Corporate Saving in Global Rebalancing[1]

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Abstract

In this paper, we examine theoretically how corporate saving in emerging markets is contributing to global rebalancing. We consider a two-country dynamic general equilibrium model, based on Bacchetta and Benhima (2014), with a Developed and an Emerging country. Firms need to save in liquid assets to finance their production projects, especially in the Emerging country. In this context, we examine the impact of a credit crunch in the Developed country and of a growth slowdown in both countries. These three shocks imply smaller global imbalances and a positive output comovement, but have a different impact on interest rates. Contrary to common wisdom, a slowdown in the Emerging market implies a trade balance improvement in the Developed country.

1 Introduction

The increase in global imbalances in the last decade posed a theoretical challenge for international macroeconomics. Why did some less developed countries with a higher need in capital, like China, lend to richer countries? The inconsistency of standard open-economy dynamic models with actual global capital flows had already been stressed before, e.g., by Lucas (1990), but the sensitivity to this issue became more acute with increasing global imbalances. This stimulated the development of several alternative theoretical frameworks.[1] However, in the aftermath of the global financial crisis we have observed a reduction in global imbalances. What light can the recent models shed on this "global rebalancing"?

In this paper, we focus on a specific dimension of global imbalances: corporate saving. Increased global imbalances were greatly associated with an increase in net saving in emerging Asia. Part of this increase can be explained by an increase in corporate saving.[2] This aspect has typically been ignored in the literature, but is the focus of our previous work in Bacchetta and Benhima (2014, henceforth BB). We proposed a two-country model where firms need to save in liquid assets to finance their working capital. We showed that a country with a less developed financial system and strong growth has a higher corporate saving rate and that saving exceeds investment. The model is consistent with the main features of global imbalances, but has also interesting properties for international spillovers. The strategy of this paper is to adopt a modified version of the BB model and focus on corporate saving in the context of global rebalancing.

It is well known that global imbalances sharply increased from 2000 to 2007. This is associated with an increase in China's total saving and part of this increase comes from the increase in corporate saving. Figure 1 that shows the evolution of the corporate saving rate for three countries: China, the U.S. and Mexico. Between 2000 and 2008, there has been a significant increase in the corporate saving rate in China, while there has been little change in the U.S.. Mexico has not been a key player in global imbalances, but it is interesting to notice that corporate saving increased from 2003 to 2007, which is a period coinciding with an increase in output growth and a slight improvement in its current account deficit. To put corporate saving in perspective, Figure 2 shows the evolution of total saving and of its

[1] See Gourinchas and Rey (2014) for a survey.

[2] E.g., see Sonali et al. (2009).

components. While the literature typically focuses on household or government saving, we see that corporate saving also contributed significantly to changes in total saving. It is too early to assess the evolution of corporate saving after the crisis (the data are published with a long delay), but the available data indicates that corporate saving has increased in the U.S. and has slightly declined in China and in Mexico.

[Figure 1 about here]

[Figure 2 about here]

It is also interesting to examine the evolution of investment. Figure 3 shows that it increased sharply in China and less strongly in Mexico, while it declined in the U.S.. During the period under review, we therefore see a relationship between increases in corporate saving and increases in investment. This positive link is a key aspect of our theoretical analysis.

[Figure 3 about here]

The process of global rebalancing occurred after the global financial crisis in 2008 and the subsequent recession in developed countries. More recently, the global economy has been affected by a slowdown in emerging market economies. We examine the impact of these developments on global imbalances in a model where corporate saving and investment determine the current account. We consider an asymmetric world economy with an Emerging country and a Developed country and examine the impact of three shocks: a credit crunch and a growth slowdown in the Developed country and a growth slowdown in the Emerging country. We find that all three shocks lead to global rebalancing. However, these shocks have a different impact on the world interest rate. The two shocks originating in the Developed country have a negative impact on the interest rate, while the shock in the Emerging country has a positive impact. This implies that the initial phase of rebalancing was associated with a downward pressure on real interest rates, but the recent period is more likely to be associated with an increase in world interest rates. We also notice that slower growth in the Emerging country improves the trade balance of the Developed country.

As mentioned, the model used in this paper is a simplified version of BB. Since we already conducted a systematic study of the model and of its dynamic properties, in this paper we focus on some implications of the model, including international spillovers. In the BB model, firms have a need for liquid assets in the spirit of Holmstrom and Tirole (2001, 2011). To introduce this aspect in a dynamic macroeconomic model, we follow Woodford (1990) where entrepreneurs have two-period projects.[3] In their first period, entrepreneurs invest in illiquid capital and decide on their liquid asset holdings. In their second period, they produce using a labor input. To pay for wages, firms can either borrow or use their liquid assets. When borrowing is limited, firms need more liquid assets. This is the reason why fast-growing countries with tight borrowing limits have higher liquid asset holdings and higher corporate saving. Moreover, higher growth leads to a joint increase in saving and in investment. When we consider an asymmetric two-country model, we assume that the liquidity motive is strong in the Emerging country and weaker in the Developed country. Consequently, the Developed country behaves similarly to standard open-economy models, while the Emerging country has a different behavior.

The strong need for liquid assets in the Emerging country introduces a new channel of international transmission. A decrease in the world interest rate has a negative impact on surplus economies holding liquid assets. This negative liquidity channel is combined with two other, more standard channels. First, there is a substitution channel as firms substitute capital for labor. Second, there is a collateral channel as credit constraints are looser with a lower interest rate. We analyze theoretically and numerically the different factors determining the strength of these different channels. In addition to affecting the spillover mechanism of interest rate changes, the large liquidity holdings in the Emerging country affect the response of the world interest rate to fundamental shocks. An interesting aspect of the model is a positive output comovement in presence of productivity shocks. This contrasts with standard intertemporal open-economy macroeconomic models, where productive shocks have negative spillovers (e.g., see Obstfeld and Rogoff, 1996). However, the mechanism leading to this positive comovement is different whether the shock originates in the Developed or in the Emerging country. Nevertheless, the liquidity needs of the Emerging country play a key role in these mechanisms, as it affects either the direct impact of the shock on the world interest rate or the spillover channel.

The rest of the paper is organized as follows. In the next section we present the model, from the individual entrepreneur to the global economy. Section 3 examines the impact of interest

[3] Woodford (1990) presents two models: one with credit-constrained consumers and endowments and a second one with credit-constrained entrepreneurs and production. Our approach is based on his second model.

rate shocks that represent the main spillover channel across the countries. Section 4 examines numerically the impact of the three shocks mentioned above. Section 5 concludes.

2 A Two-Country Model with Corporate Saving

We consider a two-country model with an Emerging country and a Developed country. The structure of both economies, based on BB, features a demand for liquidity (short-term bonds) from entrepreneurs, which they can trade domestically and internationally. Three ingredients in the model are necessary to generate a demand for liquidity. First, production takes time: capital needs one installation period before it can be used in the production process. Second, the wage bill has to be paid before output can be sold. This generates a need for funds. The third assumption is that entrepreneurs face credit constraints. This implies that entrepreneurs are not always able to borrow all the funds needed to hire labor for production. Consequently, when they invest in capital, entrepreneurs need to keep liquid assets. This creates a liquidity channel of the interest rate through which a decrease in the world's interest rate on liquid assets has a negative effect on production.

To distinguish the Developed country from the Emerging one, we denote the Developed country variables with a star superscript. Since the two economies have the same structure and differ only with regard to their parameter values, we first lay down the model for the Emerging economy. The model is then closed through the equilibrium on the bond market, which defines the world interest rate.

2.1 The Production Process

Entrepreneurs are infinitely lived and maximize the present value of their utility. They have two-period production projects as it takes one period to install capital before producing. An entrepreneur starting a project at time t invests K_{t+1}. At $t+1$, once capital is installed, he hires labor l_{t+1} to produce $Y_{t+1} = F(K_{t+1}, Z_{t+1}l_{t+1})$, where Z_t measures productivity and F is a constant-return-to-scale production function, and pays wages $w_{t+1}l_{t+1}$. This production is available only at $t+2$. At $t+2$, the entrepreneur gets another investment opportunity. The entrepreneur consumes c_t each period and can borrow or lend short-term bonds with a gross interest rate r_t.

In this setup, working capital in the form of early payment of wages interacts with credit constraints to generate a demand for liquidity. Entrepreneurs can use part of the proceeds from previous production to invest K_{t+1}. At $t+1$, however, they have no income to pay $w_{t+1}l_{t+1}$ for workers. Consequently, they have an incentive to borrow an amount L_{t+2}. When an entrepreneur is credit-constrained, however, he will not be able to borrow the desired amount to pay for the wage bill. He will therefore have a demand for liquidity at time t in the form of a positive demand for bonds, A_{t+1}.

2.2 Optimal Behavior

Entrepreneurs maximize:

$$\sum_{s=0}^{\infty} \beta^s u(c_s) \tag{1}$$

Consider an entrepreneur who invests every other period, starting at time t . Denote by W_t his initial income at time t. It is made of the output from production initiated at date $t-2$, $Y_{t-1} = F(K_{t-1}, Z_{t-1}l_{t-1})$, minus debt repayments, $r_t L_t$. Hence, $W_t = Y_{t-1} - r_t L_t$. His budget constraints at t and $t+1$ are:

$$W_t = c_t + K_{t+1} + A_{t+1} \tag{2}$$

$$r_{t+1}A_{t+1} = c_{t+1} + w_{t+1}l_{t+1} - L_{t+2} \tag{3}$$

The income of the entrepreneur at date t is allocated to consumption, c_t, investment in a new project, K_{t+1}, and bond holdings A_{t+1}. In the following period, at $t+1$, the only income is the bond return, $r_{t+1}A_{t+1}$. This has to pay for consumption c_{t+1} and the wage bill $w_{t+1}l_{t+1}$. Typically the entrepreneur will borrow, so that at the optimum $L_{t+2} \geq 0$.

The entrepreneur might face a credit constraint at date $t+1$. Due to standard moral hazard arguments, a fraction $0 \leq \phi \leq 1$ of output can be used as collateral for bond repayments:[4]

$$r_{t+2}L_{t+2} \leq \phi Y_{t+1} \tag{4}$$

Let λ_{t+1} denote the multiplier associated with this constraint. The entrepreneur's program yields the following first-order conditions:

$$F_{Kt+1}\left(1+\phi\frac{\lambda_{t+1}}{\beta^2 u'(c_{t+2})}\right) = r_{t+1}r_{t+2}\left(1+\frac{\lambda_{t+1}}{\beta^2 u'(c_{t+2})}\right) \tag{5}$$

[4] There could be a similar constraint at date t, but one can show that it is never binding, precisely because of the demand for liquidity. Assuming that capital is used as collateral instead of output, as in BB, yields similar results.

$$F_{l t+1}\left(1+\phi\frac{\lambda_{t+1}}{\beta^2 u'(c_{t+2})}\right) = w_{t+1}r_{t+2}\left(1+\frac{\lambda_{t+1}}{\beta^2 u'(c_{t+2})}\right) \tag{6}$$

When the production function is Cobb-Douglas, that is $F(K, Zl) = K^{\alpha}(Zl)^{1-\alpha}$, the first-order conditions (5) and (6) give a straightforward relationship between the liquidity needs $w_{t+1}l_{t+1}$ and capital K_{t+1}:

$$w_{t+1}l_{t+1} = \frac{1-\alpha}{\alpha}r_{t+1}K_{t+1} \tag{7}$$

With log utility, it can be shown that an entrepreneur who invests at t consumes a fixed fraction of his revenue:

$$c_t = (1-\beta)W_t \tag{8}$$

Using the Euler equation at t , we get the following rule for consumption at $t+1$:

$$c_{t+1} = \beta(1-\beta)r_{t+1}W_t \tag{9}$$

From (2) and (8), saving at t is:

$$S_{t+1} = A_{t+1} + K_{t+1} = \beta W_t \tag{10}$$

Equation (10) states that saving at t is a constant fraction of total revenues. Besides, when the constraint at $t+1$ is binding, the availability of funds to finance the wage bill at $t+1$ is limited. The fraction of saving allocated to liquidity A_{t+1} therefore depends on the liquidity needs at $t+1$, $w_{t+1}l_{t+1}$. To determine K_{t+1} we use (3), the binding credit constraint (4), (9) and (10) to get:

$$K_{t+1} + \frac{w_{t+1}l_{t+1}}{r_{t+1}} = \beta^2 W_t + \phi\frac{Y_{t+1}}{r_{t+1}r_{t+2}} \tag{11}$$

This consolidated budget constraint states that, in present-value terms, firms' saving, along with their external finance capacities, have to pay for inputs. Combining this equation with (7) and (10), we can determine jointly K_{t+1}, l_{t+1} and A_{t+1} in the constrained case.

To determine whether entrepreneurs are constrained or not, it is useful to look at labor market conditions. Entrepreneurs are constrained ($\lambda_{t+1} > 0$) whenever the market wage is lower than the first-best wage. Define $\widehat{w}(r_{t+1}, r_{t+2}, Z_{t+1}) = Z_{t+1}(1-\alpha)[\alpha^{\alpha}/(r_{t+1}^{\alpha}r_{t+2})]^{\frac{1}{1-\alpha}}$ as the first-best wage. Entrepreneurs are constrained when $w_{t+1} < \widehat{w}_{t+1}$.[5] In that case, the entrepreneur could make infinite profits by increasing the production scale, but is prevented by

[5]This can be seen by combining first-order conditions (5) and (6) in the benchmark case, which yields: $w_{t+1}\left[\left(1+\frac{\lambda_{t+1}c_{t+2}}{\beta}\right)/\left(1+\phi\frac{\lambda_{t+1}c_{t+2}}{\beta}\right)\right]^{1-\alpha} = \widehat{w}(r_{t+1}, r_{t+2}, Z_{t+1})$.

the binding credit constraint. If $w_{t+1} = \widehat{w}_{t+1}$, the production scale is undetermined, because of constant returns to scale. There is no reason for the entrepreneur to be constrained in that case.

2.3 Labor Market

Each entrepreneur has access to a project every two periods. There are two groups of entrepreneurs, each with mass one, with overlapping projects. One group of entrepreneurs gets a project in odd periods, while the other group gets a project in even periods. In a given period, the demand for labor comes from the group of entrepreneurs in their production period, so the aggregate demand for labor is given by Equation (7).

Labor is supplied domestically by a continuum of hand-to-mouth workers of mass one who do not have access to the production technology and consume all their income: $c_t^w = w_t l_t$. We assume that workers have the following labor supply:

$$l_t = \left(\frac{w_t}{\bar{w}}\right)^{\eta} \tag{12}$$

where η and $\bar{w}$ are positive constants. η is the Frisch elasticity of labor supply. When $\eta = 0$, the labor supply is inelastic at $l = 1$.

Using the labor demand equation (7), we can then infer the equilibrium labor as a function of aggregate capital K_{t+1}:

$$l_{t+1} = \left(\frac{1-\alpha}{\alpha}\frac{r_{t+1}}{\bar{w}}K_{t+1}\right)^{\frac{\eta}{\eta+1}} \tag{13}$$

When firms are constrained, the aggregate stock of capital is limited by total saving W_t, and so is equilibrium labor, preventing the equilibrium wage to reach the first-best one.

In equilibrium, l is less sensitive to r when η is low. This is because the equilibrium wage responds to the interest-rate induced increase in labor demand, which mitigates the equilibrium increase in labor, and the more so as the elasticity is low. In the extreme case where $\eta = 0$, labor demand is inelastic and $l = 1$ in equilibrium. In this case the increase in the equilibrium wage offsets the increase in r. On the opposite, if η goes to infinity, labor supply is hyperelastic at the wage $w_{t+1} = \bar{w}$ and any increase in labor demand is satisfied so $l_{t+1} = (1-\alpha)r_{t+1}K_{t+1}/\alpha\bar{w}$.

2.4 The Net Demand for Bonds and Equilibrium on the World Bond Market

Entrepreneurs can lend or borrow at the world interest rate r_t. We assume that $r_t < 1/\beta$, which ensures that credit constraints are binding in the steady state and around it.[6] The aggregate net demand for bonds B_{t+1} is equal to the net saving of the Emerging country. At each period t, there are two groups of entrepreneurs: those who invest and those who produce. As mentioned before the saving of investing entrepreneurs is $A_{t+1}+K_{t+1}$. The saving of producing entrepreneurs is simply $-L_{t+1}$. Aggregate net saving is then equal to total saving, $A_{t+1}+K_{t+1}$ $-L_{t+1}$, minus investment K_{t+1}. Therefore, the aggregate net saving in the Emerging country is the aggregate net demand for bonds, which is $B_{t+1} = A_{t+1} - L_{t+1}$.

The description of the Developed economy is identical to the Emerging one. For a given world interest rate r_{t+1}, the Developed country has a net demand for bonds $B^*_{t+1} = A^*_{t+1} - L^*_{t+1}$. The world interest rate has to be such that the world bond market clears:

$$B_{t+1} + B^*_{t+1} = 0 \tag{14}$$

2.5 An Asymmetric World Economy with Global Imbalances

We assume that the Emerging and Developed countries differ by their level of credit tightness, due to different levels of financial development, and by their level of technology. We assume $\phi^* > \phi$ and $Z^* > Z$. The asymmetry in ϕ has strong implications for the world equilibrium and for its reaction to shocks. In particular, it implies that the Emerging country will in general lend to the Developed country, i.e., $B_{t+1} > 0$ and $B^*_{t+1} < 0$. Thus, the model is consistent with the pattern of global imbalances.

To understand why the country with a tighter borrowing constraint lends to the country with a looser borrowing constraint, it is key to understand the behavior of the two groups of entrepreneurs.[7] At each period t, one group of entrepreneurs is in the production period and borrows L_{t+1} (L^*_{t+1}) and the other group is in the investment period and accumulates liquid

[6] This is true in our two-country economy as long as both countries have sufficiently strong credit constraints (ϕ and ϕ^* are low).

[7] For convenience, in this paper we assume that the constraint is always binding in both countries. BB analyze the case where the constraint is never binding for the Developed country and may not always be binding for the Emerging country.

assets A_{t+1} (A^*_{t+1}). With a loose credit constraint in the Developed country, L^*_{t+1} can be large and the need for liquid assets A^*_{t+1} is small. Thus, $B^*_{t+1} < 0$. Instead, as the credit constraint is tight in the Emerging country, L_{t+1} is small and the need for liquid assets A_{t+1} is large. Thus, $B_{t+1} > 0$.

The difference in credit tightness also affects the way the demand for bonds reacts to shocks. Consider an increase in growth in the Developed country. This increases output and relaxes the credit constraint (4). This allows borrowing from producing entrepreneurs to increase. This effect dominates and overall the country has a lower net demand for foreign bonds, i.e., B^*_{t+1} becomes more negative. Now consider an increase in growth in the Emerging country. The impact on borrowing is small since ϕ is low. On the other hand, there is a stronger need to finance the labor input, so that A_{t+1}, and thus B_{t+1}, increase. This implies that an increase in growth increases the magnitude of global imbalances, whether this increase occurs in the Developed or in the Emerging country.[8]

3 Spillovers

In this model, the international spillover of shocks goes exclusively through the world interest rate. To have a clear understanding of spillovers, it is useful to analyze the impact of interest rate shocks. For this purpose, we first consider the Emerging country as a small open economy. We can then study the effect of a change in the world interest rate, both theoretically and numerically.

3.1 Three Spillover Channels

There are three potential channels for a change in r. First, as apparent in the labor demand equation (7), a lower r_{t+1} makes firms substitute capital for labor. This is the substitution channel. Second, according to the consolidated budget constraint (11), a lower r_{t+1} makes the wage bill more costly, because it decreases the return of bonds that are used to finance it. This is the liquidity channel. Third, a lower interest rate increases the financing capacity of firms by relaxing the credit constraint. This is the collateral channel.

To study these channels, we analyze two extreme cases that are of particular interest: the

[8] BB examine the dynamic impact of a growth acceleration in the Emerging country.

case with an extreme borrowing constraint ($\phi = 0$) and the case with inelastic labor supply ($\eta = 0$). We then simulate the behavior of an economy hit by a negative shock on the world's interest rate, for these extreme cases and for intermediate cases.

3.1.1 Extreme borrowing constraint

The case with $\phi = 0$ shuts down the collateral channel and enables us to focus on the substitution and liquidity channels. In that case, the consolidated budget constraint makes the capital level depend on wealth W_t in a straightforward way, according to Equation (11). The resulting dynamics are summarized in the following proposition:

Proposition 1 *If $\phi = 0$ and the credit constraint is binding, a negative shock on r_{t+1} has a negative effect on labor and output on impact, but no effect on capital. Capital, labor, and output are negatively affected in subsequent periods when the interest rate shock is persistent.*

Proof. The level of capital is inferred from Equation (11) where $\phi = 0$. Labor is then determined by the equilibrium equation (13). Output is obtained by replacing K_{t+1} and l_{t+1}. Finally, $W_{t+1} = Y_{t+1}$ because $\phi = 0$. This gives:

$$K_{t+1} = \alpha\beta^2 W_t$$

$$l_{t+1} = \left(\frac{1-\alpha}{\alpha}\frac{r_{t+1}}{\bar{w}}\alpha\beta^2 W_t\right)^{\frac{\eta}{\eta+1}}$$

$$Y_{t+1} = W_{t+1} = Z_{t+1}^{1-\alpha}\left(\frac{1-\alpha}{\alpha}\frac{r_{t+1}}{\bar{w}}\right)^{(1-\alpha)\eta/(\eta+1)}(\alpha\beta^2 W_t)^{\alpha+(1-\alpha)\eta/(\eta+1)}$$

The impact of a decrease in r_{t+1} is then straightforward. ■

Whereas capital is not affected by r_{t+1} on impact, labor is negatively affected by a decrease in r_{t+1}, which then affects output negatively. This is the result of the combination of the substitution and liquidity channels. Through the liquidity channel, inputs are more costly, which decreases total inputs. Through the substitution channel, resources are reallocated within inputs towards capital at the expense of labor. All in all, the demand for capital stays unchanged while the demand for labor drops.

The magnitude of the equilibrium effect of r_{t+1} on l_{t+1} depends on the Frisch elasticity of labor η. Indeed, in equilibrium the decrease in labor demand depresses the wage, which mitigates the equilibrium effect of the interest rate on labor. In the case where labor supply is inelastic ($\eta = 0$), the decrease in wage perfectly offsets the decrease in interest rate, so labor stays constant at $l = 1$. In that extreme case, r_{t+1} has no effect on l_{t+1} and thus no effect on the economy. We now consider more generally the case of $\eta = 0$.

3.1.2 Inelastic labor supply

The case with $\eta = 0$ shuts down the substitution and liquidity channels and enables us to focus on the collateral channel. In that case, the following proposition applies:

Proposition 2 *If $\eta = 0$ and the credit constraint is binding, then a negative shock on r_{t+1} has a positive effect on capital.*

Proof. If $\eta = 0$ and the credit constraint is binding, then for a given W_t

$$l_{t+1} = 1$$

$$Y_{t+1} = Z_{t+1}^{1-\alpha} K_{t+1}^{\alpha}$$

$$W_{t+1} = (1-\phi) Z_{t+1}^{1-\alpha} K_{t+1}^{\alpha}$$

and the consolidated budget constraint defines K_{t+1} implicitly as a function of W_t:

$$\frac{K_{t+1}}{\alpha} - \frac{\phi Z_{t+1}^{1-\alpha} K_{t+1}^{\alpha}}{r_{t+1} r_{t+2}} = \beta^2 W_t$$

By differentiating the above equation, we find:

$$\left(1 - \frac{\phi F_{Kt+1}}{r_{t+1} r_{t+2}}\right) \frac{\partial K_{t+1}}{\partial r_{t+1}} = -\frac{\phi Z_{t+1}^{1-\alpha} K_{t+1}^{\alpha}}{r_{t+1}^2 r_{t+2}}$$

Using (5), we can show that the first term between brackets is positive as long as $\lambda_{t+1} > 0$, which implies that $\partial K_{t+1} / \partial r_{t+1} < 0$. ■

A decrease in r_{t+1} relaxes the credit constraint and allows firms to borrow more. It has therefore a positive effect on capital and hence on production. This is the collateral channel.

3.2 Numerical Analysis: Interest Rate Shocks

Here we simulate the effect of a permanent decrease in the world interest rate on the Emerging country for different values of ϕ and η. We first define a benchmark case with the following parameter values. The capital share α is set to 0.3, the discount factor β is set to 0.95, η to 3 and ϕ to 0.05. We normalize Z to 1 and $\bar{w}$ is set so that in the steady state $l = 1$. The steady-state interest rate is set at the same value as the one that holds in the two-country steady state.

We then look at the impact of a permanent 10% decrease in the interest rate r. Figure 4 shows the evolution of output, labor, capital, gross bond positions, the net demand for bonds, and wages. We observe a decline in output and labor, which indicates that the substitution and liquidity channels are at work; wages decline in line with labor. Capital increases on impact, to decline afterwards. The dynamics of capital combine the results of Propositions 1 and 2: the initial increase represents a positive collateral effect, which is subsequently dominated by the negative liquidity channel. We also observe a decline in net bond holdings B: as production decreases, the demand for liquid assets decreases. The evolution of B is actually determined by the decline in A. Borrowing L by producing firms initially increases due to the collateral effect, but then declines with the level of output. However, since L is small it has little impact on B.

[Figure 4 about here]

Figure 5 shows the impulse responses for deviations from the benchmark case. Panel A considers different levels of the credit constraint, measured by ϕ. We compare the benchmark value of $\phi = 0.05$ with a low value $\phi = 0$ and a higher value $\phi = 0.1$. A lower value of ϕ reduces the collateral effect and leads to a larger decline in output, while capital hardly increases on impact. The decline in bond holdings is also larger. In contrast, a higher value of ϕ gives a dominant role to the collateral channel. This leads to a sustained increase in capital and even to an increase in output. The decline in labor is much smaller. There is also a very strong decline in bond holdings. The reason is again that the collateral channel is stronger. A decrease in the interest rate leads to a stronger increase in borrowing and therefore to a decline in net bond holdings.

[Figure 5 about here]

Panel B of Figure 5 shows the impact of different levels of labor supply elasticity. We compare the benchmark value of $\eta = 3$ with a low value $\eta = 1$ and a high value $\eta = 4$. As suggested by Proposition 2, a higher elasticity reinforces the liquidity channel and therefore amplifies the decline in output, labor, capital, and net bonds. A lower elasticity has the opposite effect.

4 Global Rebalancing

We now consider different scenarios leading to global rebalancing in the two-country model: a growth slowdown and a credit crunch in the Developed country and a growth slowdown in the Emerging country. We simulate the dynamic impact of these shocks in a benchmark version of the model. We set the parameters in the Emerging country as in the benchmark calibration described earlier. To generate heterogeneity in net foreign asset positions, we set $\phi^* = 0.3 > \phi$ in the Developed country. Besides, we set $Z^* = 4Z$ and $\bar{w}^*$ is set so that $l^* = 1$ in the steady state. The other parameters are identical to the Emerging country. With this calibration, the Emerging country is a net lender ($B > 0$) and the Developed country is a net borrower ($B^* = -B < 0$).

4.1 Lower Growth and Credit Crunch in the Developed Country

We first examine the impact of a decline in productivity Z^* in the the Developed country. We assume that Z^* declines by 1% during 10 periods.[9] The resulting dynamics are shown in Figure 6. The impact of such a shock on the Developed country is relatively standard. A lower productivity naturally lowers output, but it also lowers borrowing from producing firms due to a tighter credit constraint (4). This lowers capital and labor and further decreases output. Lower borrowing implies an improvement in the net asset position B^* (a declining debt) and a decline in the world interest rate.

[Figure 6 about here]

The Emerging country is affected through the lower interest rate. The impact is naturally smaller than for the Developed country. Using the analysis of Section 3, we know that in the

[9]For convenience, we do not consider steady-state growth in this paper. The gradual decline in Z^* implies a period of negative growth and has similar implications as a growth slowdown. See BB for a full analysis with steady-state growth.

benchmark calibration the substitution and liquidity channels dominate, so output and labor decline over time, while capital initially increases before declining. The decline in net bonds B matches the increase in B^*.

Figure 7 shows the impact of a permanent tightening of the credit constraint, i.e., a 30% permanent decline in ϕ^* (i.e., from 0.3 to 0.21). The borrowing by producing firms declines, so that net bond demand B^* increases (net debt decreases) and the world interest rate declines. Output and labor also decline. However, capital increases. This somewhat surprising result is explained by a decline in the wage bill that increases entrepreneurs cash flow to finance capital. The impact on the Emerging country is the same as with a decline in productivity as the spillover goes through the decline in the world interest rate. However, in this case the impact is larger than in the Developed country.

[Figure 7 about here]

To summarize, both the decline in growth and the credit crunch in the Developed country lead to rebalancing with a decline in the world interest rate. Output declines in both countries.

4.2 Lower Growth in the Emerging Country

Consider now a decline in productivity growth in the Emerging country. We assume that Z declines by 1% during 10 periods. The dynamics are presented in Figure 8. The decline in productivity growth reduces output, labor, and capital in the Emerging country. This also leads to a decline in the net demand for bonds. The reason is that firms need to hold less liquidity in their production period, while their reduced borrowing in the investment period has a smaller impact. The reduced demand for bonds leads to an increase in the world interest rate.

[Figure 8 about here]

The Developed country is affected negatively by the interest rate increase since the collateral effect dominates. The impact is smaller than in the Emerging country. Consequently, we also observe a decline in output, capital, and labor while the net foreign asset position improves.[10]

[10]Notice that a similar result would obtain if the Developed country was not constrained. Instead of a collateral channel, there would be a standard cost-of-funds channel and a higher interest rate would decrease

4.3 International Comovements and the World Interest Rate

The results presented in this section show that a decline in growth, either in the Emerging country or in the Developed country, leads to a reduction in net foreign asset positions. Moreover, there is a positive output comovement since a growth decline initiating in one country is transmitted to the other country. This positive comovement differs from the outcome of growth shocks in standard models. However, the channel of transmission is different if the shock occurs in the Emerging or in the Developed country. The impact on the world interest rate is also of opposite sign: a negative growth shock in the Developed country decreases the interest rate, while a negative shock in the Emerging country increases it.

Growth shocks have a different impact both on the demand for bonds and on the interest rate spillover to the other country. A negative growth shock in the Developed country increases the demand for bonds of this country by decreasing its borrowing. The resulting lower interest rate affects negatively the Emerging country since the liquidity and substitution effects dominate. In contrast, a negative growth shock in the Emerging country decreases the demand for bonds due to a lower need for corporate liquidity. Then, the higher world interest rate has a negative impact on the Developed economy since the collateral effect dominates.

5 Conclusion

There are numerous factors determining global net capital flows. In this paper we have focused on a specific aspect, namely corporate saving and investment. By introducing realistic sources of asymmetry between an Emerging and a Developing economy, we have presented a model that is consistent with the stylized facts and has interesting implications in the context of global rebalancing. An alternative perspective would have been to focus on household saving and a demand for liquid assets emanating from credit-constrained consumers. For example, Bacchetta et al. (2013) develop such a model based on the first model in Woodford (1990). Growth and credit shocks would have similar implications for total saving as in this paper when there are only consumers. However, there would be no impact on investment and output.

A more speculative question regards the medium-term perspectives for rebalancing. Our model would predict that a growth recovery would again increase global imbalances so that

the capital stock.

the rebalancing is only a temporary phenomenon. However, this prediction is a *ceteris paribus* prediction. Besides growth, there may be other factors that will change in future years. In particular, a reduction in financial restrictions in emerging markets (e.g., financial liberalization in China) may decrease the need for high corporate saving and liquid asset holdings. This effect would clearly reduce global imbalances.

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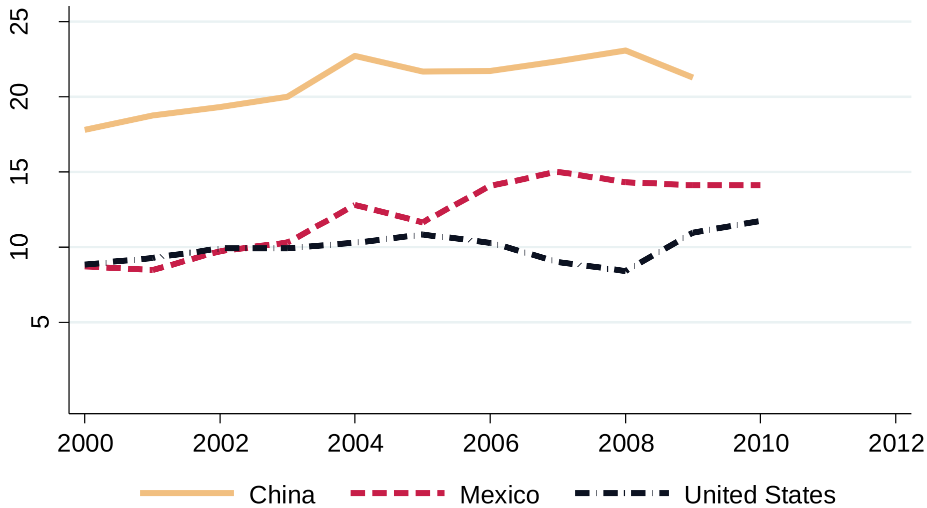
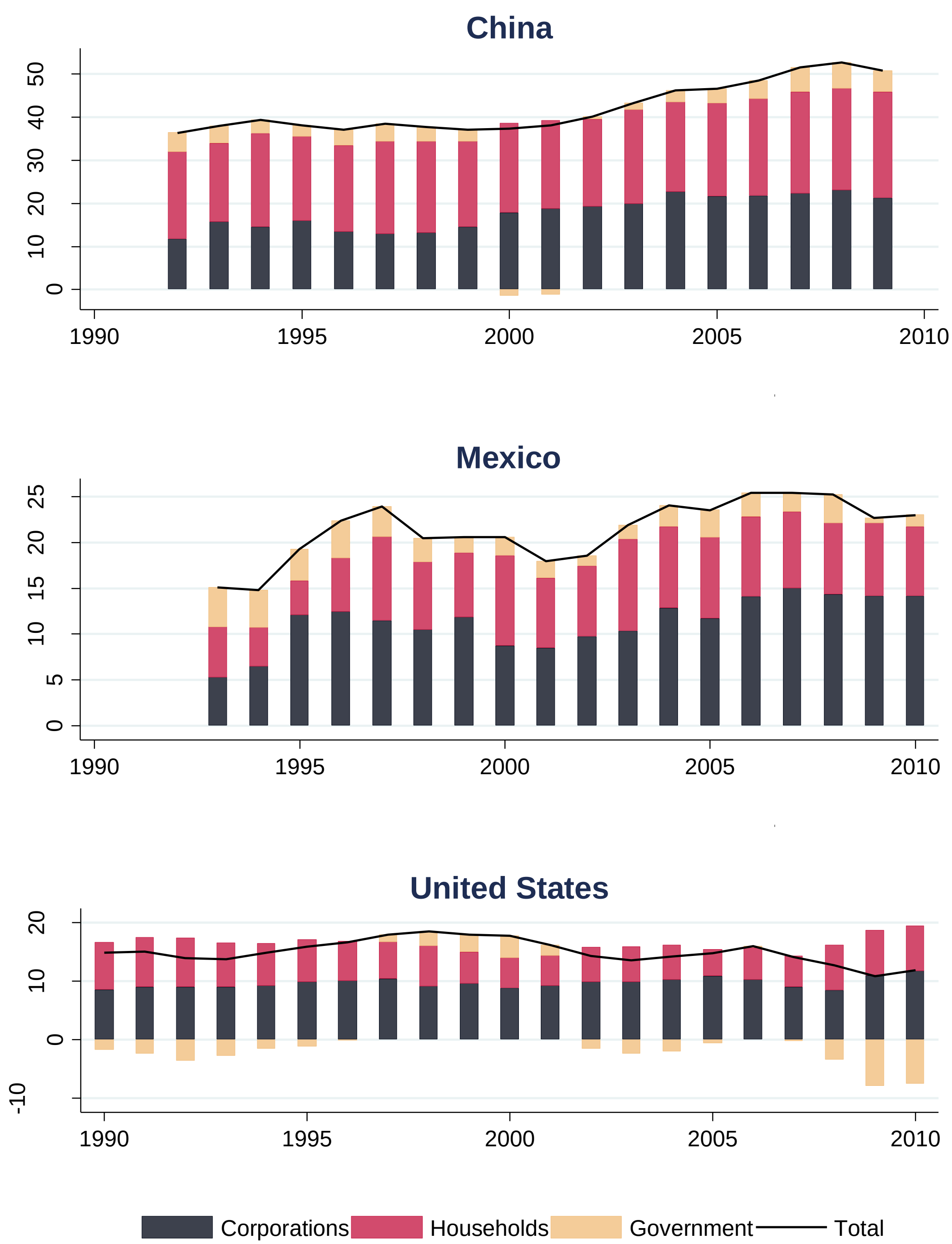
Figure 1. Corporate Saving Rates



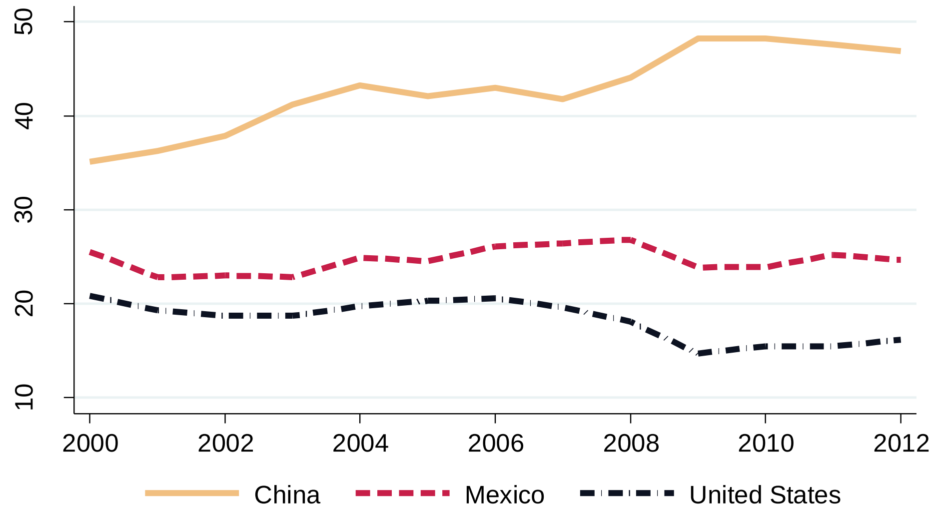
Data sources: National Bureau of Statistics of China, United Nations Statistics Division.

Figure 2. Saving and its Components



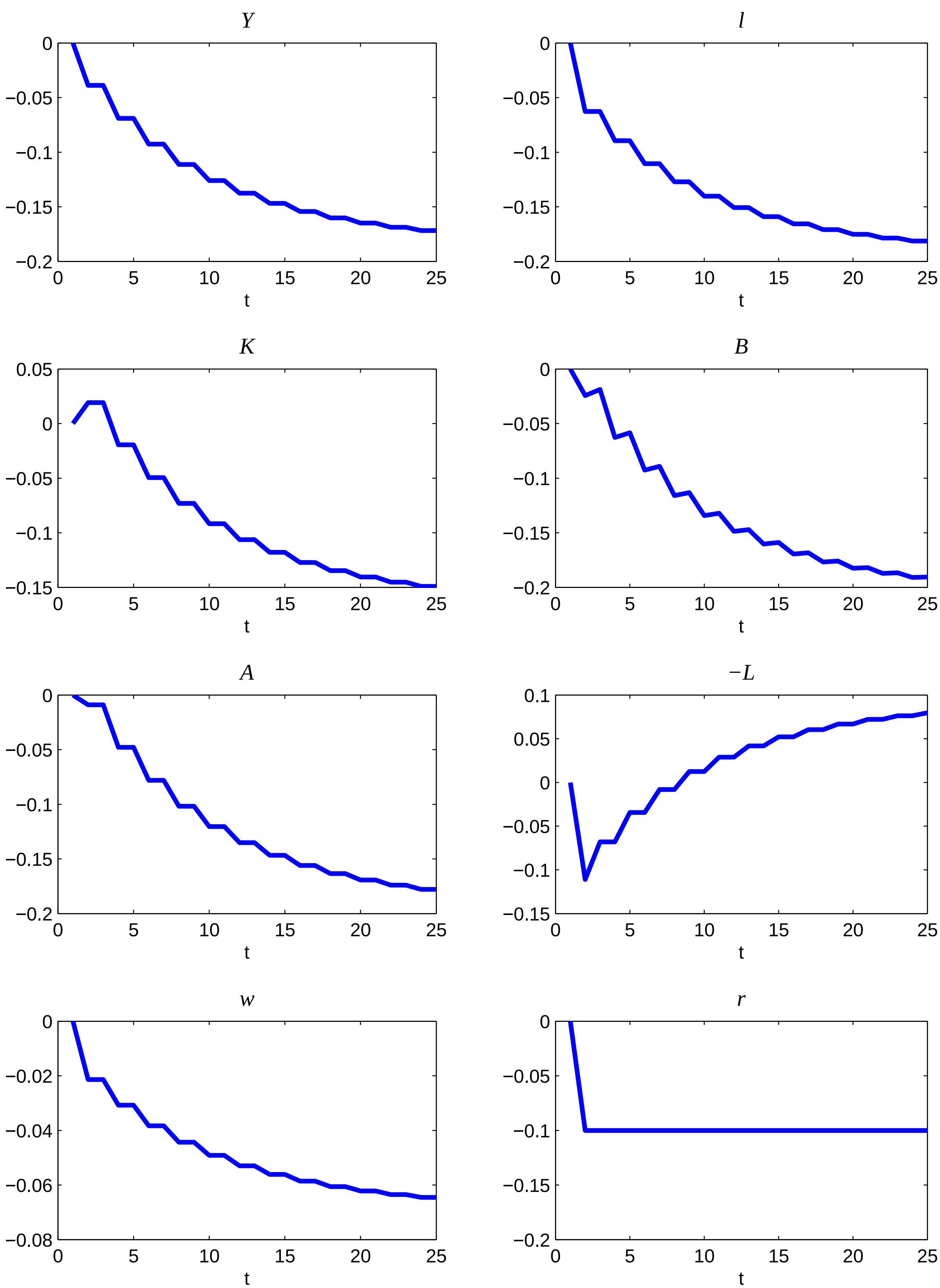
Data sources: National Bureau of Statistics of China, United Nations Statistics Division.

Figure 3. Investment Rates



Data source: IMF World Economic Outlook.

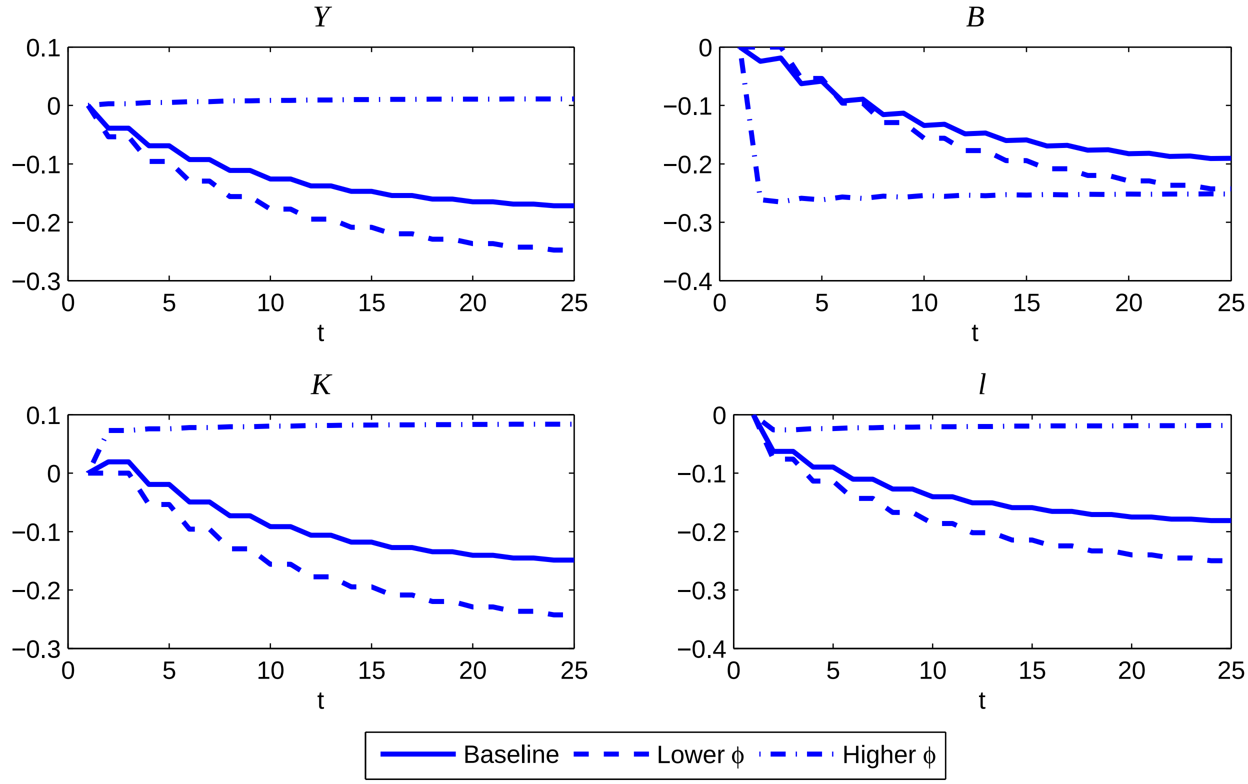
Figure 4. Negative shock on *r*



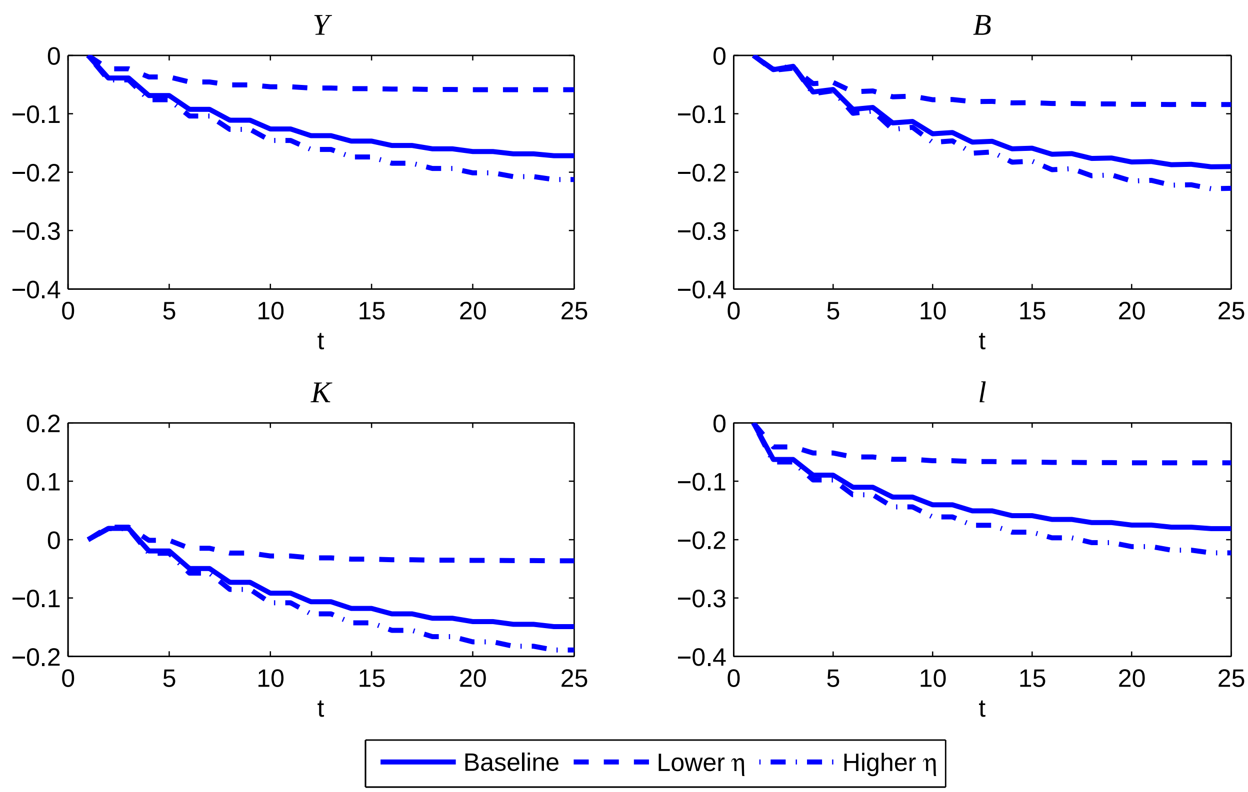
Note: Percentage deviation from steady state.

Figure 5. Sensitivity Test: Role of ϕ and η

Panel A: Role of ϕ

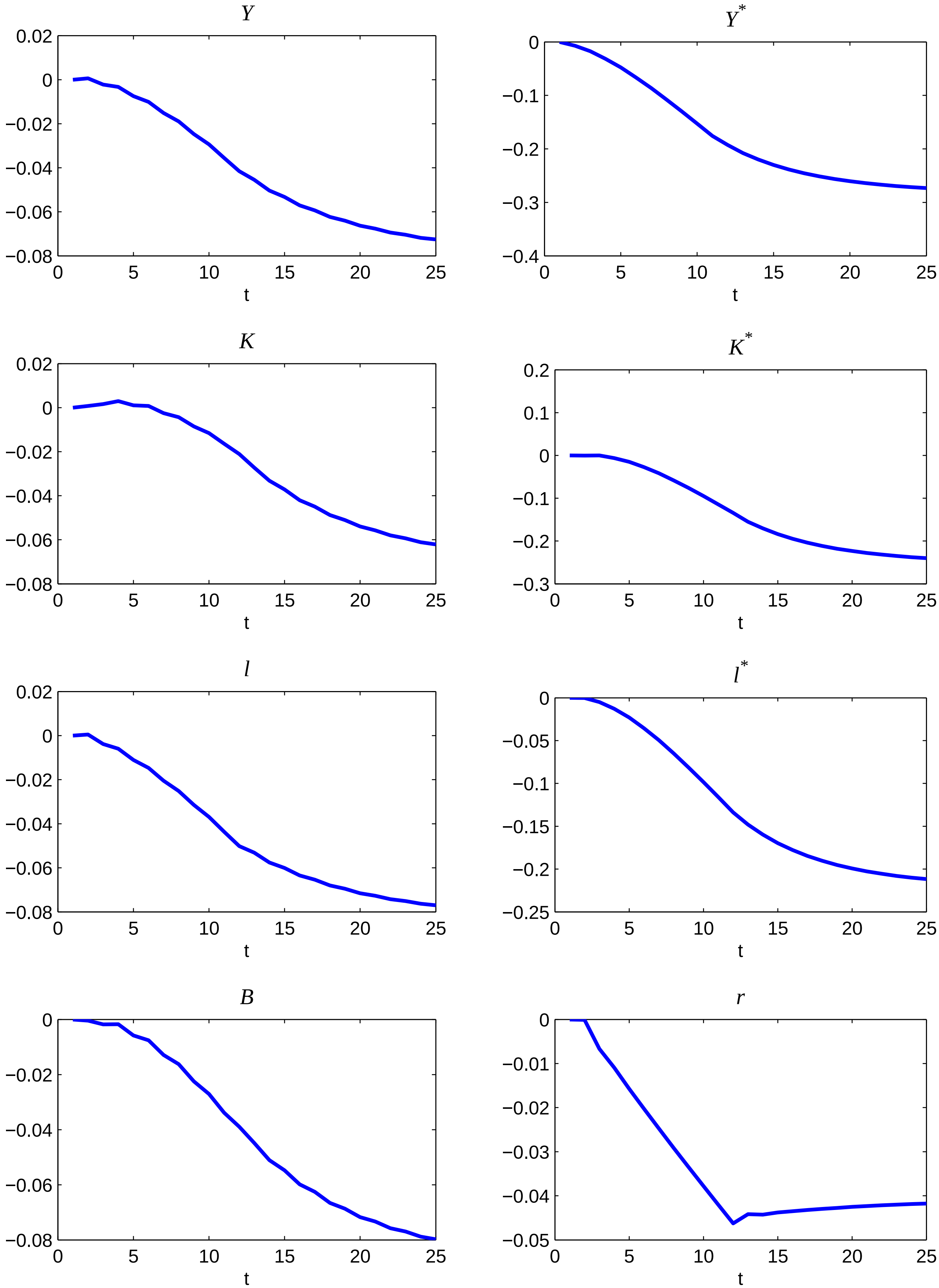


Panel B: Role of η



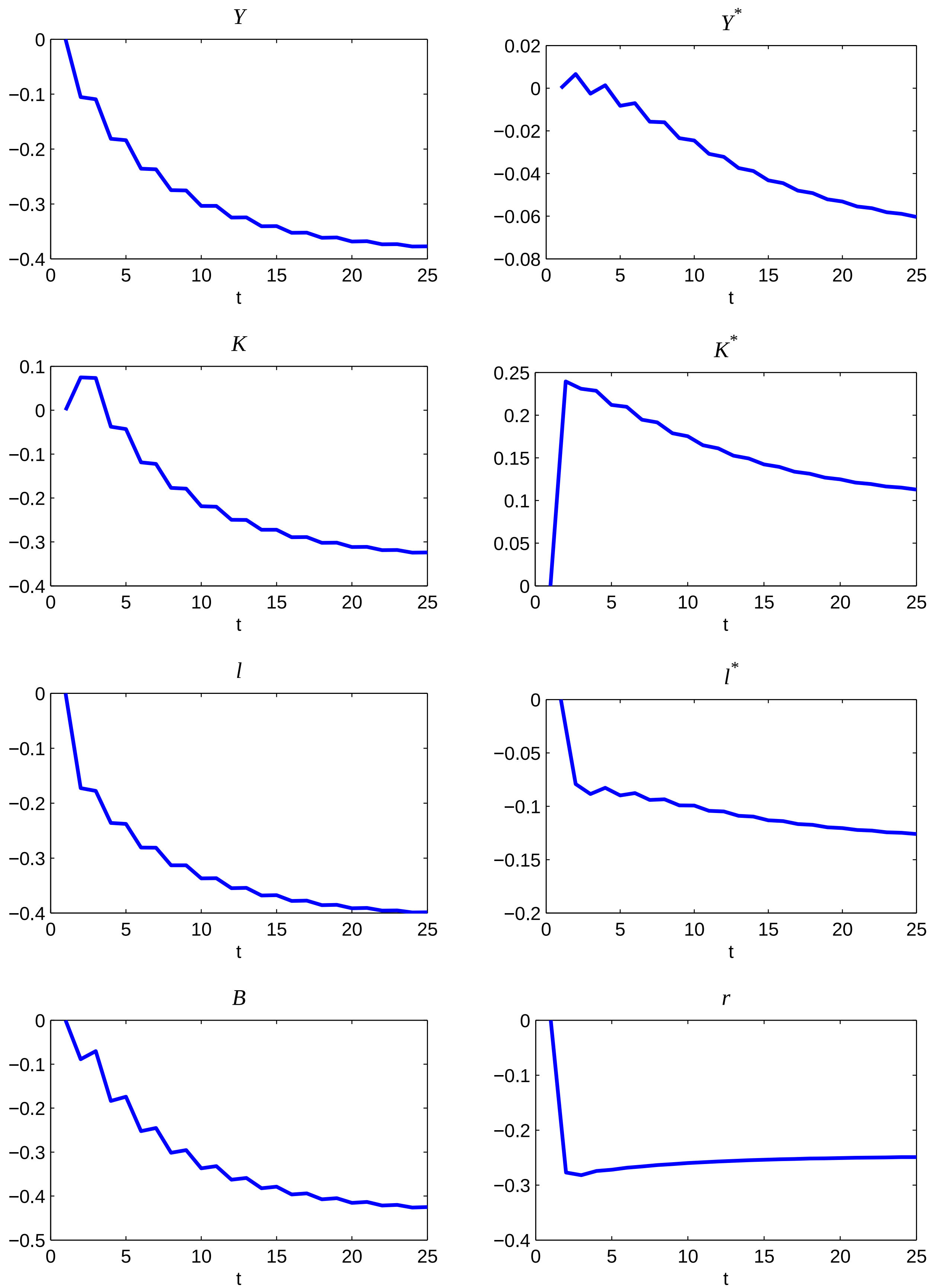
Note: Percentage deviation from steady state.

Figure 6. Negative shock on Z^*



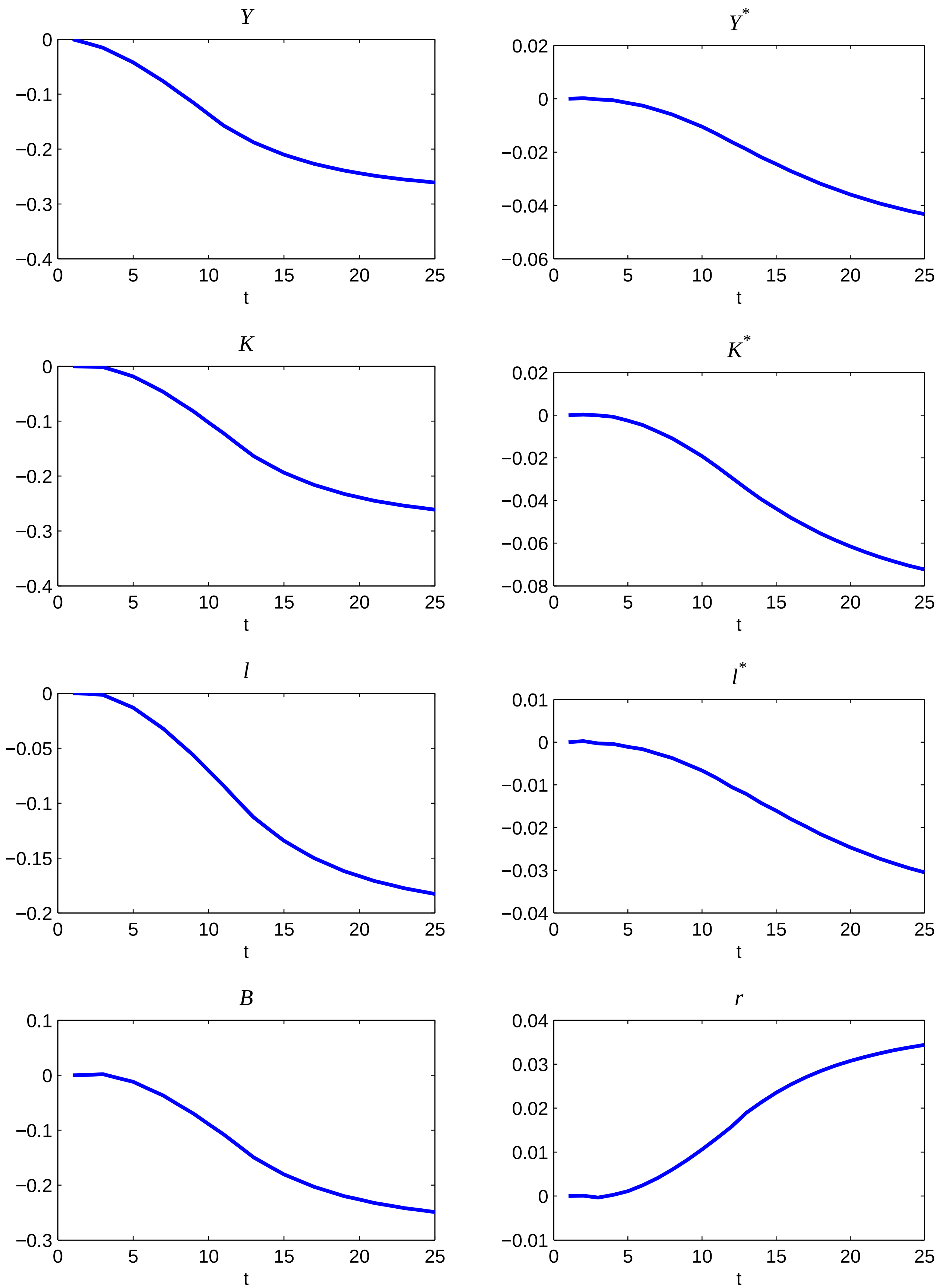
Note: Percentage deviation from steady state. Reduction of Z^* by 1% over 10 periods.

Figure 7. Negative shock on ϕ^*



Note : Percentage deviation from steady state. Reduction of ϕ^* by 30 percent

Figure 8. Negative shock on *Z*



Note: Percentage deviation from steady state. Reduction of *Z* by 1% over 10 periods.