Credit Decomposition and Business Cycles in Emerging Economies*

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Abstract

Recent empirical evidence suggests that household and business credit evolve differently and have distinct effects on the economy. However, small open economy models have not incorporated the distinction between household and business borrowing yet. We construct a dynamic stochastic general equilibrium model to study the effects of household and business credit shocks on business cycles in a small open economy. We show that household credit expansions lead to a decline in labor supply, output and investment whereas business credit expansions result in an increase in these variables. On the other hand, consumption increases and trade balance deteriorates in both cases. The differences in the transmission of the two types of credit shocks depend on the existence of housing. When we add housing to the model, credit shocks generate spillover effects from one sector to the other. Therefore, the two types of credit shocks generate similar responses in labor, output and investment. Adjustment costs in housing weaken the spillover effects and the dynamics of output and labor in the housing model get closer to the benchmark model as adjustment costs increase.

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1 Introduction

In recent years, the level of credit to the private sector has increased substantially in many emerging countries. An important part of this rise is due to the rapid expansion of household credit rather than business credit. Since household credit and business credit serve different purposes, an expansion in each type of borrowing is likely to affect the economy through different channels. However, small open economy models have yet to recognize the growing share of household credit and incorporate the distinction between household and business borrowing. In this paper, we construct a dynamic stochastic general equilibrium (DSGE) model that allows us to distinguish between these two types of credit, and study the response of the economy to household and business credit shocks.

Recent developments in credit markets show the importance of distinguishing between household and business credit. Table 1 reports the household and business credit to GDP ratios for a group of emerging economies. The two types of credit exhibit different trends: while lending to households has grown substantially over the 2000-2010 period, business credit growth has been slow. As a result, household credit has become an important component of overall private credit with potentially important consequences for business cycles.

Table 1: Household and Business Credit as % of GDP

	Household Credit			Business Credit		
	2000	2005	2010	2000	2005	2010
Brazil	10.08	10.14	18.25	16.24	17.17	25.20
Chile	17.55	21.35	26.15	47.48	42.87	45.40
Czech Republic	5.39	13.25	27.24	31.98	16.85	20.67
Hungary	4.64	17.76	25.62	24.26	17.19	27.28
S. Africa	31.29	37.27	41.54	32.68	34.74	36.89
S. Korea	18.06	35.31	36.77	33.46	35.64	47.36
Thailand	10.39	16.27	22.94	65.12	51.72	40.84
Turkey	4.11	7.01	15.28	11.22	11.29	22.32

Note: All data are obtained from respective central banks.

To present the cyclical properties of household and business credit, Table 2 shows the correlation between GDP and the changes in the two types of credit (normalized by GDP). Changes in both types of credit are positively correlated with GDP and for some countries these correlations are very strong. These descriptive statistics suggest that both types of credit are procyclical.

Table 2: Correlations between change in credit and GDP

	Change in HC/GDP	Change in BC/GDP
Brazil	0.14	0.44
Chile	0.82	0.72
Czech Republic	0.40	0.19
Hungary	0.17	0.22
S. Africa	0.31	0.24
S. Korea	0.44	0.14
Thailand	0.51	0.67
Turkey	0.58	0.37

Note: All series are seasonally adjusted and HP-filtered.

There is a large literature that documents the empirical regularities observed in credit expansion episodes. The findings of these papers indicate that credit booms are associated with economic expansions, rising equity and housing prices, real appreciation, capital inflows and widening current account deficits (Gourinchas, Valdes and Landerretche, 2001; Mendoza and Terrones, 2008). This literature, however, does not study the distinction between household and business credit expansions. Empirical studies by Büyükkarabacak and Krause (2009), Büyükkarabacak and Valev (2010), and Beck et al. (2012) on credit decomposition underline the importance of differentiating between the types of borrowers. Büyükkarabacak and Krause (2009) show that household credit leads to a deterioration in the trade balance, whereas business credit has a small but positive effect. Büyükkarabacak and Valev (2010) find that household credit expansions have been a significant predictor of banking crises. Business credit expansions are also associated with banking crises but their effect is weaker. Beck et al. (2012) show that bank lending to firms is positively associated with growth, while the relationship between household credit and growth is insignificant.

The main conclusion of these papers is that the two types of credit serve different purposes and have distinct effects on the economy.

Despite the empirical evidence on the differential effects of household and business credit, existing models in the small open economy literature abstract from the distinction between these two types of credit. For example, Mendoza (1994, 2002) considers an economy-wide borrowing constraint faced by the representative agent and does not distinguish between borrowing for consumption and investment. Aghion, Bacchetta, and Banerjee (2001, 2004), Caballero and Krishnamurthy (2001), and Schneider and Tornell (2004) model the credit constraints faced by firms and focus on the production sector. While these models yield important insights on the role of financial constraints in macroeconomic instability, their setup does not have a transmission mechanism through which credit constraints on households affect the model dynamics.

To analyze the channels through which household and business borrowing affect the real economy, we construct a DSGE model with two types of agents: households and entrepreneurs. Both agents borrow from international markets and face constraints on their borrowing. Furthermore, following Mendoza (2010) and Christiano, Motto, and Rostagno (2010) we assume that total business debt includes both standard intertemporal debt and atemporal working capital loans. We study the model dynamics under a productivity shock and two types of credit shocks: business credit and household credit. The credit shocks are modeled as stochastic processes that affect the borrowing limit of the two agents. The shocks to credit are similar to the financial sector shocks studied in Jermann and Quadrini (2009) and Kiyotaki and Moore (2008) who show that these shocks could play an important role as a source of macroeconomic fluctuations using closed economy models. The contribution of the current paper is to model household and business credit shocks separately and to analyze their effects in an open economy framework. Analyzing these two shocks separately helps understand the mechanisms through which each type of credit affects the economy. For this purpose, we study the impulse responses and business cycle moments generated by the model calibrated to the Turkish economy for the period 1995Q1-2009Q4. We calibrate our model to Turkey because it is a standard emerging market economy in terms of its business cycle properties and the data on credit variables are available at quarterly frequency for a long time period.

We examine two different specifications of the model: the benchmark model and the extended model that incorporates housing.[1] The impulse response analysis of the benchmark model shows that the two types of credit shocks have opposite effects on output, labor supply and investment: a household credit shock leads to a decline in these variables, whereas a business credit shock leads to an expansion. Since the credit constraint of households is tied to labor income, an increase in their borrowing capacity relaxes the constraint and reduces the benefit of working. The resulting decline in labor supply leads to a contraction in output and investment. In the case of a business credit shock, increased borrowing by firms directly raises their labor demand due to the working capital requirement. Higher borrowing also increases investment, which leads to a higher labor demand as well. The resulting increases in capital and labor lead to an expansion of output. Consumption and trade balance, on the other hand, respond in the same way for both shocks with consumption increasing and trade balance deteriorating after the shocks.

When we extend the model to include housing, the predictions of the model depend on the existence of adjustment costs for housing. With a common asset, real estate, demanded by both agents, changes in the demand for real estate due to a credit shock generates spillover effects from one sector to the other. Any disturbance that affects the price and the demand for real estate in one sector is transmitted to the other one through changes in the value of the real estate they own. The predictions of the model depend on the strength of this transmission mechanism, which we govern by varying adjustment costs for housing. As the adjustment costs increase, the spillover effects between the sectors weaken and the responses of some of the variables to credit shocks change.

When there are no adjustment costs in changing the amount of real estate each agent owns, the spillover effects between sectors are strong. Therefore, the two types of credit shocks generate similar responses in labor, output and investment, differently from the benchmark model. The changes in the response of the economy are most evident after the household credit shock. An increase in household borrowing raises households' demand for housing, and house prices go up. The increase in house prices reduces the entrepreneurs' demand for real estate and they generate a flow of funds by reducing the real estate they own. Using these excess funds, they increase their demand for labor and capital. While

[1] We use housing and real estate interchangeably throughout the paper.

increased household borrowing still lowers the supply of labor, the increase in labor demand dominates the decline in labor supply. As a result, equilibrium labor level and output increase.

With housing adjustment costs, the fluctuations in the housing stock variables are reduced, which weakens the transmission of shocks between the two sectors. When facing adjustment costs, both agents are less willing to change the level of real estate they own. Therefore, the increase in residential housing after a positive household credit shock decreases as the adjustment costs increase. With entrepreneurs generating a lower level of funds through housing sales, the spillover effect weakens and the dynamics of output and labor in the housing model get closer to the benchmark model as the adjustment cost parameter increases.

The responses of consumption and trade balance are not affected by the model specification. We find that both types of credit expansions lead to an increase in consumption and a deterioration of the trade balance in all versions of the model.

The differences in the impulse responses generated by the model with housing suggest that the functioning of the housing market can be an important factor in the transmission mechanism of changes in credit conditions. When we abstract from adjustment costs, the increase in house prices due to credit shocks give rise to extra income in the sector that is not affected by the shock and the differences between the two sectors are dampened. Such a mechanism can be effective in housing markets in which agents can easily change their holdings of real estate and prices quickly adjust to reflect demand and supply changes. If agents face costs in selling and buying real estate and if there are financial market imperfections and institutional inefficiencies that would prolong the transactions, the mechanism working through changes in agents' holdings of real estate may not be strong enough. In such a setting, the predictions of the benchmark model and the model with adjustment costs will be more applicable. Therefore, frictions in the housing market appears to be an important factor in understanding how different types of credit shocks affect the dynamics of the economy.

2 The Benchmark Model

We use a small open economy model inhabited by two types of agents: households and entrepreneurs. Both types of agents have access to international financial markets, but face constraints on their borrowing. For entrepreneurs there is also a working capital constraint that requires them to hold liquid assets in an amount proportional to their wage bill. There is a single tradable good, which is produced by entrepreneurs using capital and labor. Labor services are provided by households while capital is held by entrepreneurs.

2.1 Households

Households choose consumption and labor to maximize their expected lifetime utility given by

$$E_0 \sum_{t=0}^{\infty} (\beta^h)^t \frac{\left(c_t^h - \psi l_t^\eta\right)^{1-\sigma}}{1-\sigma}, \quad \eta > 1, \psi > 0 \tag{1}$$

where $\beta^h \in (0,1)$ is the discount factor, c_t^h is consumption, l_t represents labor, σ is the risk aversion parameter, η is the parameter that governs the intertemporal elasticity of substitution in labor supply, and ψ is the measure of disutility from working.

The budget constraint of households is given by

$$c_t^h + R_{t-1} b_{t-1}^h = w_t l_t + b_t^h, \tag{2}$$

where b_t^h denotes the amount borrowed at time t, $R_t = (1 + r_t)$ is the gross interest rate and r_t is the net real interest rate, and w_t is the wage rate.

Households face a credit constraint in every period and they can only borrow up to a fraction of their current income. As in Ludvigson (1999), we choose to tie borrowing to income because many banks require income statements before they provide funds to the borrowers since income is associated with some observable measure of the borrower's financial health. The credit constraint of households is of the form

$$b_t^h \leq m_t^h w_t l_t. \tag{3}$$

In the calibration of the model, β^h is chosen such that $\beta^h < 1/(1+\bar{r})$, where $\bar{r}$ is the steady-state real interest rate. This condition guarantees that the credit constraint is binding in and around the steady state. The loan-to-income ratio, denoted by m_t^h, determines the credit availability to households and is modeled as a stochastic process.

Maximizing the objective function subject to the budget and credit constraints yields the following first order conditions:

$$\left(c_t^h - \psi l_t^\eta\right)^{-\sigma} = \beta^h E_t\left[R_t\left(c_{t+1}^h - \psi l_{t+1}^\eta\right)^{-\sigma}\right] + \lambda_t^h, \tag{4}$$

$$\left(c_t^h - \psi l_t^\eta\right)^{-\sigma}\psi\eta l_t^{\eta-1} = w_t\left[\left(c_t^h - \psi l_t^\eta\right)^{-\sigma} + \lambda_t^h m_t^h\right]. \tag{5}$$

These equations differ from the first order conditions of the household's problem in a standard small open economy RBC model because of the presence of the borrowing constraint: in equation (4) the Lagrange multiplier, λ_t^h, represents the increase in lifetime utility that would arise from relaxing the borrowing constraint at time t; in equation (5) the credit constraint increases the return to labor by $w_t\lambda_t^h m_t^h$, since credit availability is tied to the labor income of the household.

2.2 Entrepreneurs

Entrepreneurs produce output by a Cobb-Douglas technology using capital and households' labor services:

$$y_t = e^{A_t}k_{t-1}^\alpha l_t^{1-\alpha}, \tag{6}$$

where A_t is an exogenous stochastic productivity shock.

The capital accumulation decision is made by the entrepreneurs and the equation for capital accumulation is given by

$$i_t = k_t - (1-\delta)k_{t-1}. \tag{7}$$

As standard in small open economy business cycle models, we use capital adjustment costs in order to avoid excessive volatility of investment. These costs take the form $\Phi(k_{t-1}, i_t) = \frac{\varphi}{2}k_{t-1}\left(\frac{i_t}{k_{t-1}} - \delta\right)^2$.

Firms have to pay a fraction θ of the wages before output becomes available and they need working capital loans from foreign lenders. They borrow $\theta w_t l_t$ at the beginning of period t and repay $R_{t-1}\theta w_t l_t$ at the end of the period as in Neumeyer and Perri (2005). As households, entrepreneurs are also restricted in their borrowing due to enforceability problems. Following Mendoza (2010), we assume that the entrepreneur's total borrowing, which includes one-period bonds and within-period working capital loans, cannot exceed a fraction of the collateral assets, which are the capital holdings in the benchmark model:

$$b_t^e + \theta w_t l_t \leq m_t^e E_t \left(q_{t+1}^k k_t \right). \tag{8}$$

The loan-to-capital ratio, denoted by m_t^e, is modeled as a stochastic process. Due to capital adjustment costs, the price of capital in terms of consumption goods differs from one. It is denoted by q_t^k and is given by

$$q_t^k = 1 + \frac{\partial \Phi(k_{t-1}, i_t)}{\partial i_t}.$$

Formally, the entrepreneur's problem is to maximize her expected utility

$$E_0 \sum_{t=0}^{\infty} (\beta^e)^t \frac{(c_t^e)^{1-\sigma}}{1-\sigma}$$

subject to technology, capital accumulation and borrowing constraints, as well as the following flow of funds constraint:

$$c_t^e + w_t l_t + i_t + \Phi(k_{t-1}, i_t) + R_{t-1} b_{t-1}^e + (R_{t-1} - 1)\, \theta w_t l_t = y_t + b_t^e, \tag{9}$$

where b_t^e is entrepreneur's borrowing, c_t^e is entrepreneur's consumption and $(R_{t-1} - 1)\, \theta w_t l_t$ represents the net cost of the working capital requirement.

We assume that $\beta^e < 1/(1+\bar{r})$, where $\bar{r}$ is the steady-state real interest rate. In the presence of credit constraints, entrepreneurs can choose to postpone consumption and quickly accumulate enough capital so that the credit constraint becomes nonbinding. Essentially, one needs to make sure that entrepreneurial consumption occurs to such an extent that self-financing does not arise. For that matter, we assume that entrepreneurs discount the future heavily so that the credit constraint is binding in and around the steady state, as in the case of households.

The first-order conditions are:

$$\left(c_t^e\right)^{-\sigma} = \beta^e E_t\left[R_t\left(c_{t+1}^e\right)^{-\sigma}\right] + \lambda_t^e, \tag{10}$$

$$\left(c_t^e\right)^{-\sigma} q_t^k = E_t\left[\beta^e\left(c_{t+1}^e\right)^{-\sigma}\left(\alpha\frac{y_{t+1}}{k_t} + (1-\delta)q_{t+1}^k - \frac{\partial\Phi(k_t, i_{t+1})}{\partial k_t}\right) + \lambda_t^e q_{t+1}^k m_t^e\right], \tag{11}$$

$$\left(c_t^e\right)^{-\sigma}(1-\alpha)\left(\frac{y_t}{l_t}\right) = \left(c_t^e\right)^{-\sigma} w_t\left[1+\theta\left(R_{t-1}-1\right)\right] + \lambda_t^e\theta w_t. \tag{12}$$

All first order conditions differ from the usual formulations because of the presence of λ_t^e, the Lagrange multiplier on the credit constraint. Investing in new capital relaxes the borrowing constraint of the entrepreneur. Therefore, investment has an additional benefit $\lambda_t^e q_{t+1}^k m_t^e$ besides its usual benefit in terms of increased future production, as shown in equation (11). The Euler equation of the entrepreneur also has the term λ_t^e which is the increase in lifetime utility from relaxing the credit constraint, as seen in equation (10). Equation (12) shows that the firm's labor demand depends on both the interest rate and the Lagrange multiplier on the credit constraint. As is standard with a working capital requirement, the cost of labor depends on the interest rate. However, since in this model the firm is constrained in its borrowing, the cost of labor also depends on how binding the credit constraint is: as the constraint becomes more binding, the cost of labor increases.

2.3 Equilibrium

Given initial conditions b_0^h, b_0^e and k_0, and the sequence of shocks to productivity, the loan-to-income ratio and the loan-to-capital ratio, the competitive equilibrium is defined as a set of allocations and prices $\left\{y_t, l_t, k_t, i_t, c_t^h, c_t^e, b_t^h, b_t^e, \lambda_t^e, \lambda_t^h, w_t, q_t^k\right\}$ such that (i) the allocations solve the problems of households and entrepreneurs at the equilibrium prices, (ii) factor markets clear, and (iii) the resource constraint holds:

$$c_t^h + c_t^e + i_t + tb_t = y_t \tag{13}$$

where the trade balance is defined as

$$tb_t = R_{t-1}\left(b^h_{t-1} + b^e_{t-1}\right) + \left(R_{t-1} - 1\right)\theta w_t l_t - \left(b^h_t + b^e_t\right). \tag{14}$$

3 Calibration

The model is solved using quarterly Turkish data for the period 1995Q1-2009Q4. The construction of the series used in the model solution is explained in detail in the Appendix. The parameter values of the model are summarized in Table 3.

We first set the discount factors of households and entrepreneurs such that the credit constraints bind in and around the steady state. The values for β^h and β^e are set to 0.95 and 0.96, respectively, which are the highest possible values that guarantee binding credit constraints in the solution of the model.

Table 3. Parameter values of the benchmark model

Parameter	Value	Description			
β^h	0.95	Discount factor of households			
β^e	0.96	Discount factor of entrepreneurs			
σ	1	Relative risk aversion coefficient			
η	1.7	Labor curvature			
ψ	4.05	Labor weight in utility			
α	0.40	Capital exponent			
δ	0.08	Annual depreciation rate			
$\bar{r}$	0.015	Real interest rate			
φ	9.08	Capital adjustment cost			
$\bar{m}^h$	0.21	Loan to income ratio			
$\bar{m}^e$	0.07	Loan to capital ratio			
θ	0.25	Working capital coefficient			
Stochastic processes					
ρ^A	0.76			$\sigma(\varepsilon^A)$	0.0198
ρ^h	0.80	ρ^h_a	0.58	$\sigma(\varepsilon^h)$	0.0412
ρ^e	0.76	ρ^e_a	0.29	$\sigma(\varepsilon^e)$	0.0276

The value of η, which determines the intertemporal elasticity of substitution in labor supply, is set to 1.7 following Correia et al. (1995). The coefficient of relative risk aversion is set to 1, which corresponds to log-utility. The annual depreciation rate is set to 0.08 following Meza and Quintin (2007). Using this value for the depreciation rate results in an average capital-output ratio of 2.01.

The parameter α is calibrated using the average value for the labor share of income in Turkey. Following Gollin (2002), we adjust the labor income figures to account for the income of the self-employed, which gives an average value of 0.60 for the labor share. The value of ψ is set to 4.05 so that the steady state labor supply equals 0.18, which is the average value in Turkey of time spent working as a percentage of total discretionary time. The capital adjustment cost parameter, φ, is set to 9.08 to match the volatility of investment relative to output. The real interest rate is taken as constant and set equal to the average real interest rate in Turkey. The steady-state value of the loan-to capital (LTC) ratio, $\bar{m}^e$, is set to match the average value of the ratio of business credit to GDP in Turkey for the sample period, which is 11.5%. Likewise, the steady-state value of the loan-to-income (LTI) ratio[2], $\bar{m}^h$, is set to match the average value of the ratio of consumer credit to GDP in the data, which is 3.15%.[3]

For the calibration of the parameter θ, we use data on short-term bank loans from the Company Accounts database of the Central Bank of Turkey, which is available for the 1997-2009 period. Total liabilities of firms in our model is $b_t^e + \theta w_t l_t$, and the loans for working capital have a shorter duration compared to the other loans. Therefore, we choose to approximate the working capital loans with short-term bank loans. Mendoza (2010) calibrates the working capital coefficient in a similar way but he uses data on total bank loans to firms since working capital loans are the only form of firm borrowing in his model. We calibrate θ by taking the average of the ratio of short-term loans to the compensation of employees, which equals 0.25.

The stochastic processes used in the model are for total factor productivity and the LTI and LTC ratios. The process for the productivity shock is estimated using the Solow

[2]Throughout the text we use LTI ratio (LTC ratio) and m_t^h (m_t^e) interchangeably.

[3]Since the value of credit is not tied to housing, we exclude housing credit from the household credit definition. When we extend the model to include housing, we redefine the household credit variable to include housing credit.

residual for Turkey as

$$A_t = \rho^A A_{t-1} + \varepsilon_t^A,$$

where ε_t^A is a normally distributed and serially uncorrelated innovation.

The LTI and LTC ratios are characterized by the following law of motion

$$m_t^i = \bar{m}^i \exp(\tilde{m}_t^i),$$

for $i = h, e$, and

$$\tilde{m}_t^i = \rho^i \tilde{m}_{t-1}^i + \rho_a^i A_t + \varepsilon_t^i$$

where innovations ε_t^i are normally distributed and serially uncorrelated. We model the shocks to credit availability as being affected by productivity shocks. It is a well-documented fact that emerging market economies borrow more when their output level is high and have limited access to international financial markets in low-output episodes. Based on this observation, we choose to incorporate the interaction between the productivity shocks, which are the main determinant of output fluctuations, and credit access. This formulation is similar to the way the country risk component of interest rates is modeled in Neumeyer and Perri (2005), as a decreasing function of expected productivity.

4 Results

4.1 Impulse Response Analysis

4.1.1 Household Credit Shock

Figure 1 shows the response of the economy to a positive one standard deviation shock to household credit, i.e. an increase in m_t^h. In order to understand the effects of the household credit shock on the economy, it is useful to first focus on its effect on the labor market. In the existence of credit constraints, labor supply equation (5) differs from the usual formulations because of the additional term $w_t \lambda_t^h m_t^h$, which represents the additional benefit of working. Since borrowing is tied to labor income, labor supply has the additional benefit of enabling a higher level of borrowing. Therefore, labor supply response is not only determined by the wage rate, but also by changes in credit availability. The labor supply response can be more clearly understood from the log-linearized version of equation (5):

$$\kappa_1 \hat{l}_t = \hat{w}_t + \kappa_2 \hat{c}_t^h + \kappa_3 \left(\hat{\lambda}_t^h + \hat{m}_t^h \right), \tag{15}$$

where $\kappa_1 > 0, \kappa_2, \kappa_3 \geq 0$, and hatted variables denote percentage deviations from their steady-state values. The exact forms of these parameters are given in the Appendix.

Equation (15) shows how household credit shocks have two effects on labor supply. There is a direct positive effect through $\hat{m}_t^h$, which leads to an increase in labor supply since the return to working increases with a higher LTI ratio as households can borrow more as a fraction of their labor income. The indirect effect works through changes in the Lagrange multiplier, λ_t^h. A higher level of credit availability makes the constraint less binding and λ_t^h declines, which reduces the benefit of working. The decline in λ_t^h is bigger than the positive effect of an increase in m_t^h, and as Figure 1 shows, both the Lagrange multiplier and the labor supply decline as a result of an increase in the LTI ratio. It is also important to note that the magnitude of the change in labor supply after a positive household credit shock is non-negligible. The simulation results suggest that an increase in the LTI ratio from 0.21 to 0.2188 leads to a 0.49 percent decline in labor supply.[4]

The response of the labor supply determines the behavior of output and it decreases as a result of the household credit shock. Despite lower output, consumption initially increases with higher borrowing. It declines after the initial increase due to the fact that agents have to repay their loans while their credit availability is at the same time decreasing. Investment falls as the marginal product of capital decreases due to lower employment. Trade balance, which captures the difference between aggregate demand and supply, declines due to the increase in consumption combined with the decline in output.

[4] A one standard deviation increase in $\tilde{m}_t^h$ raises m_t^h from its steady-state value of 0.21 to 0.2188.

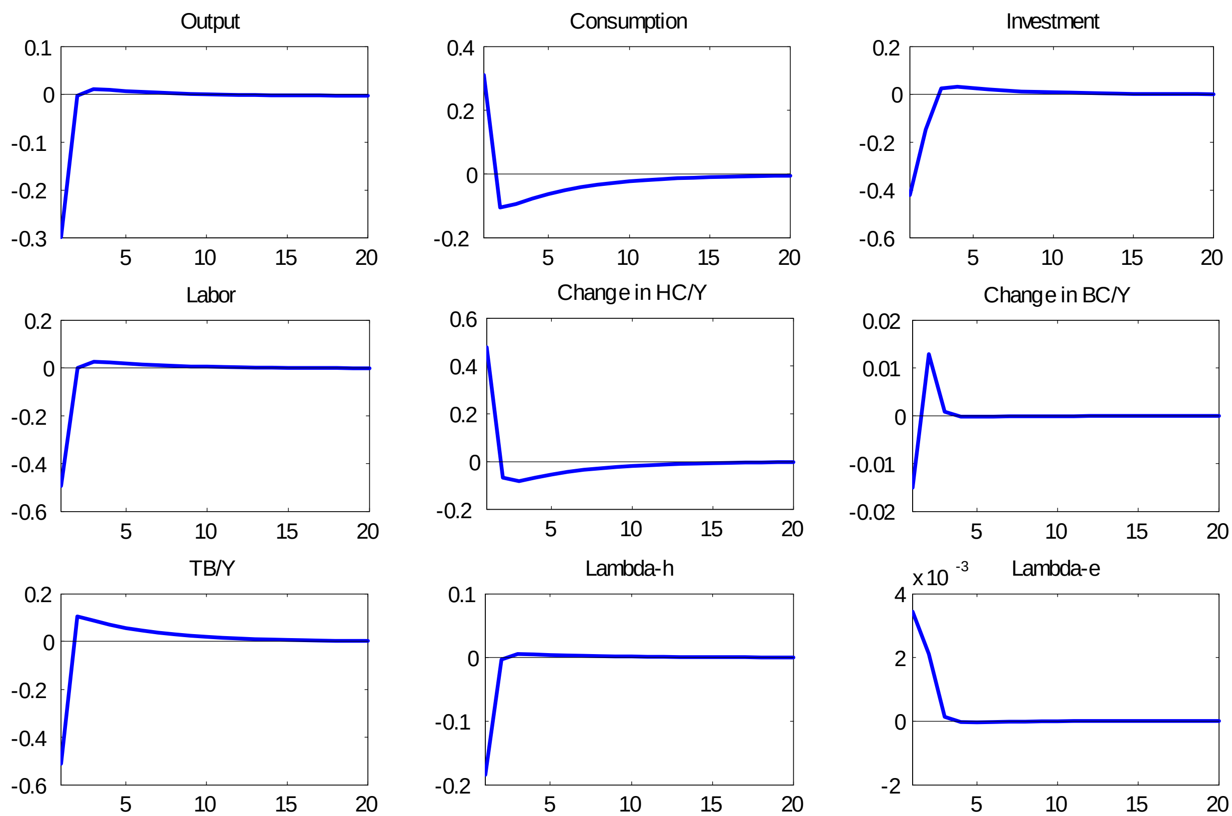

Figure 1. Positive household credit shock-Benchmark model: Percent deviation of variables from their steady-state values except for λ_t^h and λ_t^e.

4.1.2 Business Credit Shock

Figure 2 shows the impulse response functions for a positive one standard deviation shock to business credit. As expected, an increase in m_t^e relaxes the entrepreneurs' credit constraint which allows them to invest and consume more. With an increase in credit availability to firms, their labor demand increases as they have more funds available for wage payments. In equation (12), the decline in the Lagrange multiplier λ_t^e after a positive shock to the LTC ratio reduces the cost of labor and raises the labor demand of firms in the initial period. After the increase on impact, labor demand remains high for a few quarters due to the increase in the capital stock through higher investment. Therefore, there is a prolonged increase in labor and output after the shock.

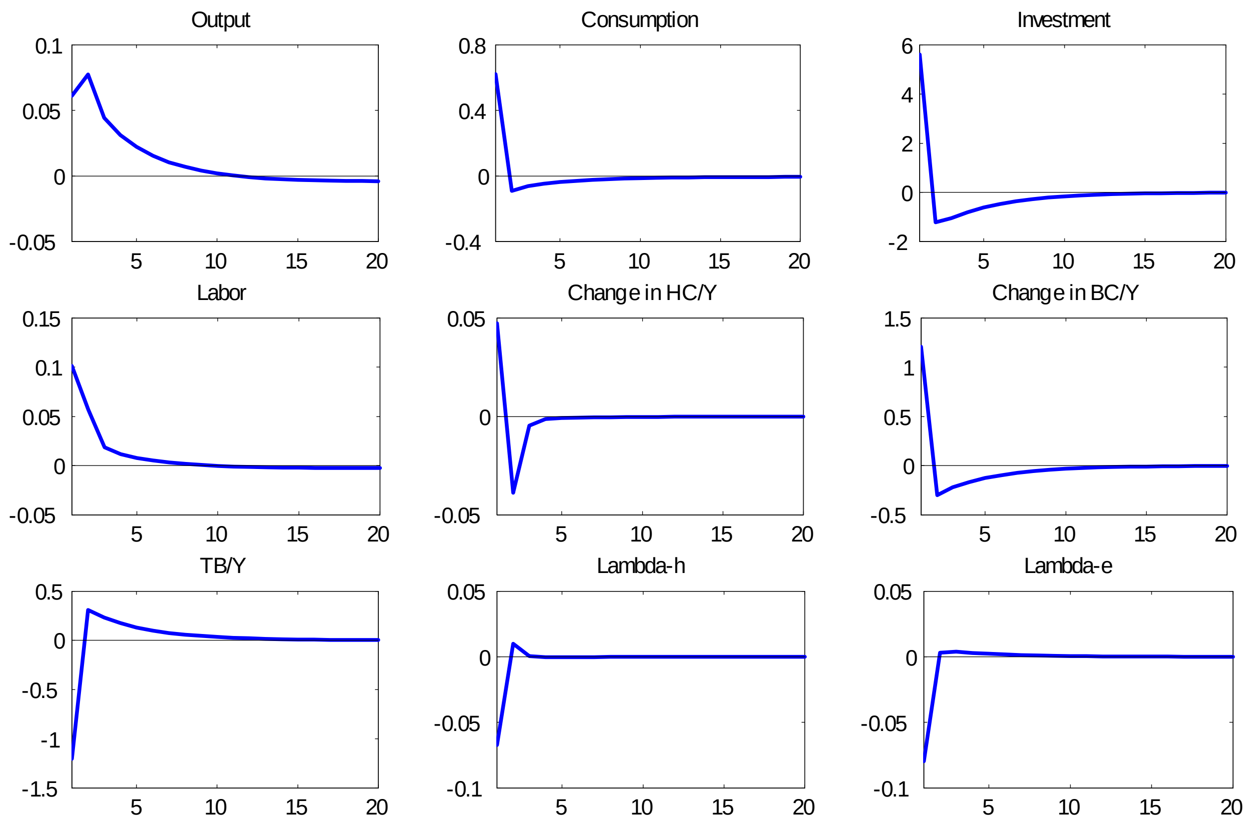

Figure 2. Positive business credit shock-Benchmark model: Percent deviation of variables from their steady-state values except for λ_t^h and λ_t^e

With higher wage income, households' credit limit increases and they increase their borrowing. Hence, a business credit shock leads to a credit expansion for both households and firms, while in the case of a household credit shock, only household credit increases and business credit falls.

The trade balance deteriorates in this case as well. While output increases, the increase in investment and consumption dominates the increase in output, deteriorating the trade balance. Overall, the two credit shocks affect the responses of labor, output and investment differently while consumption increases and trade balance deteriorates in both cases.

4.1.3 Productivity Shock

Figure 3 shows the response of the economy to a one standard deviation shock to productivity. The productivity shock has the standard effects of increasing output, consumption, investment and labor. The borrowing levels of both households and entrepreneurs increase as well. While the shock itself has positive effects on the LTI and LTC ratios through the stochastic processes, private sector credit also increases due to higher labor income and capital stock, which are raising the credit limits.

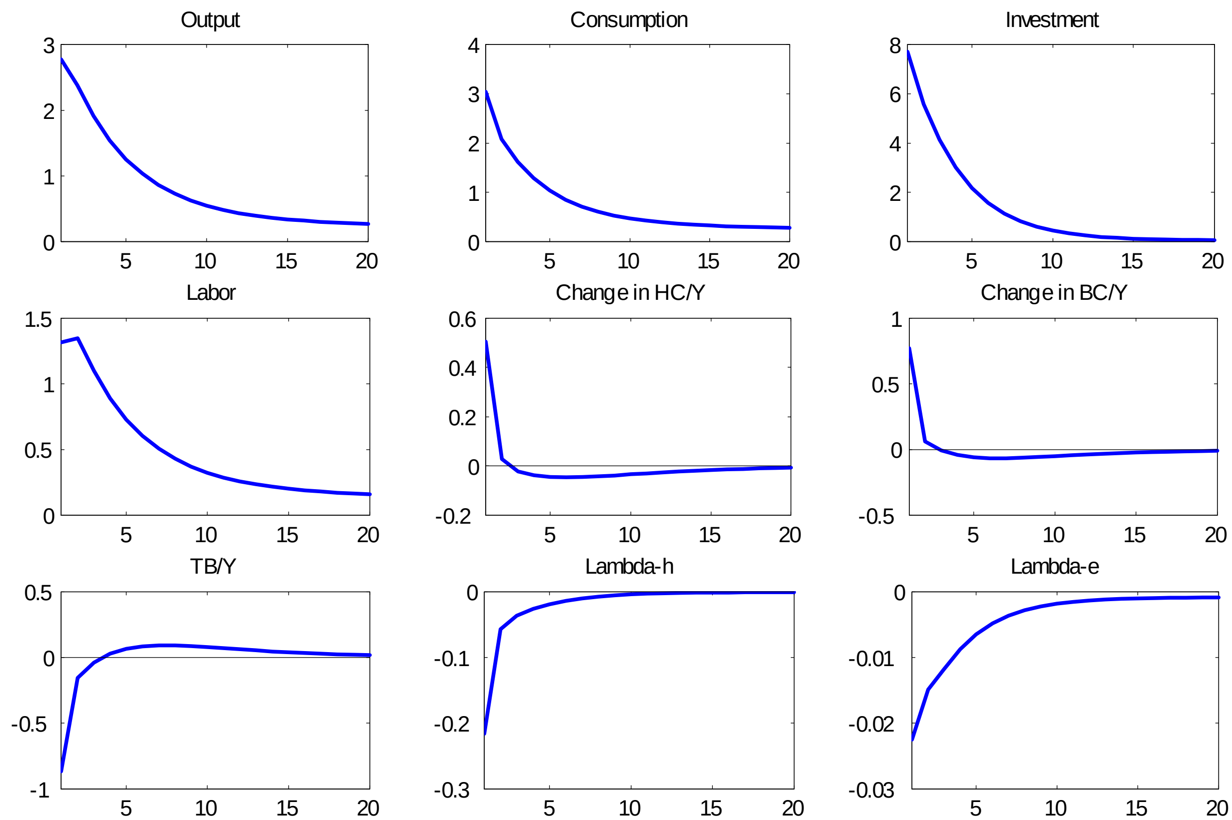

Figure 3. Productivity shock-Benchmark model: Percent deviation of variables from their steady-state values except for λ_t^h and λ_t^e

Increasing credit availability has feedback effects on the economy, although these effects do not change the directions of the impulse responses. An increase in labor income through higher productivity makes the credit constraint of the household less binding, generating the same mechanism discussed in the case of a positive household credit shock. However in this case, it is the increase in the wage rate rather than the increase in the LTI ratio that drives the mechanism. As a result, the Lagrange multiplier declines, reducing the labor supply and dampening the equilibrium labor response.

In the case of consumption and investment, the effects of increased credit are in the same direction as the effect of the productivity shock. With higher borrowing, both consumption and investment increase.

The response of the trade balance depends on the responses of output, consumption and investment. While output rises, the increase in consumption and investment outweighs the increase in output. As a result, trade balance goes down. This response is consistent with the behavior of trade balance observed in emerging economies during economic expansions.

5 The Model with Housing

In this section we extend the benchmark model to consider the role of housing in determining the model dynamics. Changes over time in credit availability can have important feedback effects from real estate prices to the rest of the economy. In Turkey, 30 percent of the bank loans extended to households is for housing purposes in the 2005-2009 period. Therefore, it is important to capture the demand for housing in a model that studies the effects of household credit on the economy. Since this type of credit is tied to the value of housing, it allows us to analyze the effects of house prices on household's credit constraint and borrowing. To incorporate real estate into the model, we follow the approach in Iacoviello (2005) and study an alternative model specification in which real estate enters both the utility function of households and the production function of entrepreneurs. Households get utility from housing services provided by their housing stock, h_t^h, and their utility function is given by[5]

$$E_0 \sum_{t=0}^{\infty} (\beta^h)^t \ln \left(c_t^h - \psi l_t^\eta \right) + j \ln h_t^h.$$

The production function is given by

$$y_t = e^{A_t} k_{t-1}^{\alpha} (h_{t-1}^e)^{\mu} l_t^{1-\alpha-\mu}, \tag{16}$$

[5]Note that we also use a log utility function in the benchmark model as the relative risk aversion coefficient, σ, is set to 1.

where h_{t-1}^e denotes the stock of real estate held by firms. Furthermore, we modify the credit constraints to incorporate housing as collateral for both households and firms. More specifically, we change the credit constraints of households and firms as follows

$$b_t^h \leq m_t^h \left[w_t l_t + \chi E_t \left(q_{t+1}^h h_t^h \right) \right], \tag{17}$$

and

$$b_t^e + \theta w_t l_t \leq m_t^e E_t (q_{t+1}^k k_t + q_{t+1}^h h_t^e), \tag{18}$$

where q_t^h denotes the price of real estate in period t.

We assume that the total stock of real estate is fixed as in Liu et al. (2011). The market clearing condition for the housing sector is

$$h_t^h + h_t^e = H,$$

where H denotes the fixed stock of real estate.

The two key parameters that determine the stocks of residential and commercial real estate, are j and μ. We set j equal to 0.82, which gives a housing stock to GDP ratio of 100 percent. We set μ, the elasticity of output to entrepreneurial real estate, to 0.08. This number implies that the steady-state value of commercial real estate over annual output is 50 percent.[6] We set χ to 0.064 to match the share of housing credit in total household credit, which is 30 percent. The average value of the ratio of household credit, including housing loans, to GDP is 4.5% in the data. We keep the value of $\bar{m}^h$ at 0.21 to match the steady-state household credit to GDP ratio of 4.5%. We slightly change the steady-state value of $\bar{m}^e$ and set it to 0.063 to keep the steady-state business credit to GDP ratio at 11.5%.

We study two versions of the model with housing. First, we assume that agents do not face any adjustment costs when adjusting their stocks of real estate. Then, we study a version in which both households and firms face costs in adjusting the amount of real

[6] Statistical databases for Turkey do not report any values on the stock of real estate. We set the values of j and μ such that the residential housing to annual GDP ratio is equal to 1, and the commercial real estate to annual GDP ratio is 0.5. In Iacoviello (2005), housing stock to annual GDP ratio is equal to 1.4 and commercial real estate over annual output is 0.5.

estate they own. The functional form for the housing adjustment costs is $\frac{\phi}{2}\left(h_t^i - h_{t-1}^i\right)^2$, for $i = h, e$. We analyze the implications of using adjustment costs by varying the parameter that determines the size of these costs, ϕ.

5.1 Impulse Response Analysis

5.1.1 No adjustment cost

We first study the implications of the model with housing assuming that agents do not face any adjustment costs when they change the amount of real estate they own. Figures 4 and 5 show the impulse responses to positive household and business credit shocks for both the benchmark model and the model with housing where we set $\phi = 0$. Using this specification, output and labor move in the same direction for the two shocks, whereas they move in different directions in the benchmark model. This difference is due to the fact that the addition of housing to the model generates spillover effects between the household and the production sectors. More specifically, any disturbance that affects house prices and the demand for real estate in one sector is transmitted to the other one through changes in the value of the real estate they own.

Consider the effect of a positive shock to the LTI ratio. In the benchmark model, an increase in the LTI ratio leads to lower labor supply and output. In the model with housing, these responses are reversed. A shock to household credit is transmitted to the entrepreneurs through the existence of a common asset, housing. An increase in household borrowing raises households' demand for housing, and house prices go up. The increase in house prices lowers the entrepreneurs' demand for real estate, which allows them to generate a flow of funds by reducing the real estate they own. Using these excess funds, they increase their labor demand.[7] While the increase in the LTI ratio still reduces the labor supply, as the movement of λ_t^h implies, the increase in labor demand dominates the decline in labor supply. As a result, equilibrium labor level and output increase.

[7] To be exact, the excess flow of funds generated through the sale of real estate reduces the firm's demand for borrowing and the Lagrange multiplier on its credit constraint. This decline in the Lagrange multiplier decreases the cost of labor, as can be seen in equation (12).

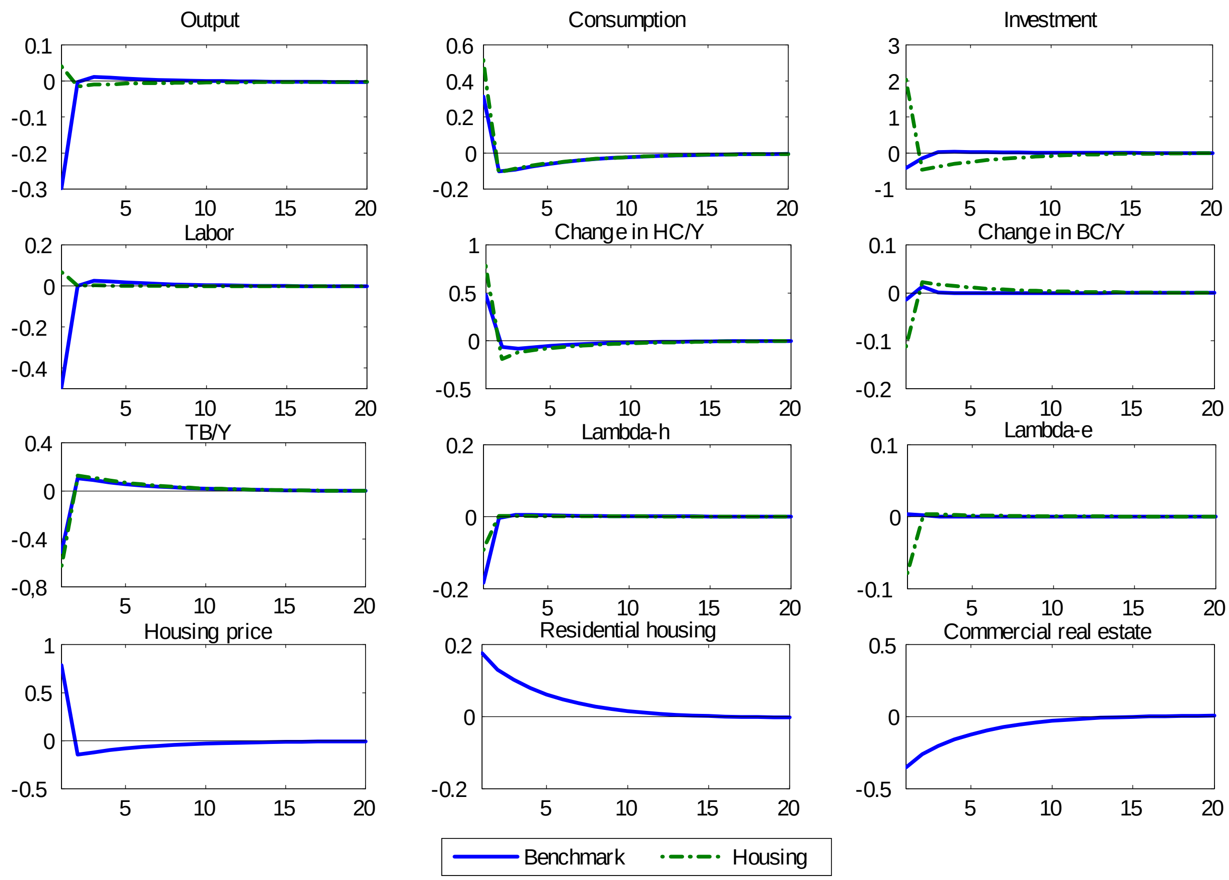

Figure 4. Positive household credit shock-The model with housing: Percent deviation of variables from their steady-state values except for λ_t^h and λ_t^e

A positive shock to business credit increases labor demand through higher credit availability of firms, as in the benchmark model. However, the increase in labor turns out to be lower in the model with housing. This difference is again due to the spillover effects generated by housing. As entrepreneurs demand more real estate, house prices increase, and households generate a flow of funds by reducing their housing stock. Due to these excess funds, the household's credit constraint becomes less binding and the Lagrange multiplier decreases more, which leads to a bigger reduction in the labor supply. Since the increase in labor demand is still higher than the decrease in labor supply, employment goes up but less so than the benchmark model.

The spillover effects of housing are also important for the behavior of investment. In the benchmark model, investment decreases after a household credit shock whereas it increases in the model with housing. The excess funds that entrepreneurs generate through a reduction of their real estate holdings raises their consumption, which reduces the cost of investment as the marginal utility of consumption decreases. At the same time, the increase in labor raises the marginal product of capital. As a result, firms reduce their real estate holdings and invest in capital.

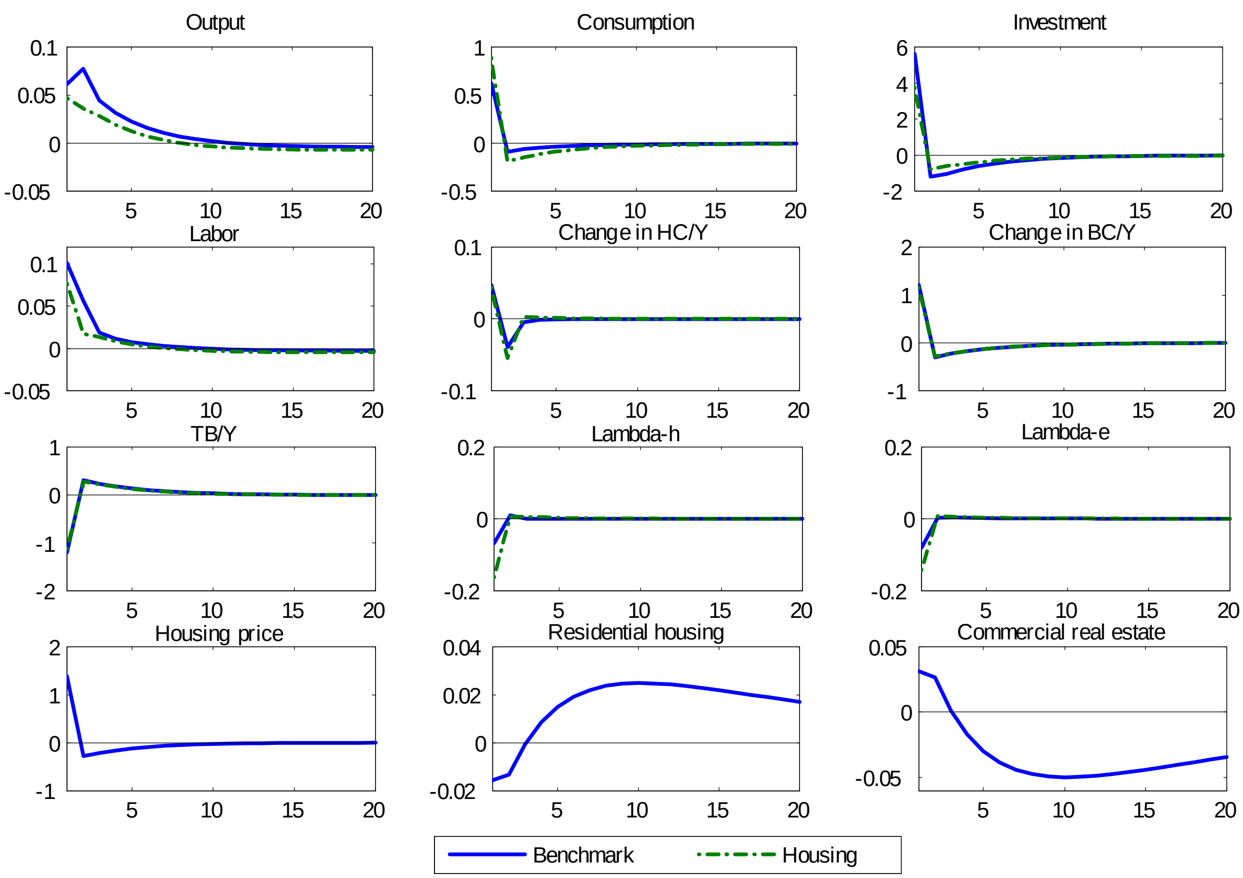

Figure 5. Positive business credit shock-The model with housing: Percent deviation of variables from their steady-state values except for λ_t^h and λ_t^e

The predictions of our model regarding investment is similar to the findings of Liu et al. (2011). They show that when firms are credit constrained, a housing demand shock originating in the household sector raises the land price and thereby expands firms' borrowing capacity, enabling firms to finance expansions of investment and production. In this analysis, we find that along with investment, equilibrium employment is also affected by the mechanism generated by housing. In other words, we identify an additional mechanism that propagates the effects of a shock that influences housing prices.

To summarize, when housing enters the objective function of both agents, it generates spillover effects between the household and the production sectors. As a result, the two types of credit shocks affect the key macroeconomic variables in the same direction. The benchmark model does not have the mechanism generated by housing since the two sectors are not linked through a common asset. Therefore, the household and business credit shocks affect labor supply, output and investment in opposite directions.

5.2 Positive adjustment cost

Here we simulate our model such that agents face positive adjustment costs. In the existence of housing, the household and business sectors are linked to each other by a common asset which creates spillover effects from one sector to the other. The strength of the interaction between the two sectors depends on how fast the agents can change their housing stocks and housing can be transferred between the two sectors. In reality, for both residential and commercial real estate, selling and buying real estate as well as moving entail substantial costs in terms of time and effort, in addition to any direct costs for moving services or real estate commissions. These costs can be represented by adjustment costs on real estate. In addition to this, there are costs associated with converting commercial real estate to residential housing and vice versa. In the model without adjustment costs, we treat commercial and residential real estate as perfect substitutes and abstract from the costs of converting one type of real estate to the other. It is plausible to think that converting one type of real estate to the other one is costly, and these costs can also be proxied by adjustment costs on the agents' stocks of real estate.

To capture the costs associated with real estate transactions, we use housing adjustment costs of the form specified above. We analyze the effects of these costs on model dynamics by comparing impulse response functions for three different values of the adjustment cost parameter, $\phi = 0, 2, 10$. Since the housing channel mainly affects the model dynamics in the case of a household credit shock, we report the impulse responses for a positive shock to the LTI ratio in Figure 6 and we only report the dynamics of the variables affected by the adjustment costs.

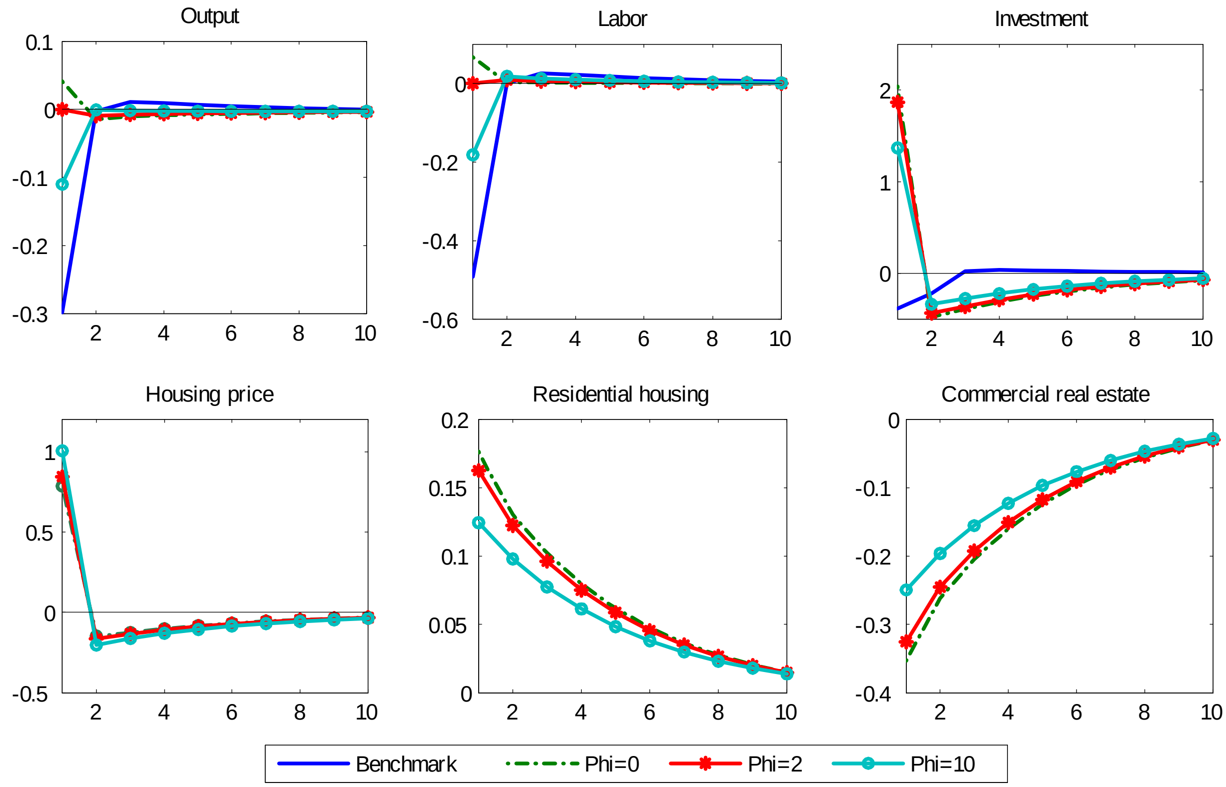

Figure 6. Positive household credit shock-The model with housing for different adjustment cost parameters: Percent deviation of variables from their steady-state values

With housing adjustment costs, the fluctuations in the housing stock variables are reduced, which weakens the transmission of shocks between the two sectors. When facing adjustment costs, both agents are less willing to change the level of real estate they own. Therefore, the increase in residential housing after a positive household credit shock decreases as adjustment costs increase. With entrepreneurs generating a lower level of funds through housing sales, the spillover effect weakens and the dynamics of output and labor in the housing model get closer to the benchmark model as the adjustment cost parameter increases. Specifically, starting at $\phi = 2$, output decreases after a household credit shock. The increase in investment also declines as adjustment costs increase.

These results show that the flexibility of the housing market can be an important factor in understanding how different types of credit shocks affect the dynamics of the economy. The costs of selling and buying real estate, financial market imperfections and institutional inefficiencies that prolong the transactions weaken the mechanism working through changes in agents' holdings of real estate. The strength of this mechanism determines whether the benchmark model or the extended model with housing would be more applicable.

6 Business Cycle Statistics

In this section, we examine the ability of the model to match the main characteristics of business cycles observed in Turkey in the period 1995Q1-2009Q4. Table 4 documents the key business cycle moments obtained from the data and the three versions of the model: the benchmark model (without housing), and the housing model with and without adjustment costs. The models are log-linearized around the steady state and the moments are calculated using HP-filtered series. In all versions, the model dynamics are generated by productivity and two credit shocks.

Business cycle properties of Turkey conform with the properties observed in other emerging market economies as documented by Neumeyer and Perri (2005) and Aguiar and Gopinath (2007), among others. In particular, the volatility of consumption is higher than output, investment is about three times more volatile than output, and the ratio of trade balance to output is strongly countercyclical. The volatility of labor supply is quite low compared to output, and its correlation with output is also lower than the correlations of consumption and investment.

In Turkey, the changes in household credit and business credit relative to output are both procyclical, which is consistent with the cyclical pattern of private sector credit observed in other emerging economies as illustrated in Table 2. This pattern shows that credit expansions for both types of credit occur in periods of high output. The correlation of household credit with output is higher, suggesting that household credit responds more strongly to cyclical fluctuations.The correlations of changes in household credit and business credit with the trade balance are negative. Credit expansion, whether it is household credit or business credit, leads to an increase in imports as imported goods are used both by consumers and as inputs by firms. Also, household credit has a higher correlation than business credit.

All three versions of the model replicate most of the features of the data quite successfully. In the benchmark model consumption is as volatile as output and the model with housing can match the relative volatility of consumption perfectly. The relative volatility of labor and the volatility of the trade balance-to-GDP ratio are quite close to the data. The volatilities of the changes in the two types of credit relative to output are lower in the benchmark model than in the data. However, the addition of housing to the model improves the fit of the model with respect to the credit variables.

The model also does a good job in matching the correlations. In particular, all versions generate a strongly countercyclical trade balance, which is hard to generate in standard small open economy RBC models. The correlations of the changes in credit with output are positive and correlations with the trade balance are negative for both types of credit in the model as in the data. While all versions of the model match the correlation of the household credit with the trade balance quite well, they overestimate the negative correlation between business credit and the trade balance.

Table 4. Business cycle properties

	Standard Deviations					Correlations			
	Data	Benchm. Model	Housing $\phi=0$	Housing $\phi=10$		Data	Benchm. Model	Housing $\phi=0$	Housing $\phi=10$
$\sigma(Y)$	3.78	3.42	3.67	3.59	$\rho(C,Y)$	0.81	0.95	0.95	0.95
$\sigma(C)/\sigma(Y)$	1.13	1.00	1.13	1.12	$\rho(I,Y)$	0.91	0.82	0.87	0.87
$\sigma(I)/\sigma(Y)$	3.13	3.13	3.13	3.13	$\rho(L,Y)$	0.58	0.98	0.99	0.99
$\sigma(L)/\sigma(Y)$	0.53	0.54	0.61	0.58	$\rho(\frac{TB}{Y},Y)$	-0.69	-0.34	-0.46	-0.43
$\sigma(\frac{TB}{Y})$	1.78	1.64	1.93	1.93	$\rho(\frac{\Delta HC}{Y},Y)$	0.64	0.36	0.43	0.40
$\sigma(\frac{\Delta HC}{Y})$	1.03	0.71	1.15	1.09	$\rho(\frac{\Delta BC}{Y},Y)$	0.44	0.32	0.38	0.37
$\sigma(\frac{\Delta BC}{Y})$	2.53	1.50	1.65	1.64	$\rho(\frac{\Delta HC}{Y},\frac{TB}{Y})$	-0.73	-0.66	-0.76	-0.77
					$\rho(\frac{\Delta BC}{Y},\frac{TB}{Y})$	-0.36	-0.94	-0.90	-0.90

Note: Trade balance (TB) is exports minus imports. Change in household credit (ΔHC) is HC_t-HC_{t-1}, change in business credit (ΔBC) is BC_t-BC_{t-1}. GDP (Y), consumption (C), investment (I), and Labor (L) in logarithms. All series are HP filtered. The standard deviations are reported in percentage terms.

7 Sensitivity Analysis

7.1 Cobb-Douglas Utility Function

In the model, we use GHH-type preferences which have been extensively used in small open economy models since they improve the ability of these models to match business cycle facts in open economies (see Correia et al., 1995, Neumeyer and Perri, 2005, among others). These preferences mute the income effect in the labor supply decision, which is important for the predictions of our model. Here we analyze how the results of the benchmark model change if we consider a Cobb-Douglas utility function of the form

$$u(c_t, l_t) = \frac{[(c_t^h)^\gamma (1 - l_t)^{(1-\gamma)}]^{1-\sigma}}{1 - \sigma}.$$

The most important differences between the GHH and Cobb-Douglas cases are observed in the case of a productivity shock. Therefore, we plot the impulse responses for a productivity shock to understand the implications of using Cobb-Douglas preferences.[8] With the baseline preferences, labor supply increases after a productivity shock whereas using Cobb-Douglas preferences leads to a decline in labor supply. As productivity increases, the increase in wages causes a decline in labor supply due to the presence of income effect in the Cobb-Douglas case. This negative income effect coupled with the negative effect due to the relaxation of the credit constraint leads to a decrease in labor in equilibrium. As a result of this, equilibrium paths of output, consumption and investment exhibit smaller increases in the Cobb-Douglas case.

Using Cobb-Douglas preferences leads to a lower response of labor for all shocks due to income effect. As a result, the correlation between output and labor in the simulation of the model turns out to be negative, while in the data it is positive (-0.16 in the model vs. 0.58 in the data). Therefore, we believe that using GHH preferences provides labor supply dynamics that are more consistent with the data.

[8] The impulse responses for the other shocks are available upon request.

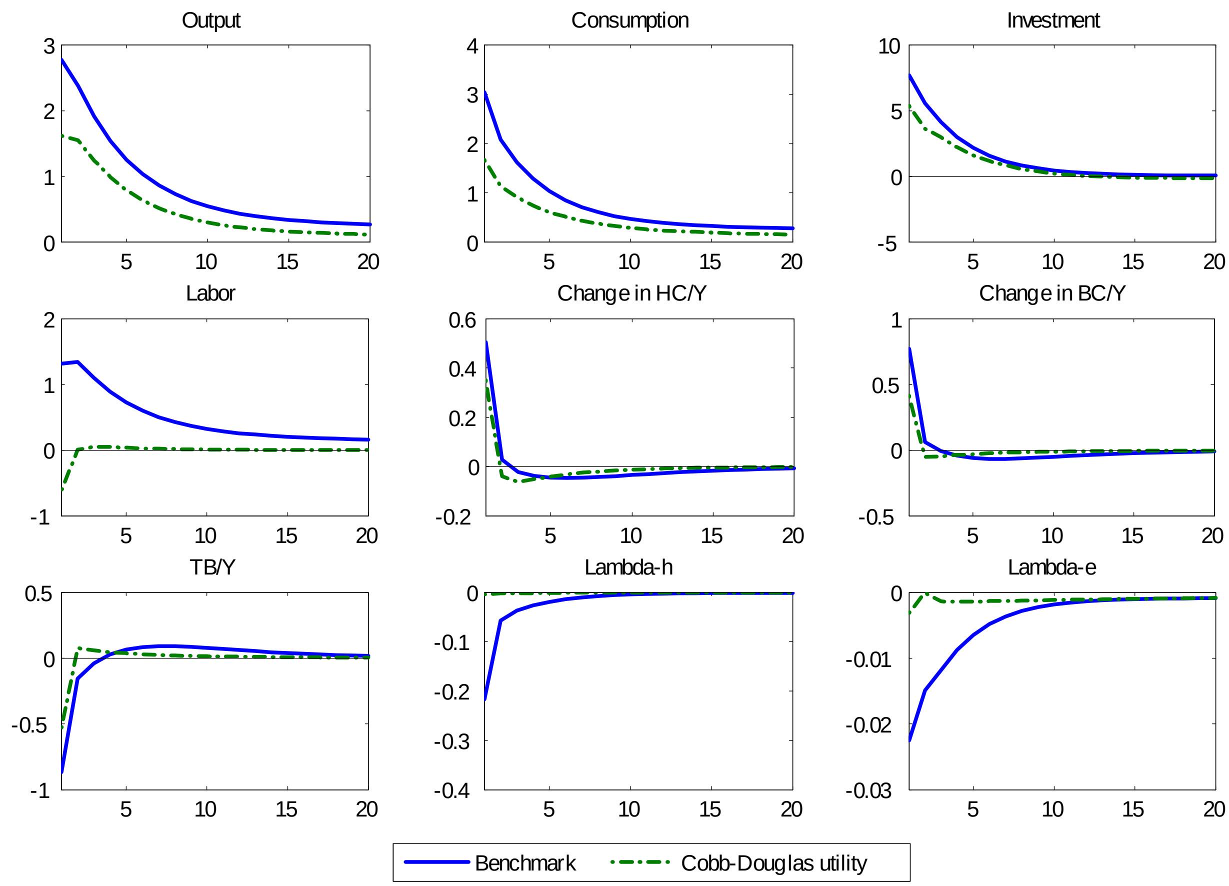

Figure 7. Productivity shock-Cobb-Douglas utility function: Percent deviation of variables from their steady-state values except for λ_t^h and λ_t^e

7.2 Working Capital

In the benchmark model we assume that a fraction θ of wage payments needs to be financed by working capital, and θ is set to 0.25. Here we analyze how the value of θ affects the response of the economy to a business credit shock by setting θ equal to 0 and 0.50.[9] While the directions of the responses are similar for the three values, the magnitudes are different for some of the variables. Specifically, the immediate responses in labor and output after the shock are amplified for larger values of θ. With an increase in the borrowing capacity of firms, entrepreneurs' labor demand increases more for higher values of the working capital coefficient. While the responses of labor and output are higher on impact as θ increases, the response of investment is dampened due to the decline in funds that are available for

[9]Since the responses of the main variables do not change much depending on θ for productivity and household credit shocks, here we discuss only the case of a shock to business credit.

investment. As entrepreneurs invest less in capital and hire more labor after the credit expansion, capital accumulates less and output converges back to the steady state faster when θ is higher.

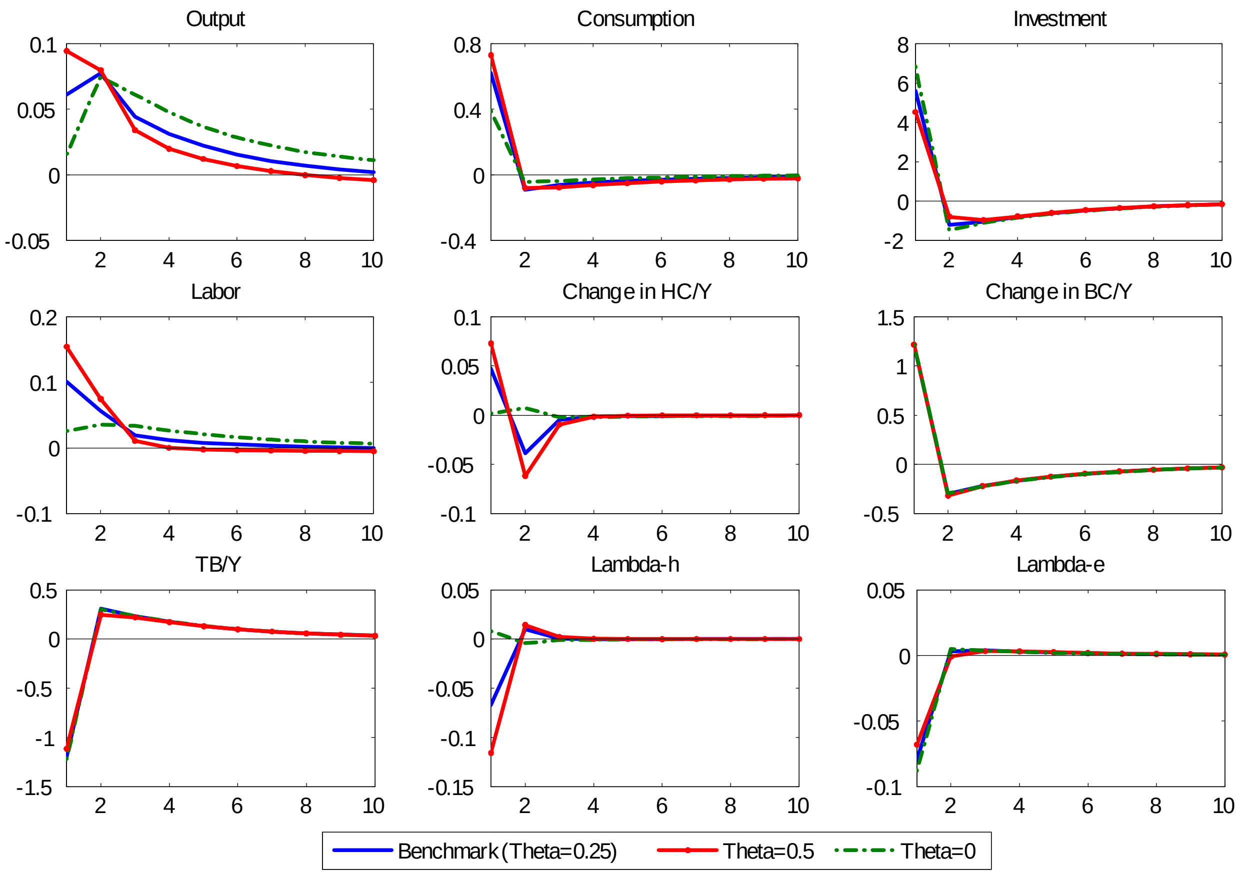

Figure 8. Positive business credit shock-Different θ values: Percent deviation of variables from their steady-state values except for λ_t^h and λ_t^e

8 Concluding Remarks

This paper extends the small open economy literature on borrowing constraints by studying the differential effects of household and business credit constraints on business cycles. We show that the differences in the transmission of the two types of credit shocks depend on the existence of housing. The impulse responses of labor, output and investment show that when housing is abstracted from the model, household credit expansions lead to a decline in these variables whereas an increase in business credit results in an expansion.

When we introduce housing, the results depend on the strength of the spillover effects between sectors generated by housing. By considering varying degrees of adjustment costs in housing, we analyze the model dynamics for different levels of the spillover effects. With high adjustment costs, the results of the housing model are similar to the benchmark model. On the other hand, when adjustment costs are low, both types of credit start affecting the economy in the same direction since transmission of shocks through changes in real estate holdings dampens the differences between the sectors. These results suggest that the strength of the spillover effects generated by housing appears to be an important factor in understanding how different types of credit shocks affect the dynamics of the economy.

Our analysis highlights the importance of labor dynamics in understanding the effects of household and business credit expansions on business cycles. We show that credit expansions are likely to affect both labor supply and labor demand, and the mechanisms generated by the two types of credit can be quite different. We leave the empirical investigation of the link between credit and employment for future research.

While our contribution has been to provide evidence in support of differentiating between household and business credit in studying the effects of credit expansions on business cycles, we plan to extend our research to incorporate the role of financial institutions where banks face exchange rate risks while intermediating the funds to credit constrained households and entrepreneurs. We believe that the interaction between credit constraints, real exchange rate dynamics and collateral type merits investigation.

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Appendix

Log-linearized version of equation (5):

Log-linearizing equation (5) around the steady state gives the following equation where $\bar{x}$ denotes the steady-state value of the variable x_t, and $\hat{x}_t$ denotes the log-deviation from its steady-state value:

$$\kappa_1 \hat{l}_t = \hat{w}_t + \kappa_2 \hat{c}_t^h + \kappa_3 \left(\hat{\lambda}_t^h + \hat{m}_t^h \right),$$

where

$$\begin{aligned} \kappa_1 &= (\eta - 1) + \bar{w}\bar{\lambda}^h \bar{m}^h \sigma \left(\bar{c}^h - \psi \bar{l}^\eta \right)^{\sigma - 1} \bar{l}, \\ \kappa_2 &= \frac{\sigma \bar{w}\bar{\lambda}^h \bar{m}^h \bar{c}^h \left(\bar{c}^h - \psi \bar{l}^\eta \right)^{\sigma-1}}{\psi \eta \bar{l}^{\eta - 1}}, \\ \kappa_3 &= \frac{\bar{w}\bar{\lambda}^h \bar{m}^h \left(\bar{c}^h - \psi \bar{l}^\eta \right)^{\sigma}}{\psi \eta \bar{l}^{\eta - 1}}. \end{aligned}$$

Construction of the series used in the paper:

The nominal GDP, investment and consumption series are converted into real units by dividing the nominal series with the GDP deflator for constant 2005 prices.

Capital Stock: The capital stock is generated using a perpetual inventory method. The nominal investment series has been converted into 2005 prices and seasonally adjusted for constructing the capital stock data. For the perpetual inventory method, we use a yearly depreciation rate of 0.08 as Meza and Quintin (2007). To set the initial capital stock, we follow Young (1995) and Meza and Quintin (2007) and assume that the growth rate of investment in the first five years of the series is representative of the growth rate of investment in previous years.

Labor Input: We calculate total hours worked by multiplying the average hours per worker with total employment. Since there is no data for average hours per worker for the whole economy, we use average hours per worker in the manufacturing sector (Bergoeing et al. (2002) and Meza and Quintin (2007) also use manufacturing sector data). In order to find average hours per worker in the manufacturing sector, we multiply an index of total hours worked in manufacturing by the actual hours worked in 2005, which is the base year. We then divide this by the number of workers in manufacturing, which is also calculated as the index of workers times the actual number of workers in 2005. We scale the resulting series by 1274, an approximation of total discretionary time available in a quarter (corresponds to 98 weekly hours used by Correia et al., 1995). We use this series as representative of average hours per worker in the economy as a whole, and multiply it by total employment to get total hours worked. We seasonally adjust this data and use it as the measure of total hours worked to calculate total factor productivity as explained below.

To calibrate the parameter that measures the disutility from working, ψ, we need a measure of total hours per capita. We divide the total hours worked series by the total working age population, which corresponds to the population of age 15 and higher. We then set ψ so that the steady state labor supply equals the average for Turkey of total hours per capita as a fraction of total discretionary time, which is 0.18.

The total employment and total working age population figures are reported twice a year by the Turkish Statistical Institute in the period 1995-1999, and quarterly figures are available starting in 2000. The quarterly values are obtained from the biannual figures through linear interpolation in the period where quarterly data are missing.

Labor income: Calculating the labor share of income as the ratio of the compensation of employees to income gives an average value of 0.31, which implies that α, the capital exponent in the production function, equals 0.69. This value is much higher than the standard values used in the literature, which are in the range of 0.30 to 0.40. Gollin (2002) points out that there is a wide variation in labor shares across countries, and this problem is due to the fact that the labor income of the self-employed is often treated incorrectly as capital income. He goes on to show that once the income of the self-employed is treated as labor income, these disparities vanish and labor shares fall in the range 0.65-0.80. Following one of the methods he uses, we correct our labor income figures to account for the income of the self-employed. For this purpose, we divide the compensation employees by the number of employees and multiply these by total employment minus the number of employers.

Taking the ratio of these new labor income figures to GDP gives an average value of 0.60, which is much closer to values used in the literature. Note that the data on compensation of employees are only available until the end of 2006. Therefore, the data we use for this part of the calibration covers the period 1995-2006.

We also use the compensation of employees data in the calibration of the working capital coefficient θ. We calibrate this parameter as the average of the ratio of short-term loans to the compensation of employees. Since the working capital requirement represents borrowing by firms to pay for the wage income of their workers, we use the unadjusted data on compensation of employees, directly from the GDP figures. We do not use the adjusted data since the adjustment is to correct for the income of the self-employed, which is not relevant for the working capital requirement.

Total Factor Productivity: The data on TFP have been constructed as

$$A_t = \log(y_t) - \alpha \log(k_{t-1}) - (1-\alpha)\log(l_t)$$

where y_t is GDP in 2005 prices, k_t is capital stock in 2005 prices and l_t is total hours worked. The TFP series is then linearly detrended and the residuals are used to estimate the AR(1) process for the productivity shock.

Real interest rate: The series for the real interest rate is computed using the procedure followed by Neumeyer and Perri (2005). The real interest rate for Turkey is computed as the U.S. real interest rate plus the sovereign spread for Turkey. The sovereign spread is measured by J.P. Morgan's Emerging Markets Bond Index Global (EMBIG), which is available starting in 1998. The EMBIG spreads measure the premium above U.S. Treasury securities in basis points for dollar denominated sovereign debt. The U.S. real interest rate is computed by subtracting expected inflation rate from the interest rate on 90-day U.S. Treasury bills. Expected inflation in period t is computed as the average of U.S. GDP deflator inflation in the current period and in the three preceding periods.

Business Credit: We construct the real value of business credit in 2005 prices by dividing the business credit series with the GDP deflator. Since the credit constraint on firms takes the form

$$b_t^e \leq m_t^e k_t,$$

we calculate the series for m_t^e as the ratio of the real value of business credit divided by the capital stock, where both series are in units of 2005 prices.

Household Credit: The credit constraint on households takes the form

$$b_t^h \leq m_t^h (w_t l_t).$$

Therefore, we calculate m_t^h as the household credit divided by the labor share of total output, which is equal to $0.6y_t$ according to our calibration.

Data sources:

- GDP, GDP deflator, investment, consumption, trade balance, import and export unit values, U.S. Treasury bill rate: International Financial Statistics

- Indexes of total hours worked and total employment in manufacturing: OECD

- Total employment and total working age population: Turkish Statistical Institute

- Household credit (housing credit, consumer credit, individual credit cards, and loans to personnel) and business credit (credit to non-financial companies and individual corporations): Central Bank of Turkey

- Short-term bank loans of firms: Company Accounts database, Central Bank of Turkey