Very preliminary and incomplete

Monetary policy transmission in the Tunisian banking sector[1]

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Abstract

Like some other emerging markets, Tunisia uses a broad set of monetary policy instruments - interest rate, reserve requirements and foreign exchange interventions. We study in more details macroeconomic impact of the interest rate and required reserve. We estimate interest rate pass-through to loan rates. It is somewhat sluggish, presumably due to the underdevelopment of financial sector and administrative regulations. Banks increase loan rates with growing risk of default of the real sector. We identify loan supply and loan demand function with the macro-level data and claim that the central bank had some impact on the supply of loans. Using a structural VAR model with sign restrictions we confirm that positive innovations of money market rate reduce loans. They also seem to have negative impact on prices. On the other hand, required reserve shocks, which tend to be almost fully accommodated by the central bank, lead to unintended price and loan increases.

1. Introduction

The impact of monetary policy instruments on the banking sector is of key importance for the efficiency of the monetary transmission as a whole. The aim of this paper is to show how changes in the interest rate and required reserve are transmitted into the Tunisian financial sector and what impact they have on the main macroeconomic variables – output, prices and loans. The exercise is done solely on the macro level data.

Tunisia is a small open economy with a relatively high degree of regulation of various markets, conducting discretional and eclectic monetary policy with seemingly dominating elements of real exchange rate targeting, but using also interest rate and required reserve. This is a complex toolkit serving not only or maybe even not primarily inflation control, but also stability of the banking sector and real sector activity.

The exchange rate system in Tunisia is de jure managed float, but de facto it is a peg to the basket of currencies dominated by the euro. The Tunisian central bank (BCT) follows a

[1] The paper was written when the author was serving as an expert ad hoc in the twinning project between Banque Centrale de Tuninisie and Banque de France, aimed at introducing inflation targeting and financed by the European Commission. The author would like to thank Ryszard Kokoszczynski, Jan Przystupa, Tomasz Łyziak and Tarak Jardak for many helpful discussions and comments. The usual disclaimer applies.

policy of a predetermined depreciation rate of the Tunisian dinar to sustain competitiveness of the economy. Such policy, although quite successful in the past (Fanizza et al. (2002), eventually led to surplus liquidity. It may also have originated credit boom in 2010-2011. The problem of liquidity surplus has been additionally exacerbated in the aftermath of privatization and resulting capital inflows, especially over 2006-2009.

Tunisian banking sector is burdened with a high ratio of non-performing loans (NPLs). The problem of bad loans originated in the government's policy of designating a part of bank loans to the so-called "priority sectors" of the economy (mostly tourism). Terrorist attack on the WTC in September 2001 and then on Djerba island (Tunisia) reduced the number of foreign visitors and caused financial problems of the tourism sector, which then were transmitted to the banking sector. A fear of a negative impact of interest rate increases on the health of banks' loan portfolio as well as of a possible interest rate inefficiency in curbing loans led BCT to replace changes in the interest rate by augmenting required reserve since the end of 2006[2]. Social unrest in 2011 brought about increased demand for liquidity and a change in monetary policy: to circumvent possible credit crunch and insolvencies the ratio of required reserve was cut from 12.5% to 2% and since then remains unchanged[3].

The aforementioned reluctance to use interest rate to stabilize inflation and output resulted in a very low variability of the policy rate and short-term money market rate. In particular, up to the end of 2008, the central bank provided banking sector with funds in a flexible way (daily and then weekly fine tuning) to the amount needed to meet the required reserve. It offered practically unlimited access to non-reservable sources of finance and in practice to a big extent offset increases in the required reserve. It also regularly mopped excess liquidity. As a result, up to the amount of the required reserve, monetary base in Tunisia was demand determined.

The paper shows monetary transmission in the Tunisian banking sector in a fairly complex way taking into account multiplicity of targets and instruments of the Tunisian monetary policy. In particular, we show impact of the interest rate on retail loan rates (interest rate pass-through), the impact of interest rate and required reserve rate on price behaviour and real sector activity. Moreover, we check whether credit channel operates and in this aim we identify long-run loan demand and loan supply functions.

Our findings suggest that the interest rate, although not used very actively by the central bank, has some impact on banks and real sector behaviour – the interest rate pass-through to loan rates is relatively slow, but nonetheless there seems to exist a long-run relationship between money market rate and at least some retail rates. Adjusting their interest rates on short-term loans banks tend to overreact; in the case of rates on medium-term loans as well

[2] Required reserve is not remunerated; various rates are applied to sight, short-term and long-term deposits. Deposits in foreign currencies are not subject to the required reserve.

[3] Central bank carried out refinancing operations through a fixed rate tender procedure with full allotment to circumvent possible credit crunch and insolvencies.

interest rate on consumption loans the pass-through is full. Money market rate (a proxy for the policy rate) seems to affect prices, whereas there are some doubts about its impact on the real sector activity. On the other hand, required reserve tightening turns out to increase consumer prices. Moreover, a shock to the required reserve does not reduce loans; we observe rather an unintended, opaque impact and therefore claim that in Tunisia the required reserve seems to be rather a costly tax imposed on the banking sector than an efficient monetary policy instrument.

The structure of the paper is as follows: we start with a review of the relevant literature, then we present data and a handful of stylized facts. The next part describes estimation method and results: firstly interest rate pass-through to the selected loan rates, secondly credit channel and thirdly the required reserve channel. The last part concludes and brings implications for the monetary policy.

2. Literature review

To our knowledge, this is a first paper showing monetary transmission in the Tunisian banking sector. Scarce works showing monetary policy and monetary transmission in Tunisia concentrate mostly on the exchange rate and stylized facts (Fanizza et al. (2002), Chailloux et al. (2009). In this paper we show interest rate, credit and required reserve channels in more details. Analyses of the interest rate pass-through and lending channel are primarily based on Agénor and Montiel (2006), Disyatat (2010), Gambacorta (2008), Hülsewig et al. (2004) and Hülsewig et al. (2005), who stress the role of credit market imperfections. Estimation of the required reserve impact on output, prices and loans bases on the Uhlig's vector autoregression (VAR) with sign restrictions (2005) and Glocker, Towbin (2012b) model for Brazil.

In Agénor and Montiel (2006) the loan rate includes a risk premium (defined as a mark-up over funding costs) of borrowers' default. Monetary policy tightening leads to an increased probability of default. Thus, when modelling interest rate pass-through it is useful to take into account a possible impact of the risk. Also, Gambacorta (2008) stresses that interest rate on lending depends inter alia on the risk of credit portfolio and GDP. A higher non-performing ratio increases loan rates, since banks must compensate the higher percentage of bad loans that will have to be written-off. On the other hand, increasing GDP and better economic conditions result in a growing number of profitable projects in terms of expected net present value and rise demand for loans. Some authors claim that only permanent increase in GDP increases loan demand, whereas transitory changes tend to be associated with increased self-financing.

Variations in the health of financial intermediaries in terms of leverage and asset quality as well as in perception of risk, constitute the relevant mechanisms through which the effects

of monetary policy shocks may be propagated by the lending channel [Disyatat (2010)]. An increased risk lowers incentives of banks to provide loans to the non-financial sector. Moreover, as monetary tightening lowers prices, the value of firms' collateral falls, reducing their creditworthiness. Thus, a tighter monetary policy triggers negative effects of credit market imperfections in a fairly complex way. Lending channel affects mostly non-tradable sector which hinges more on bank loans than the tradable sector, having easier access to world capital markets [Tornell, Westermann (2003)].

Required reserve increases are commonly expected to reduce liquidity of the banking sector and credit supply. Lower credit supply would negatively impact aggregate demand through investment and consumption and finally alleviate price pressures. However, the opposite effect, i.e. expansion of demand and higher inflation cannot be ruled out [Agénor, Montiel (2006)]. Namely, an increase in the required reserve ratio increases cost of deposits for the banking sector and therefore reduces banks' demand for deposits. As a result banks lower deposit rates[4]. This expands consumption to the extent that spending depends on the interest rate. Alternatively, resources can be reallocated, thus required reserve increase may lead to higher prices of other financial or non-financial assets, like land, real estate and stock exchange indexes. This can additionally expand consumption through the wealth effect. To restore equilibrium loan rates should rise. In fact, however, they may turn out either unaffected or even lower. The former occurs if the central bank is ready to elastically provide banks with funds at a policy rate, i.e. if the refinancing rate of the central bank is not altered and the marginal cost of funds does not change. The necessary condition for the loan rate to be unaffected is for deposits and loans from the central bank to be perfect substitutes. If it is not the case, i.e. if there is risk resulting from the maturity mismatch between short-term central bank credits and longer-term loans to the non-financial sector, or if banks are risk averse loan rates would rise (Agénor and Montiel (2006), Glocker and Towbin (2012a). However, surplus liquidity in the banking system seems to be a perfect substitute of deposits. On the other hand, Agénor and El Aynaoui (2010) show that an increase in the required reserve ratio may even result in lower loan rates, since the positive price effect increases the value of collateral which induces banks to charge a lower premium.

It seems therefore, that actual behaviour of loan rates, that is whether they remain unchanged, go up or fall after required rate increase may be case-specific.

Theoretical models show therefore, that the overall macroeconomic effect of required reserve changes is ambiguous and depends on the relative strength of the reaction of depositors (semi-elasticity of demand for deposits with respect to deposit rates) and borrowers (semi-elasticity of loan demand with respect to loan rates). Importantly, macroeconomic effects of the required reserve change depend on the importance of bank

[4] Although, as it is argued by Walsh (2012), in the DSGE (calibrated version) model used by Glocker and Towbin (2012a), the impact of the required reserve on deposit rates is rather small.

lending as a source of external funds and on the degree to which lending can be easily substituted with other sources of financing, e.g. capital markets, funds from abroad (Glocker and Towbin (2012b).

Empirical evidence on the impact of required reserve changes is relatively scarce, especially this concerning loans, prices and output. The latest includes Glocker and Towbin (2012b) for Brazil and Tovar et al. (2012) for Latin America. Glocker and Towbin using time series show that increases in the required reserve curb credit growth, induce economic slowdown, but in the same time increase prices. Tovar et al. using panel data present evidence that required reserve has a very limited and only transitory impact on loan growth.

3. Stylized facts

Tunisia is a small open economy. Its main trading partner is the euro area (France, Italy, Germany). Though significantly dependent on the euro area demand, its domestic business fluctuations tended to be mostly driven by idiosyncratic shocks [Canova, Ciccarelli (2011)]. GDP in Tunisia was several times considerably hit by negative exogenous shocks – in 2009 in the aftermath of the world financial crisis and in 2011 owing to the social unrest in Tunisia itself caused mainly by high unemployment rate, inequalities in wealth distribution and corruption. The social unrest triggered a civil war in the neighbouring Libya which lasted from February to November 2011, and in turn affected Tunisian economy. In 2011 there were considerable migrations of Tunisian workforce employed in Libya, a related fall in remittances, flees of Libyan citizens to Tunisia, and a higher demand for Tunisian food and other consumer goods. A smaller negative shock happened in 2002 and resulted from a global slowdown and the terrorist attack on Djerba island, which temporarily discouraged tourists.

Tunisian financial sector is dominated by banks. Capitalization of the stock market related to GDP (24%) and the number of listed enterprises is smaller than in other countries of the region (e.g. Egypt, Morocco); moreover banks account for about 70% of stock exchange capitalization (Report on Monetary Transmission in Tunisia, 2012, BCT). Thus, the corporate sector relies mostly on banks as the external source of funds.

The ratio of bank assets and bank loans to GDP in 2010 reached 87% and 57% respectively, i.e. the level which is comparable to some other emerging markets (e.g. Poland). The level of self-financing of the enterprise sector is high (estimations point at a range of 65-75% in the 2000s, [Chaari, Couppey-Soubeyran (2008)], moreover, loans are concentrated in a small number of enterprises. Three public banks involved in servicing agriculture, housing and tourism have some 40% of total assets and realize government policy with respect to these sectors. These factors may weaken responses of real sector variables to the interest rate shocks.

The aforementioned Djerba terrorist attack and the ensuing economic slowdown had a negative impact on loans – they visibly decelerated since mid-2002 to the end of 2003. Since mid-2007 loans began to increase at rates much higher than in the past; financial crisis slowed them only temporarily. As it is shown in Fig. 1, there is a visible discrepancy between GDP and loans growth since mid-2008. Sharply increasing loans were financing higher imports (BCT, Annual Report 2010). Also, they might have fuelled real estate price boom. Rising short-term money market (Taux du marché monétaire, thereafter TMM) since 2010 did not curb credit expansion. TMM increases were passed to the retail rates with a delay; moreover, the reaction of banks was much smaller than the change in the money market rate. With inflation going down (Fig. 2, left-hand panel) and lower output growth CBT resorted to increase in the required reserve ratio to slow down credit growth.

Banking sector tended to be overliquid over 2007-2008; in 2009 excess reserves were still positive, but relatively low. Starting from mid-2010, banks displayed negative excess reserves (Fig. A6 in the Appendix). Simultaneously the rate of growth of loans sharply increased what leads us to the conclusion that surplus liquidity enabled banks to offer more loans.

Financial market in Tunisia is still underdeveloped: there is no secondary market for treasuries, thus the yield curve does not exist. The volume of interbank transactions, although steadily increasing, is low. Up to the end of 2008 TMM movements simply mirrored the rate on BCT operations (Taux d'appel d'offres, TAO). Only since 2009, when central bank introduced standing facilities, money market rate has become more volatile.

There are administratively fixed upper and lower limits on some retail deposit rates. The upper limits are aimed at reducing bargaining power of public institutions and firms disposing of considerable amounts of funds, impacting rates offered by banks. It means that in some cases banks are not price-setters in the retail market. The lower limits are to protect some kinds of households' deposits from inflation.

An important feature of the banking sector which has been constraining monetary policy is a big portfolio of non-performing loans. Although NPLs have been falling down steadily since mid-2005, when they reached 25% of total loans to the private sector, they still pose a significant problem with a share of about 12% (2010).

BCT has adopted a broad set of measures to solve the NPLs problem. They include a change in procedures for realizing real estate collateral, more favourable tax deductibility rules for NPL provisions and write-downs, and the establishment of asset recovery companies[5].

[5]Most banks have established asset recovery companies, to which they have transferred their old NPLs, which, in the most part, have been fully provisioned. The amount recovered on the loans transferred so far has been modest. Specifically, procedures for sale of real estate under judicial supervision have been simplified, the tax-deductible portion of provisions against NPLs has been raised to 85% in 2004 and 100% in 2005, and the conditions for writing down fully provisioned bad debt have been clarified. In 2006 a system of compliance

Cyclical part of the non-performing loans and cyclical part of GDP, which can be interpreted as the output gap (both were obtained from HP filtering, see Graph 2, right-hand panel) tend to be negatively correlated especially over 2006-2011.

4. Data

In the pass-through estimations we use quarterly data from 2000.Q4 to 2011.Q3, in the estimation of the credit channel we extend the sample backwards, namely to 2000.Q1[6]. Owing to high variability of agricultural production, we employ non-agricultural GDP, GDP deflator is used to obtain loans in real terms. As loans we use claims on non-financial sector in the domestic currency to both private individuals and enterprises net of bad loans . Short-term money market rate (TMM) is a proxy for the refinancing rate. What is problematic in the pass-through estimation on the Tunisian time series data is a very low variability of the money market rate, at least over the period August 2003-August 2006; thus the results should be treated and interpreted with a necessary dose of caution, rather qualitatively than quantitatively.

We examine behaviour of interest rate on short-term, medium-term and long-term loans to the enterprise sector and a loan rate on loans for consumption coming from bank surveys; they are linearly interpolated from semi-annual to quarterly frequency. We leave apart interest rate on loans for housing, since they were be impacted by social policy of the state, especially at the beginning of 2000s. Then, when modelling credit channel we use short-term loan rate as a proxy for lending rates in the banking sector (currently short-term account for about 30%, medium-term loans for some 40% of loans, whereas long-term for about 20%; the rest, i.e. about 10% is banking overdraft, see Report on Monetary Transmission, BCT, 2012, mimeo). The default risk of the non-financial sector is measured with the non-performing loans ratio..

For analysis of the impact of required reserve on output, prices and loans we use monthly data. Output is represented by manufacturing production, prices – by CPI without food and energy prices. The VAR comprises also money market rate, compulsory banks reserves and the effective required reserve ratio. We use effective required reserve rather than statutory, since the latter is a discrete variable (it has been used for the robustness check only). There are, however, some caveats stemming from implementation of the effective required reserve. It is impacted not only by the central bank policy, but also by policy of commercial

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control in credit institutions was designed to determine and assess risks of noncompliance with laws, regulations and sound practices and another system, effective since 2008, on internal controls establishing a number of obligations in this area.

[6] Interest rate data come from surveys and are available since 2000.H2. Since for the credit channel estimation we have to introduce 5 variables what quickly reduces the degrees of freedom, we decided to use for 2000.Q1-2000.Q3 loan rate data forecasted for this period. Taking into account that TMM was stable between 1999.Q2 and 2000.Q4, we suppose not to make a considerable error with such an approach.

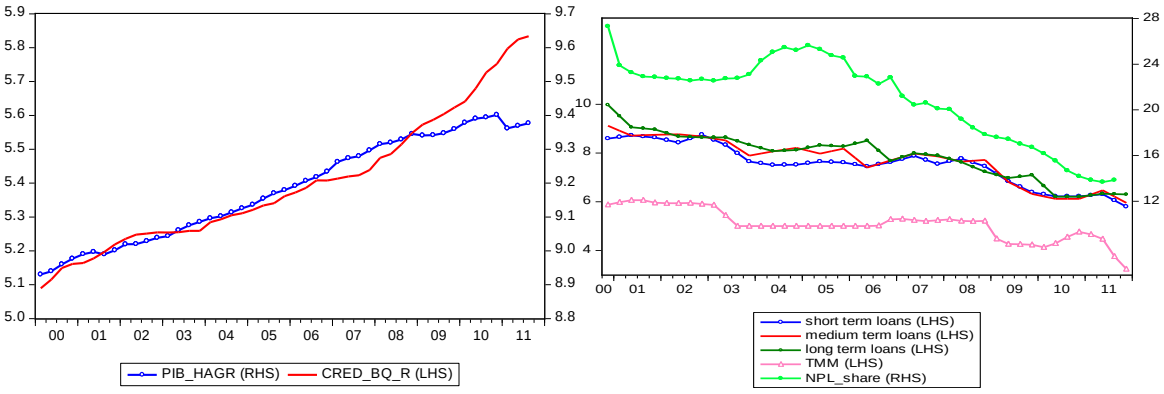
banks, which can influence the structure of deposits. A rapid development of certificate of deposits in Tunisia, just after central bank has started to use the required reserve more actively, may serve as an example.

Monetary data come from the BCT, GDP and CPI from the INS (National Statistical Institute). GDP and prices are in logs. GDP, loans, compulsory reserves and NPLs are seasonally adjusted; there is strong seasonality in NPLs, since the write-offs usually took place in December.

Unit root test results are presented in the statistical appendix. As it is clear from table A1 and A2, all variables are non-stationary in levels, but stationary in first differences (standing as respective Δs). Thus, it is possible to use them in the cointegrating relations.

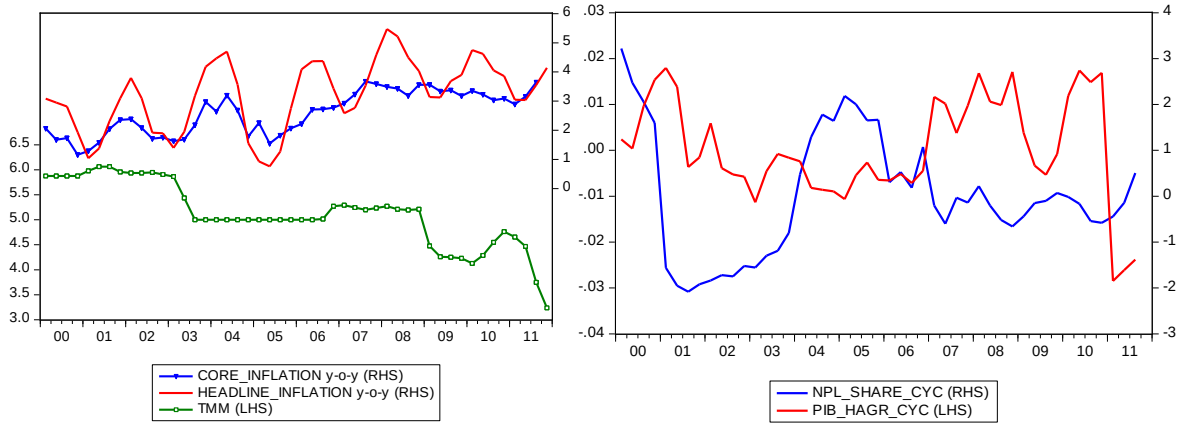
To capture the most important shocks which affected Tunisian economy we use a set of following dummies: (i) for a sharp phase of the financial crisis after the Lehman Brothers collapse in 2009, (ii) for the social unrest in Tunisia in 2011[7]. Moreover, we use a dummy for the first quarter of 2001 when under the new banking law a process of sanitation of banks' balance sheets was launched.

Fig. 1: GDP excluding agriculture, loans to the economy in real terms (left panel), short-term loan rate, medium-term loan rate, long-term loan rate, money market rate and non-performing loans (right panel)



[7] We have also tested a dummy for the Djerba attack, but in all cases it turned out to be insignificant.

Fig. 2: Inflation rate (headline and core) and TMM (left-hand panel) and cyclical part of non-performing loans and non-agriculture output gap (right-hand panel)



5. Estimation results

5.1 Interest rate pass-through

In the estimation of the interest rate pass-through we use the cost-of-funds approach. We assume that banks operate in the oligopolistic environment. They are price takers in the money market and price setters in the retail market. Thus, loan rate is set as a premium over money market rate. These are usual assumptions in the interest rate pass-through literature, however as aforementioned, there are some segments of the deposit market, where banks are rather price-takers. There exist institutional depositors who can affect the cost of funds. To overcame this problem, there are upper limits on these interest rates set administratively. Nonetheless, the effectiveness of pass-through and banks' liabilities structure may be affected. Unfortunately, data on deposit rates are even shorter than those on loans, what makes it extremely difficult to check on the macro level the impact they might exert on loan rates.

We examine pass-through to short-term, medium-term and long-term loan rates for the enterprise sector and to the rate on consumer loans. In the first stage of the estimation we check whether the cointegration exists[8] between variables of interest. This is usually a difficult problem; in the case of the Tunisian data the problem is exacerbated by a very low variability of money market rate resulting from a specific monetary policy and sample shortness. Taking this into account, we use Johansen test with a Bartlett correction for small samples and perform a battery of stability tests.

If the series are cointegrated, we analyse properties of the relationship basing on a three-dimensional vector error correction model (VECM), which is defined as:

$$(1)\ \varphi L(\Delta y_t) = c + \theta(L)\Delta x_t + \vartheta(L)\Delta z_t - \alpha(y_{t-k} - \beta x_{t-k} - \delta z_{t-k} - \gamma) + \varepsilon_t,$$

[8]All estimations of cointegrating systems were performed in CATS in RATS, the remaining parts in RATS (sign restrictions) and in Eviews.

where y_t and x_t are respectively retail loan rate and money market rate, z_t is the share of non-performing loans in total loans; coefficient α measures the speed of adjustment towards equilibrium, whereas β - the long-run pass-through effect. Usually, $\beta \leq 1$, but in a short sample dominated by changes of a policy rate in one direction and strong competition for market share it may exceed one. We expect δ to be negative, what means that with growing risk banks increase their offered loan rates.

It may occur, however, that money market rate and retail rates are not cointegrated, i.e. the levels of examined variables do not move together. For such cases we estimate a dynamic relationship and use the autoregressive distributed lag (ARDL) model on first differences to take into account non-stationarity of the variables. The ARDL model (see e.g. Greene(2003) looks as follows:

$$(2)\ y_t = \mu + \sum_{i=1}^{p} \gamma_i y_{t-i} + \sum_{j=0}^{r} \beta_j\ x_{t-j} + \delta w_t + \varepsilon_t$$

The immediate or a short-run effect is equal to β_0, whereas the long-run effect can be calculated as: $\sum_{j=0}^{m} \beta_j \Big/ 1 - \sum_{i=1}^{n} \gamma_i$ and *m*, *n* are lags chosen by the information criterion (to determine the number of lags in the VECM and ARDL we used Schwartz criterion). As the variable w_t we use non-performing loans and or output gap which can be perceived as a measure of demand (then the obtained sign would be positive) or rather a risk factor – then the obtained sign would be negative.

Assuming a trend in the data we obtain one cointegrating relation for the short-term rate. Analysis of the loading matrix suggests that this is a loan rate equation (the lowest and highly significant coefficient). Test of stability of the trace test looks reasonably well, equation residuals are normally distributed. Thus, the long-run relationship looks as follows:

$$i_t^{LS} = 1.12_{(24.2)} i_t^M + 0.05_{(6.6)} npl_t$$

The dynamic form is:

$$\Delta i_t^{LS} = -0.59_{(-8.8)}(i_{t-1}^{LS} - 1.12 i_{t-1}^M + 0.05 npls_{t-1}) + 0.66_{(8.8)} \Delta i_{t-1}^M + 0.03_{(8..8)} \Delta npl_{t-1} + 0.31_{(3.8)} dum_{2009} + 0.26_{(4.7)} dum_{2011} + 0.46_{(7.7)}$$

t-statistics are in parentheses. The pace of return of the loan rate to equilibrium (almost 60% of disequilibrium between the two rates is eliminated within a quarter) seems to be reasonable. The long-run pass-through coefficient is well above 1. A formal test rejects the null that the long-run pass-through is equal to one ($\chi^2(1)$=4.132, p-value= 0.042). This may support a hypothesis of a fierce competition Stability test does not display major disturbances in the relationship.

The results suggest that non-performing loans tend to be an important variable in price-setting in the banking sector. If they grow by 1 pp. loan rate increases in the long run by about 5 basis points, and in the short-run by 3 basis points.

For the medium term loan rate we do not find a cointegrating vector, therefore we build a dynamic model. The results are as follows (t-stat in parentheses):

$$\begin{aligned}\Delta i_t^{LM} = {} & 0.22_{(1.43)}\Delta i_{t-1}^{LM} - 0.38_{(-2.62)}\Delta i_{t-2}^{LM} + 0.24_{(2.18)}\Delta i_t^{M} + 0.21_{(1.6)}\Delta i_{t-1}^{M} \\ & + 0.27_{(1.90)}\Delta i_{t-2}^{M} + 0.26_{(1.90)}\Delta i_{t-3}^{M} + 0.07_{(2.50)}\Delta npl_{t-1} \\ & + \sum_{i=1}^{i=3}\theta_i season_i - 0.01_{(-0.54)}\end{aligned}$$

The instantaneous adjustment coefficient is 0.24, what means that within a quarter when money market rate changes by 1 pp., the loan rate changes by approximately a quarter of a percentage point, the long-run adjustment multiplier is equal to 0.85. However, Wald test does not reject the null that the long-run multiplier is equal to 1 ($\chi^2(1)$=0.89, p-value 0.34). Thus, our estimate shows that the pass-through, albeit somewhat sluggish, tends to be full or close to full. An increase in the share of non-performing loans in total loans by 1pp. increases medium-term loan rate by 7 base points. The adj. R^2=0.49, residuals do not display serial correlation (it is eliminated by seasonal dummies), residuals are normally distributed (J-B=2.5, p-value 0.28), and homoscedastic. Both CUSUM and square CUSUM tests suggest that the obtained parameters are stable.

For the long-term rate Johansen cointegration test suggests one cointegrating relation, however the relationship displays temporary instabilities.

$$i_t^{LL} = 0.63_{(5.7)}i_t^{M} + 0.17_{(8.6)}npls_t + 0.7_{(1.5)}$$

In this case the null of the full pass-through is strongly rejected. The coefficient showing the speed of return to equilibrium reaches -0.335 (t-stat=-6.711), what actually means that the equilibrium is restored within 3 quarters, i.e. the process is relatively long The insolvency risk proxied with the non-performing loans adds some 17 base points to the pass-through process and is much higher than for other interest rates. This is a reasonable result, taking into account that uncertainty increases with the maturity of loan. We do not show the short-run equation, since besides the error-correction term and lagged dependent variable it does not contain any significant terms.

Finally, for the loan rate on consumption loans we obtain a cointegrating relation only if we assume no deterministic components in the data. Since this seems unreliable, we build an ARDL model:

$$\Delta i_t^{LCS} = 0.66_{(6.15)}\Delta i_{t-1}^{LCS} + 0.44_{(5.76)}\Delta i_t^{M} - 0.03_{(1.9)}gap_{t-1} - 0.01_{(-0.58)}$$

R^2=0.61, the residuals are normally distributed and do not exhibit heteroskedasticity. If money market rate increases by 1 pp., then the instantaneous adjustment is 0.44 pp. Point

estimate of the long-run multiplier is equal to 1.07, but the null that it is one is not rejected ($\chi^2(1)$=0.066, p-value=0.80). Interestingly, in this case non-performing loans were insignificant. In contrast, output gap seems to improve the fit – banks lower interest rates on loans for consumption with the output gap. Growing output gap reduces the risk of default.

The main results are summarized in table below.

Table 1: Loan rate pass-through

Loan rate	Long term coefficient β	NPL	Output gap	Coefficient α (speed of the return to equilib.)	Estimation method	H_0: β=1
Short-term	1,12	0,05		0,6	VECM	Rejected
Medium-term	0,85	0,07		Non applicable	ARDL	Accepted
Long-term	0,63	0,17		0,33	VECM	Rejected
Cons.	1,07		-0,03	Non applicable	ARDL	Accepted

The most efficient interest rate pass-through is this to the short-term interest rate. Put it another way, our results show that the central bank has the quickest impact on the short-term loan rate and by the same token, on the short-term loans. Medium-term interest rate as well as the rate on consumption loans seem to adjust slower than the short-term rate, whereas the long-term rate adjusts in the slowest way.

For the short-term rate we have obtained the long-term pass-through coefficient exceeding one. This can be caused by various reasons, from poor data quality and sample shortness to strong competition in the banking sector for the market share in periods dominated by TMM falls. Taking into account a rapid development of banking sector in Tunisia, quickly growing number of bank branches and customers we think that this is a plausible explanation.

On the other hand, it should be also remembered that in the short samples Chi-square (χ^2) test may too often reject a true H_0. Another possible reason is the fact that some deposit rates are affected by public institutions and firms, and money market rate may not be a good proxy of the cost of funds. Once again, this factor should have an impact rather in cases of monetary policy tightening. Another possible reason is that we do not consider the impact of surplus liquidity on the interest rate setting.

On the other hand, although point estimates of the long term pass-through to both medium and the rate on loans for consumption are either below or slightly above one, formal tests do not reject full adjustment. Only for long-term loans the pass-through effect tends to be less than full.

As in the case of pass-through exceeding one, the reasons for less than full transmission should be further investigated. Taking into account that the analysed period was dominated

by interest rate falls, we discard the hypothesis that banks cared about long-term relationship and therefore shielded their customers from some money market rate changes. It seems that rather the contrary was true: certain segments of loan market may exhibit lesser degree of competition, thus we interpret the low level of pass-through as a signal of market imperfections. As aforementioned, the market of loans for agriculture, housing and tourism has been dominated by 3 specialised public banks. Loans to agriculture and especially housing can be these of the longest maturity. This supports hypothesis of a weaker competition. Moreover, public banks may be more risk averse than private banks and therefore adjust interest rate less aggressively.

Furthermore, TMM is the short-term rate (but in fact the only available), and therefore not necessarily the best proxy of the cost of funds in the case of medium and long-term loans.

What seems important, is that in the price-setting process banks take into account risk of insolvency of the enterprise sector and tend to increase their rates accordingly. This factor seems to be more important for medium and long-term loan rates as well as for the rate on loans for consumption.

Although our aggregate approach to interest rates does not offer too many premises about credit channel operation and its possible role in the economy, we conclude here only that the fact that banks tend to consider insolvency risk of their debtors may mean that they also tend to reduce loan supply if the risk increases. By no means is it sufficient for credit channel identification, but it simply supports hypothesis that it may be operative.

5.2 Loan supply and loan demand

This part of the paper is devoted to the credit channel: we try to verify whether it is operative. Our estimation is solely based on the aggregate data. Most studies performed on macro data identified just one cointegrating equation, which was usually interpreted as demand for loans. Developments in supply were usually perceived as negligible (for a review of this literature see Sørensen et al. (2009). Identification on the macroeconomic level is difficult, because the same variables may determine both supply and demand and therefore disentangling supply and demand may be problematic. This is why credit channel identification has been recently performed rather on data coming from bank surveys, e.g. SLOOS, where questions about supply and demand are asked explicitly[9]. Unfortunately, such data do not exist in Tunisia[10]. Moreover, there are no data on borrowers' balance sheets, thus it also makes it impossible to directly verify whether financial stance of the corporate sector impacts loan supply by banks. Therefore, to shed some light into the

[9] See e.g. Ciccarelli, Maddaloni, Peydró (2011).

[10] In the Report on the Monetary Transmission in Tunisia (2012), Andrade et al. provide a study based on a panel of micro data; CBT, mimeo.

problem of credit channel operation, we use the seminal Bernanke and Blinder (1988) model further developed by Hülsewig et al. (2004) and Hülsewig et al. (2005)[11].

In a nutshell, to identify unobservable loan supply and loan demand Hülsewig et al. use a VECM with a set of exclusion and homogeneity restrictions. In particular, it is assumed that loan demand is a function of GDP and loan rate. We expect that loans grow with GDP for at least two reasons: credit is demanded to finance working capital and expected higher economic growth and increased profitability of investment projects lead to a higher demand for loans. Furthermore, we adopt the usual assumption that loan demand falls with the loan rate, the latter variable is a proxy for the cost of loan. This is a common assumption in the literature, however, as it is pointed by Sørensen et al., following theoretical work by Friedman and Kuttner (1993) and empirical findings by Casolaro and Gambacorta (2006), demand for loans can be determined rather by a spread between the short-term loan rate and money market rate that is used for alternative forms of financing, i.e. issuance of debt securities; its cost is proxied by the money market rate plus a (constant) risk premium.

We test whether demand in Tunisia is rather a function of the spread between loan rate and money market rate, instead of a level of the loan rate. In our case, the rationale behind this non-standard assumption differs from the one suggested by Friedman and Kuttner (1993), since financial sector is rather underdeveloped and the enterprise sector relies mostly on banks as a source of external financing. Namely, it is a common practice of the Tunisian commercial banks to specify their offer as "TMM plus a margin", thus it may be the case that customers perceive spread as a cost of loans.

Finally in the demand function a zero restriction is imposed on non-performing loans, as they are supposed not to affect credit demand.

For the loan supply, we assume that it is determined by the loan rate – banks increase supply with the loan rate and - by a rate proxying the cost of external funds. We expect that growing cost of funds will have a negative impact on supply. Moreover, it is expected that the supply function is affected by the spread between the two interest rates (homogeneity restriction). A negative impact is expected from a variable reflecting default risk of borrowers. A zero restriction is imposed on GDP, what may be disputable, since in the presence of information frictions banks may lower supply if the economic conditions worsen[12]. In the method we use, this is wholly attributed to the measure of risk. These are its obvious caveats, therefore we treat results of our estimations rather as a supposition supporting existence of credit channel than a hard conclusion.

To model loan supply and demand functions we have used 5 variables: loans in real terms, GDP, loan rate (short-term loans), money market rate (TMM), and non-performing loans. Taking into account that the share of non-performing loans tends to be quite high and that

[11] Empirical paper in this vein is e.g. De Mello and Pisu (2009) for Brazil.
[12] See e.g. Bernanke, Grtler(1995).

they may behave in a different way than regular loans, we decided to model credit channel using only regular loans. Moreover, as before, we use a set of dummies: for the financial crisis, for the Tunisian social unrest and for the beginning of a more active policy aimed at resolution of the problem of bad loans. We allow for the deterministic trend in the cointegration space since we suspect that it could gauge the effect of a fast development of banking sector in terms of public access to bank services. The number of bank branches rose significantly over the analysed period. Residuals of equations for loans, GDP and non-performing loans are normally distributed and do not display serial correlation. On the other hand, both equation for the loan rate and money market rate are not normally distributed, but they are not excessively skewed. Basing on the information criteria, we use one lag.

Johansen (trace) test for cointegration with Bartlett correction suggests two cointegrating relations (see Appendix, Table 4). Inspection of the loading matrix suggests that parameter at the error correction term in the second equation is statistically significant but positive, whereas for the equilibrium to be restored it should be negative. This suggests that the second equation rather overshoots than returns to equilibrium in loans. This is not the case of the first equation. Comparison of statistically significant coefficients from the loading matrix and signs of parameters obtained in the cointegrating matrix suggests that in the first equation equilibrium is restored through loan rate adjustment.

Additionally, we restrict deterministic trend in the demand equation to zero, but leave it unrestricted in the supply equation, as we suspected that with more branches banks are closer to their customers, and therefore are able to develop lending by attracting new customers.

The restrictions are strongly rejected ($\chi^2(3)$=23.97, p-value 0.000). For the second set of restrictions, i.e. differing from the basic one with the assumption that demand depends negatively on interest rate spread rather than on the level of the loan rate, $\chi^2(3)$=7.55, p-value 0.056. Taking into account that our sample is small and that in such cases χ^2test may too often reject a true H_0, we decide to treat the obtained system as the long-run demand function (the first equation) and the long-run supply function (second equation), namely:

$$l_t^d = 0.5_{(6.7)} y_t - 0.5_{(12.7)} (i_t^{LS} - i_t^{MM})$$

$$l_t^s = 0.7_{(7.4)} (i_t^{LS} - i_t^{MM}) - 0.07_{(21.6)} npl_t + 0.03_{12.8} trend$$

The first equation shows that loan demand increases with GDP, however one might expect a somewhat higher demand elasticity with respect to the scale variable. An increase of GDP by 1% leads to rise in demand for loans by about 0.5%. An increase in spread by 1 percentage point induces a fall in demand by 0.5%. Parameter showing the speed of returning to equilibrium of the demand function is -0.29 (stat t=-10.617) what means that almost 30% of disequilibrium of the demand for loans is eliminated within a quarter. For the loan supply the results suggest that banks tend to increase loans by some 0.7% if spread increases by 1

percentage point. On the other hand, they reduce it by some 0.06% if non-performing loans increase by 1%; finally time trend – representing factors like easier access to customers, as expected, tends to increase loan supply. What is obvious in these estimates is too high semi-elasticity of both loan demand and supply with respect to the spread. This may be due to omitted variables.

Stability tests show that over the time the imposed restrictions hold (Fig.A1 in the Appendix). They also show that the log-constancy test of the system holds as well. There is, however, a problem with the trace statistic over the period 2006 mid-2008, which presumably reflects the fact that the loan supply function does not return to equilibrium. Although stability tests broadly support our specification, it should be stressed that specifications used as a robustness check displayed many problems from a lack of 2 cointegrating relations (interest rates other than the short-term) to problems with rejected restrictions and/or overall instability. Sample shortness seems to be an important obstacle to obtain fairly stable results with holding restrictions using a somewhat different set of variables.

Weak exogeneity test suggests that GDP is weakly exogenous, i.e. real loans seem not to contain information about GDP trajectory.

All in all, our results suggest that credit channel may operate in the Tunisian economy, although the demand equation should have been modified to better reflect actual features of the Tunisian economy. Equilibrium is restored solely through loan rate changes – i.e. banks increase rates to curb the excessive demand. Central bank has some impact on loan supply through the money market rate, but the supply function tends rather to overshoot than to return to equilibrium.

5.3 Impact of the reserve requirements on the monetary transmission

Results from the previous section suggest that the central bank has an impact on loans through the money market rate. However, it also used the required reserve to curb credits. This section provides evidence on the macroeconomic results of required reserve tightening.

For the analysis of the required reserve channel we use a structural VAR with sign restrictions basing on Uhlig (2005) and Glocker, Towbin (2012b).

In particular, we estimate a model:

$$y_t = \sum_{t-1}^{p} A_i y_{t-i} + \theta x_t + e_t$$

With e_t being an error term with variance-covariance matrix $\sum$, $e_t \sim N(0, \sum)$. A_i and θ are coefficient matrices; y_t is a vector of endogenous, whereas x_t of exogenous variables (e.g. constant, dummies, trend).

Uhlig's sign restriction approach is to look at the distribution of the space of impulse vectors, conditional on the requirement that the responses to these impulse vectors meet a particular set of restrictions. Similarly to Glocker, Towbin (2012b), to identify the required reserve shock we assume that an upward shock induces an increase in banks' compulsory reserves. The restriction is imposed for three months. Moreover, we assume that prices and output react to the required reserve shock with a delay. Loans and TMM rate are not restricted in any way. They can react instantaneously to the required reserve shock. Money market rate behaviour should bring information, whether required reserve shocks were fully offset by accommodative liquidity injections by the central bank.

Simultaneously, we identify the interest rate shock assuming that monetary tightening (i.e. an increase in TMM) causes a fall in banks' reserves. As before, prices and output react with a lag, whereas all other variables are not restricted. Both shocks are orthogonal to each other to ensure that the required reserve shock is not impacted by the interest rate shock. The approach makes it possible to take into account a simultaneity problem of the interest rate (determined by the open market operations of the central bank) and required reserve changes. We identify a shock to the (effective) required reserve ratio, but as a robustness check we use weighted average of the required reserve (it is rather a discrete variable, so we decided to use rather the effective rate in our principal VAR setting).

The VAR is built on 6 variables. As endogenous variables we use manufacturing output serving as a proxy for the real sector activity, non-food non-energy consumer prices to proxy core inflation, regular loans in nominal terms, compulsory reserves of banking sector at central bank, short-term interest rate (TMM) and the effective rate of required reserve. As exogenous variables we employ a deterministic trend and dummy variables for the period of financial crisis, social unrest and for large residuals in 2003[13]. Four lags guarantee VAR stability and non-skewness of residuals. However, we could not reject H_0 of residuals autocorrelation (first and second lag).
Variables are expressed in logs with exception of the interest rate and the ratio of the effective required reserve. Thus, we allow for an implicit cointegration between variables.

A positive innovation to the required reserve rate induces a very slight increase in the money market rate – the maximum effect is about 4 basis points and occurs only 5-7 months after the shock. This leads to a conclusion that the central bank rather aimed at smoothing money market rate. and tended to provide banks with almost all liquidity they demanded. Interestingly, loans tend to rise after reserve tightening, what is in clear opposition to the theory and presumably central bank's goal of required reserve change. There can be two underlying reasons: firstly, a fierce competition in the banking sector for market shares. This supports out tentative conclusion on the basis of the interest rate pass-through estimations. Secondly, we suspect that in a quest for cost reduction (an increase in the non-remunerated required reserve plays a role of an implicit tax on banks), banks might have wanted to

[13] There was inflation shock in 2003 in the aftermath of a hike in oil prices;

reduce funds absorbed in the open market operations and expand credit activity at prevailing retail rates which tended to be much higher than the central bank's TAO rate. This could be especially true for 2007-2009, when banks were awash with liquidity and the banking system as a whole displayed surplus liquidity. Fig. A1 in the Appendix shows that practically since the beginning of 2007, when central bank started to actively use the required reserve up to the end of 2008, banking system had positive excess reserves. Put it another way, in spite of required reserve increases, banks were much more liquid than in the period 2003-2006 (we do not have data on excess reserves for years 2000-2002).

Figure 3 shows that prices tend to rise after required reserve tightening, output slightly increases as well, but in this case it is rather a transitory phenomenon. Two factors might affect prices - higher demand financed with loans and, as predicted by Agénor and Montiel (2006) and Glocker and Towbin (2012a), increased spending resulting from the lower deposit rates. However, Andrade et al. (2012) on the bank-level data show that in Tunisia deposit rates reacted rather to surplus liquidity than to changes in the required reserve. Thus, higher inflation is probably rather due to the perverse impact of the required reserve on loans than on the required reserve's impact on deposit rates[14].

Interest rate shock does not seem to affect industrial output, but it reduces loans and prices (Fig.4). The fact that output remains practically intact after monetary tightening may confirm Tornell and Westerman's (2003) observation that lower loan supply affects mostly non-tradable sector, which is more dependent on loans than tradable sector, the latter having a better access to other sources of financing, like foreign loans, capital from parent company in the case of subsidiaries or simply revenues from exports. A decrease in loans and perhaps operation of the expectations channel affect consumer price behaviour.

Our specification ignores the exchange rate. Over most of the period covered by our estimations exchange rate was highly managed to safeguard competitiveness. The exchange rate policy was conducted somewhat independently from the interest rate policy, owing to the asymmetric openness of capital account. Thus, we do not expect that the exchange rate reacts in a significant way to interest rate or required reserve innovations. Therefore , we do not suppose that lower inflation is caused by the exchange rate appreciation. Nonetheless, this needs a formal confirmation and should be thought of as a possible future extension.

As a robustness check of our results we used a VAR re-specified with total reserves replacing compulsory reserves and weighted average required reserve rate replacing the effective rate. The results of the required reserve shock are robust across various specifications – there is an increase in loans and prices after a positive required reserve innovation. On the

[14]Glocker and Towbin (2012b) obtain a similar result for prices in Brazil, i.e. an increase after a positive change in the required reserve, but in their estimations loans behave in the expected way, i.e. they tend to fall. Falling loans and increasing spread between loan and deposit rate suggest that the price effect in Brazil is mostly due to lower deposit rates which induce higher consumption spending and exchange rate depreciation.

other hand, there are some doubts concerning the impact of interest rate innovation on prices – in some settings (e.g. with total reserves) prices do not react at all – this effect needs still more investigations.

Our estimations show that the BCT tended to accommodate required reserve increases, allowing only for very slight increases in the money market rate and therefore to the grand extent was undermining a desired policy goal. As a result, the required rate hikes seem to have all their costs – i.e. higher prices, wealth redistribution (a non-remunerated required reserve is an implicit tax) with no gains from curbing excessive credit activity of the banking sector.

Fig.3 Impulse responses to the effective required reserve shock

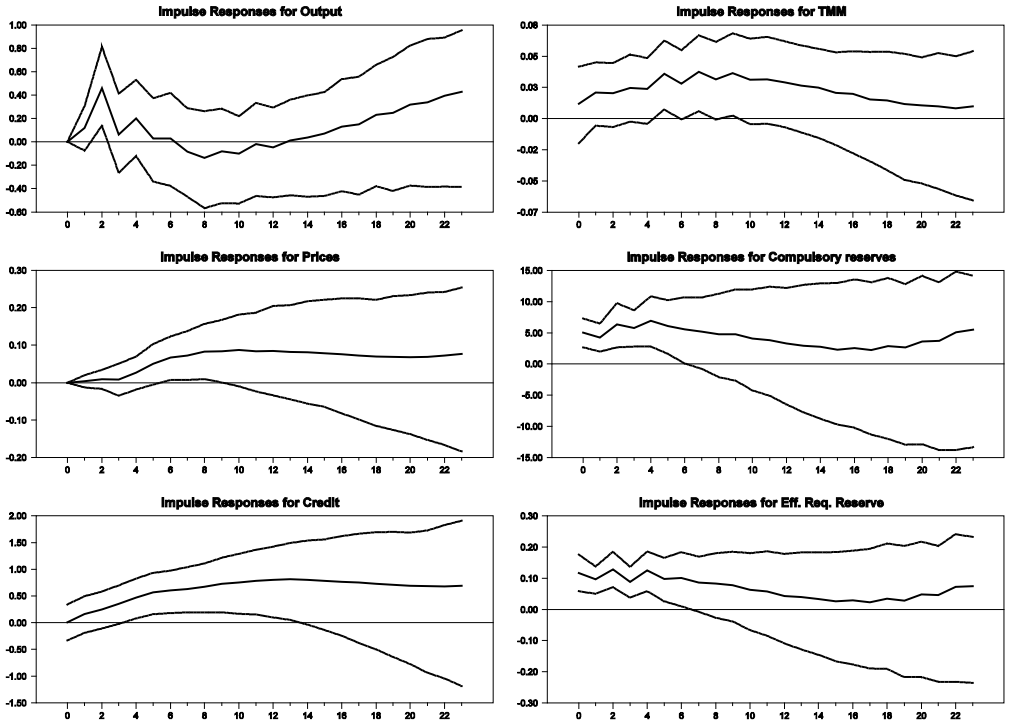
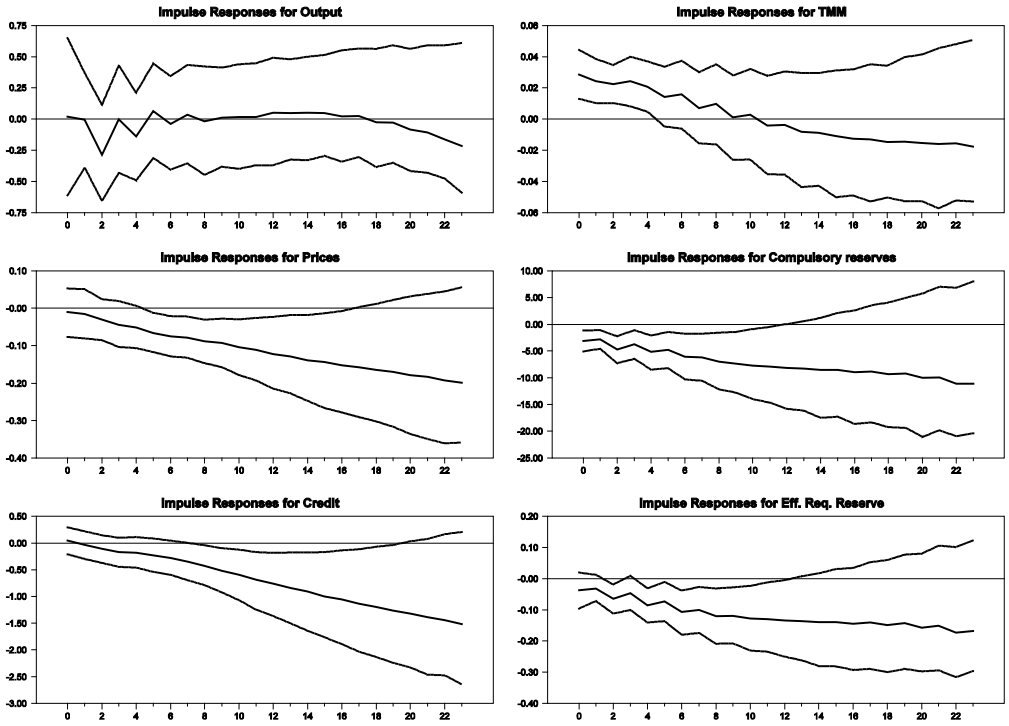


Figure 4. Impulse responses to the interest rate shock



Impulse Responses: TMM shock

6. Summary and conclusions

The paper provides a handful of results on the monetary transmission in the Tunisian banking sector. In its monetary policy Central Bank of Tunisia uses a very complex toolkit of instruments, comprising interest rate, required reserves and exchange rate, in the aim of hitting four goals: stability of the banking sector, gradual amelioration of its assets quality, sustaining competitiveness of the real sector and low inflation. For the two former targets it applies interest rate and required reserve ratio, whereas for the latter two – the exchange rate. Asymmetric openness of the capital account makes it possible to conduct interest rate policy independently – at least to some extent – from the exchange rate.

The estimates have been performed on the macroeconomic data solely. Time series are relatively short; some data have been unavailable, e.g. monthly and quarterly interest rates in the banking sector, and therefore they had to be interpolated from semi-annual frequencies. Low variability of the money market rate over a prolonged period, i.e. August 2003-August 2006 posed additional problems in the estimations.

In the paper we demonstrate the impact of the money market rate on loan rates in the banking sector and the role of money market rate in the loan supply function. Moreover, we provide evidence on responses of macroeconomic variables to the required reserve and interest rate shocks. In particular, our results show that the interest rate pass-through is relatively slow, nonetheless in many cases it is full.. Disequilibrium between money market rate and the retail rates is eliminated within two to three quarters. The short-term loan rate

adjusts the quickest. In the price-setting process banks tend to take into account the default risk in the real sector and increase rates if the ratio of non-performing loans is growing.

Credit channel may be operative, however, due to identification problems on the macroeconomic level, we interpret our results rather as supporting such a conclusion, albeit not as a hard evidence. Banks increase loan supply with the loan rate and reduce after monetary tightening; they also reduce supply with an increasing risk of real sector insolvency. Thus, banks play an active role in the monetary policy propagation. Credit supply tends rather to overshoot than to return to the long-run equilibrium. At least for some sub-periods of the analysed period we have observed instability of the long-run relationship. At this stage of our analysis it is difficult to determine whether it was due to evolution in banks' behaviour resulting from development of surplus liquidity, perception of risk, changes in monetary policy, growing role of required reserve in the policy toolkit or to other reasons. The demand function tends to return to the equilibrium.

Finally, we have examined reactions of prices, industrial output and loans to the required reserve ratio and interest rate shocks. Whereas the former display unintended outcomes (prices and loans tend to grow after an increase in the required reserve), the latter seem to be in line with the interest rate channel theory. The fact that interest rate does not affect output (industrial production) should not come as a surprise, taking into account a high degree of self-financing by firms, concentration of loans, and predicted by the literature stronger dependence of non-tradable than tradable sector on loans. It seems that BCT allowing only for very slight increases in the money market rate in the aftermath of the required reserve tightening tended to offset its own policy, and therefore required reserve raises did not result in a fall of loans extended by the banking system.

All in all, we conclude that the banking sector has a significant impact on the monetary transmission in terms of lags and the magnitude of transmitted impulses. Non-performing loans affect both loan prices and loan quantities provided by the banking sector.

The fact that loans and inflation seem to be responsive to the interest rate may encourage monetary authorities to rely more on this instrument. On the other hand, required reserve policy deserves more consideration.

Appendix [to be completed]

Table A1: Unit root test: levels of variables

Variable	Augmented Dickey-Fuller test, prob. in ( )	
	With trend and constant	With constant
Non-agricultural GDP (y)	-0.324746 (0.9876)	-1.61303 (0.4681)
Loans in real terms (l)	1.152115 (0.9999)	3.115202 (1.00)
Medium term loan rate (i^{LM})	-2.920269 (0.1659)	-0.108425 (0.9422)
Short term loan rate (i^{LS})	-2.531480 (0.3124)	-0.130068 (0.9398)
Long-term loan rate (i^{LL})	-1.582845 (0.7830)	-0.307856 (0.9051)
Money market rate (i^{M})	-2.811709 (0.2003)	-0.308512 (0.9158)
Yields on T-Bills (i^{TB})	-2.829314 (0.1945)	-0.643971 (0.8507)
NPL ratio (npl)	-1.3715 (0.8562)	-0.878452 (0.7863)
Effective required reserve	-2.13157 (0.5241)	-2.132644 (0.2324)

Table A2: Unit root test: first differences of variables

Variable	Augmented Dickey-Fuller test, prob. in ( )	
	With trend and constant	With constant
Non-agricultural GDP (Δy)	-6.146118 (0.000)	-5.914314 (0.000)
Loans in real terms (Δl)	-4.511419 (0.004)	-3.890322 (0.004)
Medium term loan rate (Δi^{LM})	-5.378426 (0.000)	-5.48948 (0.000)
Short term loan rate (Δi^{LS})	-3.418961 (0.0613)	-3.33333 (0.019)
Long term loan rate (Δi^{LL})	-6.697323 (0.000)	-6.815570)0.000)
Money market rate (Δi^{M})	-3.760312 (0.028)	-3.621680 (0.009)
Yields on T-Bills (Δi^{TB})	-5.103164 (0.0007)	-5.147307 (0.001)
NPL ratio (Δnpl)	-5.004931 (0.001)	-3.148631 (0.030)
Effective required reserve	-4.89162 (0.0005)	-4.907448 0.0001

Table A3: Johansen cointegration test [to be added]

p-r	r	Eig.Value	Trace	Trace*	Frac95	P-Value	P-Value*
5	0						
4	1						
3	2						
2	3						
1	4						

Table A4: Credit channel - Johansen cointegration test

p-r	r	Eig.Value	Trace	Trace*	Frac95	P-Value	P-Value*
5	0	0.830	169.103	158.594	88.554	0.000	0.000

4	1	0.634	89.265	85.043	63.659	0.000	0.000
3	2	0.439	44.014	42.557	42.770	0.037	0.053
2	3	0.246	18.018	17.666	25.731	0.350	0.374
1	4	0.111	5.310	5.274	12.448	0.561	0.566

Figure A1: Excess reserves and required reserve ratio

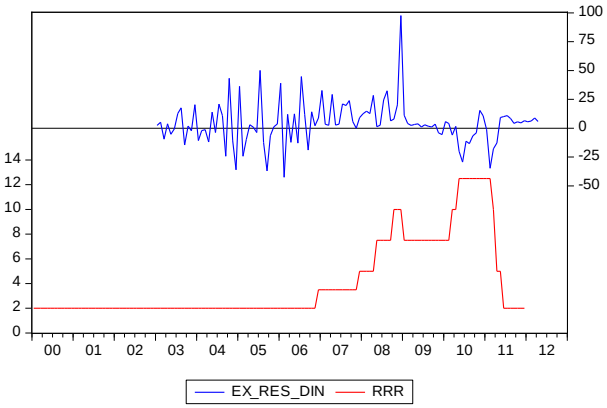


Figure A2 : Credit channel - stability tests of restrictions

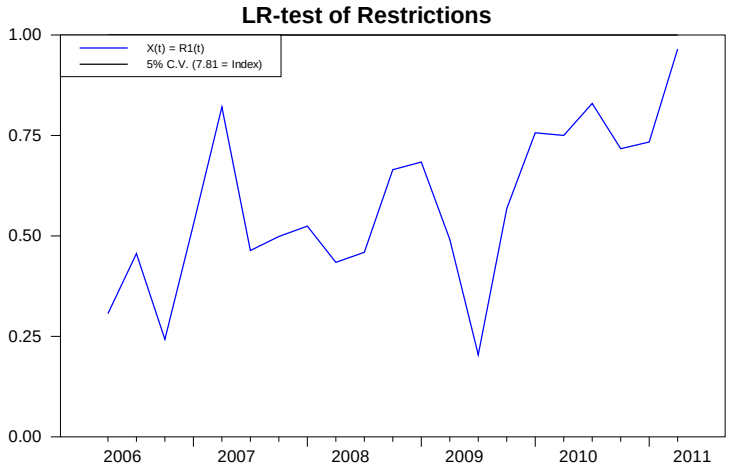


Figure A3: Credit channel – stability test

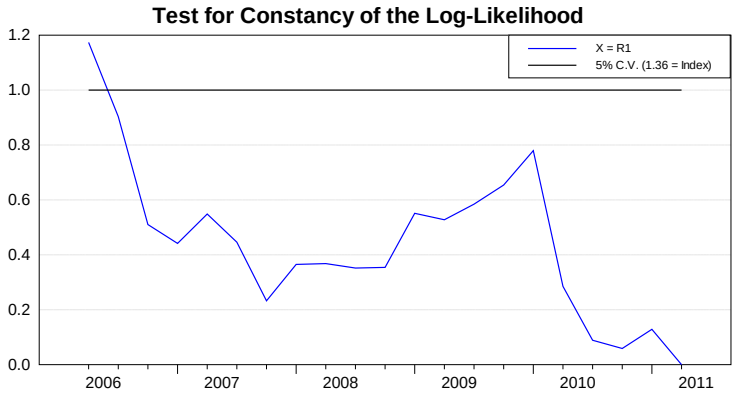
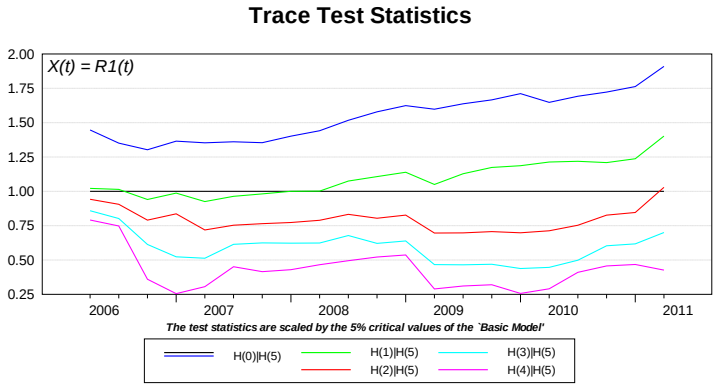


Figure A4: credit channel – stability of the trace test



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