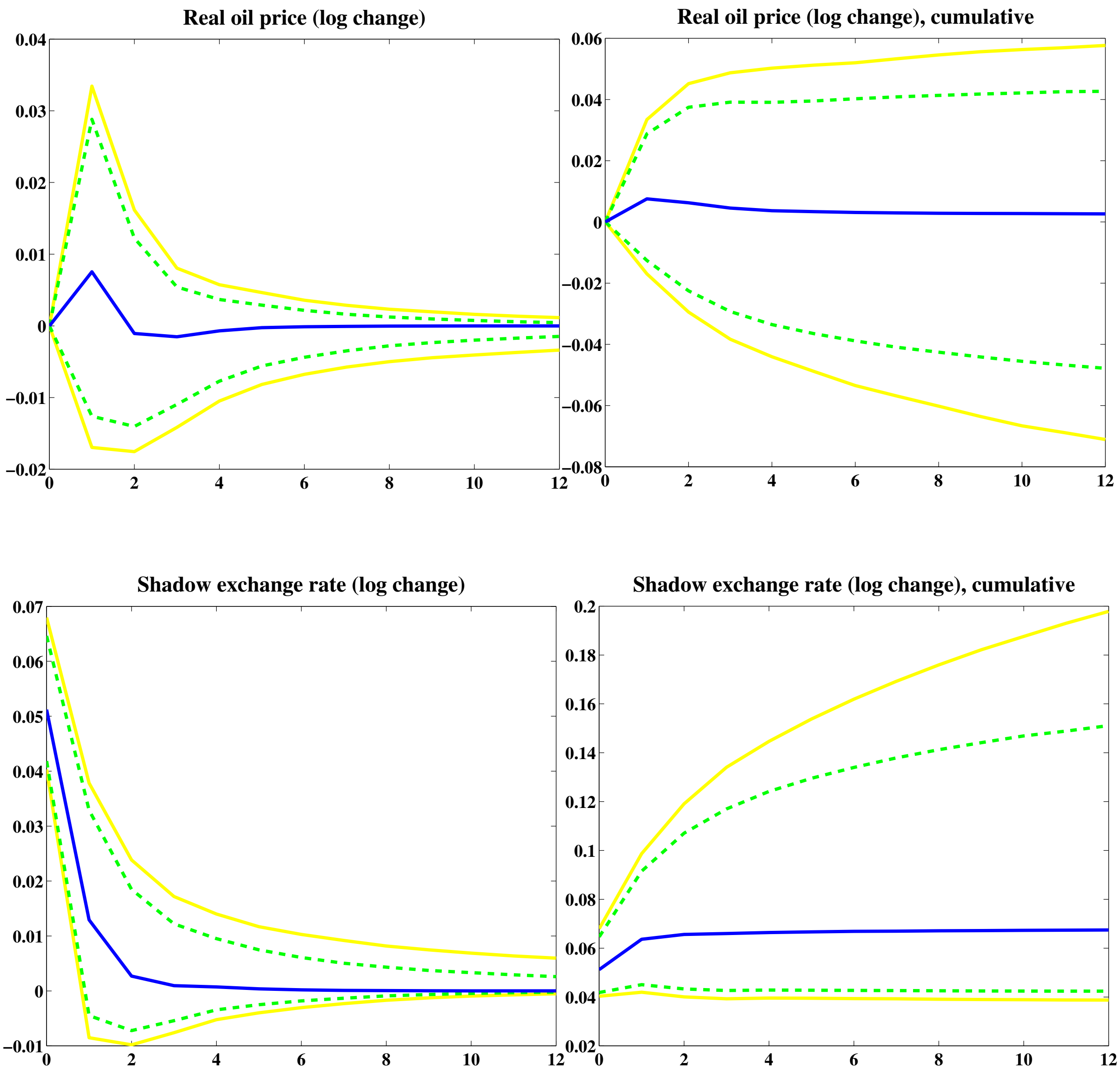
The left-hand panels display the quarterly responses of the real oil price growth rate and the shadow exchange rate growth rate to a one-standard-deviation residual real oil price shock, while the right-hand panels show the cumulative responses of the real oil price growth rate and the shadow exchange rate growth rate.

Figure 13: System with exchange rates and oil prices: Responses to a residual exchange rate shock



The left-hand panels display the quarterly responses of the nominal housing credit growth rate and the housing markup growth rate to a one-standard-deviation residual shadow exchange rate shock, while the right-hand panels show the cumulative responses of the nominal housing credit growth rate and the housing markup growth rate.

Figure 13 (continued): System with exchange rates and oil prices: Responses to a residual exchange rate shock



The left-hand panels display the quarterly responses of the real oil price growth rate and the shadow exchange rate growth rate to a one-standard-deviation residual shadow exchange rate shock, while the right-hand panels show the cumulative responses of the real oil price growth rate and the shadow exchange rate growth rate.