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Modeling Unconventional Monetary Instruments: A Case Study on Croatian Micro Data

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Modeling Unconventional Monetary Instruments: A Case Study on Croatian micro data

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Zagreb, May 2012

Abstract

This paper estimates an impact of an unconventional monetary policy instrument implemented in the environment of high liquidity in a dollarized economy. The instrument ise designed to be counter-cyclical as well as conducive to reduction of external imbalances and vulnerabilities. Dollarization represents additional constraint to policy makers, as high liquidity could potentially lead to (pro cyclical) depreciation pressures.

With monetary transmission mechanism i.e. interest rate channel being ineffective in the high liquidity environment, policy makers turn towards instruments that lower interest rates in the economy while circumventing overly liquid financial sector. Specifically, banks will be rewarded by lower regulatory cost for loans extended to exporters, as these loans would count towards fulfillment of the obligatory reserve requirement.

Interest rates elasticity to cost of banks' financing is estimated on the panel of Croatian firms and banks using random effects estimation. Results confirm sufficiently high elasticity that make (selective) lowering of regulatory cost warranted.

JEL classification: E58, E43, E47, E65, G21

Keywords: Central Banks Policies, Interest Rates Determination, Banks

1. Introduction and motivation

After the collapse of Lehman Brothers the whole new era of monetary policy began: the era of unconventional monetary policy instruments. Central banks of advanced economies have embarked on the unprecedented array of liquidity easing and liquidity provisioning (Bernanke 2009). They have done so by various systemic domestic liquidity arrangements, relaxing collateral requirements, widening counterparty access to central bank liquidity requirements and especially by lengthening the term of liquidity provisioning central bank instruments(Yehoue, Ishi et al. 2009). These tools of monetary management have served well and have been successful in abating and alleviating the financial stress in the markets(Bini Smaghi 2009).

However, 4 years on, the growth is still sluggish, unemployment remains stubbornly high, and recovery prospect are weak, not in small part due to the sovereign debt crises that ensued and still lingers. The unprecedented liquidity and historically low key interest rates have been inadequate to translate into real sector growth. The usual channels of monetary transmission have been blocked or at least severely impaired. The extensive use of various unorthodox monetary policy instruments has resulted in the global liquidity trap, where the usual monetary policy framework remains ineffective (Krugman 2009).

Against this background, some monetary policymakers are looking into second generation unorthodox tools. This time around it is neither the stability of financial markets nor is the financial sector in general in focus. It is about the real sector growth. The monetary authorities are up against not only the protracted recession, but also against the pro-cyclical austerity fiscal programs undertaken across the board.

Monetary policy is facing (almost) a zero lower bound constraint. i.e. financial sector is in, or close to, the liquidity trap, and interest rate channel and well as credit channel are largely ineffective. This paper is an attempt to journey into realm of monetary instruments aiming directly at enhancing growth.

The uncharted territory of growth enhancing monetary instruments presents a challenge for policy makers. It hinges on getting right the fine line between anti-cyclical measures of monetary policy which is it's mandate and selective liquidity or even selective credit provisioning that it is not.

"In general, unconventional measures can be defined as those policies that directly target the cost and availability of external finance to banks, households and non-financial companies." (Bini Smaghi 2009). They are "aggressive and creative policy actions, many of which are reflected in the size and composition of the (Fed's) balance sheet" (Bernanke 2009), usually having an effect of increasing the balance sheet and assuming more credit risk. The model presented here attempts to

quantifying the impact of one such measure of monetary policy in the context of small euroized economy.

This paper is organized as follows: post crises monetary and real sector developments are surveyed to motivate the design of the unconventional measure; measure is described and explained and model developed to quantify the impact of the measure. Paper concludes with the results and a policy recommendation.

2. Stylized facts and design of unconventional measures

Real sector dynamics and credit growth over time have systematically shown a robust relation, based both on cross country evidence and on Croatian data [reference]. However, in the high liquidity conditions, which persist in the post-Lehman period, the usual monetary policy instruments by which central banks can (at least in theory) influence the supply (or a price of) credit become ineffective. Consequently, the ability of central bank to influence the real sector developments is severely impaired. Small open economies, especially dollarized economies, face additional challenges as strong domestic liquidity creation may prompt depreciation pressures. Monetary transmission is in principle very difficult to model even in developed economies in "normal" times (Bernanke and Gertler 2009); in times of protracted financial stress in small open economies, it is next to impossible.

In designing the unconventional monetary measures central banks want to circumvent the overly liquid financial sector and directly influence the real sector interest rates.

Specifically, Croatian credit growth during and after the financial crises has been directed towards the credit to the government and big government-owned enterprises, perceived by banks to carry lower credit risk then private sector hit hard by the crises. Economic recovery remains feeble and is founded on the public investment in the non-tradable sector. Credit growth to non-financial enterprises in 2011. was solid 9,6%, or in absolute terms about 1.5 billion EUR, but with no GDP growth at all (0.0% in 2011)

Table 1: Credit allocation in 2011 by enterprise size and sector

in % and EUR

	Small enterpr.	Medium enterpr.	Big enterpr.	Size not available	Total
Public enterprises	0%	1%	**33%**	0%	34%
Private enterprises	18%	9%	25%	4%	56%
Foreign owned enter.	3%	0%	6%	0%	10%
Total	21%	10%	65%	4%	100%
					1,450 mil. EUR

The central bank designed unconventional measures to counter that trend by incentivizing banks to engage more private sector credit risk and to allocate more credit to tradable sector, to achieve balanced growth. To do so, banks will be rewarded by lowering regulatory burden to credit allocated to exporters. Lower regulatory cost, it is envisaged, will enable banks to lower interest rates charged on loans to exporters and eventually shift the overall credit allocation to more competitive and more profitable private sector and away from (often) loss making public sector. This would contribute not only to growth but to overall competitiveness of the economy. Also, this measure should reduce the external imbalances.

Regulatory cost

The measure is designed to lower banks regulatory burden, thus reducing banks' cost of financing. The motivation stems from the need to reduce the rate of reserve requirement set at comparatively high level. It is precisely for this reason that a reduction in the reserve requirement is assumed to be potentially significant enough to lead to a reduction of interest rates on loans banks extend to private sector.

This reserve requirement reduction is different than previous monetary measures in that before the changes of monetary instruments were generally applied across the board. This time, loans extended to exporters are to be counted towards fulfillment of required reserve obligation[1]. The transmission mechanism, functioning via selective reduction of reserve requirement, it is hoped, would reduce the interest rates to enterprises and even more so to export oriented enterprises.

While regulatory cost and banks' cost of financing are different concepts, they are connected. Regulatory cost is specific to each bank, because it depends on the structure of deposits as well as cost of these deposits[2]. Each class of deposits carry its own regulatory cost, as different regulatory requirements are imposed depending on whether deposits are in domestic currency or foreign currency, some classes of deposits are exempt (deposits of international development banks) etc. Reserve requirement is also partially maintained on regular banks' transaction accounts and partially held at separate unremunerated accounts, to be used only under the great liquidity stress and subject to a special central bank decision (lender of last resort). All these factors, as well as initially different cost of each class of liabilities for different bank, contribute to the fact that regulatory cost is highly bank specific.

[1] Reserve requirement of 13,5% levied on both domestic and foreign currency liabilities and held at unremunerated central bank account differs from minimally required foreign liquid assets (MRFA) of 17% that banks hold against foreign currency deposits. The measure is designed to include loans to exporters as "foreign assets" for the purpose of MRFA regulation, in effect draining banks FA and replacing it with domestic assets. For brevity, both regulations are referred to as "reserve requirement".

[2] deposits and received loans, deposits throughout the text for brevity

Aggregate estimates based on total banking sector data are only approximation of impact of monetary shock. Consequently, even the unified change of regulatory cost, i.e. reduction of general reserve requirement rate is going to be an asymmetric shocks for each bank.

Additionally the current design of this non-conventional measure, rewards banks with reduction of regulatory burden for credit extended to exporters. This adds a layer of bank discrimination, as structure of assets is going to be a factor in calculation regulatory cost, on top of the structure (and cost of) liabilities.

Interest rates

Descriptive statistics point to the fact that exporters already pay lower interest rates.

Table 2: Interest rates by instrument and export status, 31.12.2011.

	Non-exporters	Exporters
Other loans	9,18	6,98
Tourism	6,19	4,52
Construction	10,83	8,00
Agriculture	7,27	7,37
Investment loans	8,09	6,45
Housing loans	6,96	6,78
Export financing loans	8,52	5,80
Loans for short term assets	10,54	8,35
Consumer loans	10,45	10,45
Cash advances	13,45	
Overdrafts	10,84	10,29

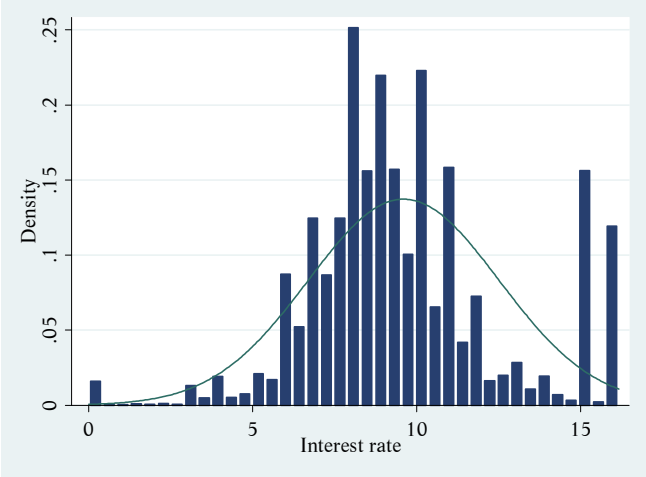
Source: CNB credit and interest rates registry

This is consistent with the theory postulating that exporters profit from a productivity premium. Firms self select into exporting status; only more productive firms choose to export. Through "learning by exporting", selected firms become "better" once they start to export. (Damijan and Kostevc 2011). Also, from banks point of view, loans to exporters carry lower foreign exchange risk.

Interest rates charged by banks on the loans for short-term assets range between 0%[3] and 16.0755%, with the mean interest rate being a, rather high, 9.6%.

[3] Nominal interest rates, as reported in contracts. Effective interest rates take into account various commissions and charges and cannot be zero

Figure 1: Interest rates on corporate loans for short-term assets



Percentiles	
1%	3.00%
5%	6.00%
10%	6.58%
25%	7.98%
50%	9.11%
75%	11.00%
90%	15.00%
95%	15.56%
99%	16.08%

No. of loans	9864
Mean IR	9.60%
Std. Dev.	2.91%

Source: CNB credit and interest rates registry

The loans for short-term assets account for almost 40% of 16.5 billion EUR stock of loans to corporate sector on Dec. 31, 2011. Investment loans accounted for additional 26% of total loans with the mean interest rate charged on those loans being 7.4 %. While distribution of interest rates on loans for short-term assets is centered around the mean of 9.6%, a substantial share of loans is charged maximally permitted (by law) interest rate of 15% as well as penalty interest rate of 16.08%. Given the importance of bank financing in total external financing of firms in bank-centric systems like Croatian, cost of 9.6% charged on 40% of total loans significantly determines the total cost of firm financing.

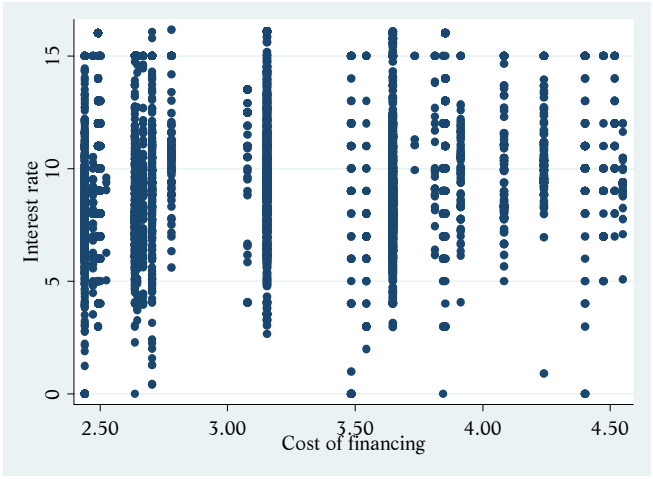
3. Variables and the model

The model needs to be able to quantify the impact of asymmetric regulatory easing on the interest rates enterprises of different characteristics pay on bank loans. Since the current economic environment, both domestically and globally has recently so profoundly changed, the historical data and by extension, the time series modeling approach would be of weak informative power. Instead, a rich dataset is used and inferences are made from the cross-section data.

Dependent variable is interest rate firm_i pays on a loan in bank_j. Panel consists of 8362 firms that have all together 9862 loans for short-term assets at 27 banks. Most banks have 1 loan, but some have up to 4. Two or more loans for short-term assets one firm has with one bank count as one firm/bank observation. This set encompasses all loans of this type and assigns a firms/bank pair to each loan. The product is standard across banking sector (loan for short-term assets it defined strictly by statistical reporting rules) so behavior of banks and firms can be assessed in homogenous circumstances.

First independent variable is ***cost of financing*** of banks that ranges from 2.43% to 4.55%. It is calculated as weighted interest rate paid on domestic deposit and foreign liabilities. Cost of capital and hybrid instruments are not included. Simple average of 3.4% (below) is further reduced by weighting by the size of bank to 2.87% as bigger banks benefit from the cheaper sources of financing.

Figure 2: Interest rates (%) and bank cost of financing (%)



Cost of financing, percentiles

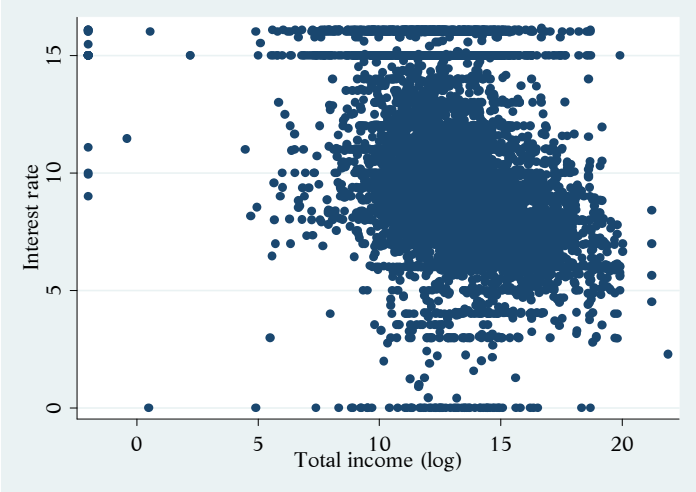
1%	2.43%
5%	2.44%
10%	2.47%
25%	2.63%
50%	3.48%
75%	3.91%
90%	4.47%
95%	4.51%
99%	4.55%

Banks	27
Mean	3.36%
Std. Dev.	0.75%

Source: CNB credit and interest rates registry, Croatian companies' database

Firms in the sample have ***total income*** (second independent variable) ranging from over 3 billion EUR annually to only 1 EUR, with median income of 365 000 EUR. Descriptive statistics indicate that bigger firms benefit more from lower interest rates then small and medium firms. Again, a significant proportion of firms *across all sizes* pay maximum (and penalty) interest rates.

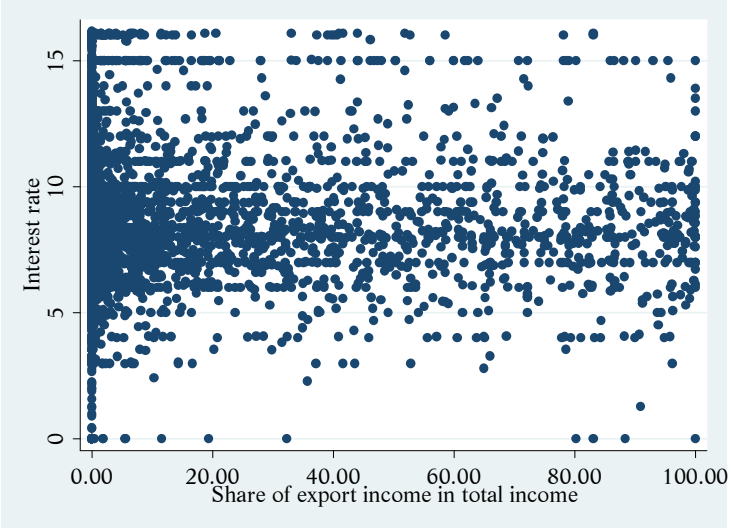
Figure 2: Interest rates (%) and (log of) total income (in EUR)



Source: CNB credit and interest rates registry, Croatian companies' database

As for the third independent variable ***exporter status***, the majority of the firms in the sample are not exporters, as their operating income comes in its entirety from the domestic market. However, total income of exporting firms[4] account for almost 75% of total income of all firms.

Figure 4: Interest rates and share of export revenues in total revenues



Share of export income, percentiles

1%	0.00%
5%	0.00%
10%	0.00%
25%	0.00%
50%	0.00%
75%	0.21%
90%	19.26%
95%	52.90%
99%	95.70%

Firms	8362
Mean	6.46%
Std. Dev	18.80%

Source: CNB credit and interest rates registry, Croatian companies' database

Summarizing, the independent variables are:

cost of financing of a bank (**cf**), which is a weighted interest rate paid on all deposits and received loans; the variable that will ultimately be affected by regulatory easing;
share of export income in total income of a firm (**share**), which controls for the export status of a firms;
total income of a firm (**inc**)**,** scaling variable.

Table 3: Correlations between variables

	ir	cf	share	inc
ir	1.0000			
cf	0.0996*	1.0000		
share	-0.1156*	0.0000	1.0000	
inc	-0.1077*	0.0000	0.0550*	1.0000

*at 5% significance

[4] Exporting firm is defined by share of export income =>10.

Correlations are of expected sign - banks with higher cost of financing charge higher interest rates; exporting status contributes to lower interest rates as well as higher total income i.e. big enterprises are charged less than SMEs. There is also some correlation between independent variables, i.e. size of enterprise and its status as exporter, pointing to the fact that exporters are more like to be a bigger that a medium or small firm.

In the model, elasticity of interest rates to cost of bank financing is estimated, controlling for firm specific factors.

$$\mathbf{Interest\_rates}_{ij} = \beta_0 + \beta_1 \mathbf{Cost\_of\_financing}_{ij} + \beta_2 \mathbf{Share\_of\_export\_income}_{ij} + \beta_3 \mathbf{Total\_income}_{ij} + \nu_i + \varepsilon_{ij}$$

Estimation is done using random effects, as "firms" are presumed to be a sample from a larger population. Firm with a given level of total income and share of export income is a random effect, as it is not that particular firm that is of interest, rather it is randomly chosen from a population of similar firms. Also, as interest rates are on the censored sample (ranging from 0% to 16.0755%) tobit estimation is used, as OLS yield inconsistent results at and near the end-sample points.

Results indicate that coefficients are of expected sign, with unitary change of cost of financing translating into about one third of that change to interest rates. Exporters status and size have expectedly negative signs. All regression coefficients are significant at 1%.

Table 4: Estimation results, random effects, tobit

	Coef./se
Interest rate	
Cost of financing	0.351***
	(0.05)
Share of export income in total income	-0.007***
	(0.00)
Total income (log)	-0.446***
	(0.01)
Constant	14.395***
	(0.23)
sigma_u	
Constant	1.528***
	(0.05)
sigma_e	
Constant	2.241***
	(0.03)

* p<0.10, ** p<0.05, *** p<0.01

Regression coefficient of 0.351 means that a unitary decrease in cost of financing, (unitary decrease is 1 p.p., from 3% to 2% or from 4% to 3%) leads to a 0.35 p.p. decrease in interest rates charged by banks to corporate clients. For average interest rate of 9.60% this decrease of 0.35 p.p. reduces the interest rate to 9.25%. In relative terms, a decrease of interest rate from 9.60% to 9.25% amounts to a reduction of 3.6%.

Likewise, the increase of 10 p.p. of share of export income in total income reduces interest rate for 0.07 p.p. A unitary increase of (log of) total income (roughly tripling the income in EUR) reduces interest rate for almost one half of p.p.

For selected levels of cost of financing and exporter status, the predicted interest rates are as follows:

Table 5: Values of interest rates as predicted by the model

	Share of export income in total income		
	0%	50%	100%
Cost of financing			
2%	9.23%	8.88%	8.52%
3%	9.58%	9.23%	8.87%
4%	9.93%	9.58%	9.22%

The central question of impact of reduction of regulatory cost (and by extension, the cost of bank financing) to interest rates is better illustrated by using semi elasticities. The semi elasticity would give proportional change in y (interest rate) for a unit change in x (cost of financing). At lower level of interest rates i.e. those interest rates that are charged to exporters and bigger firms, a reduction of 0.35 p.p. would translate into bigger ***relative*** relief. Semi elasticies e(y)/d(x) are calculated as:

$$\frac{\Delta\, y/y}{\Delta\, x} = \frac{\Delta\, y}{\Delta\, x} \times x = marginal\ effect \times \frac{1}{y}$$

For non-exporter with a loan in a bank with higher cost of financing, the reduction of cost of financing for 1% would reduce the interest rate for 3.57% i.e. from 9.93% to 9.58%. For exporter in a bank with lower cost of financing, the same reduction would amount to decrease of 4.18%, from 8.52% to 8.17%.

Table 6: Semi elasticities implied by the model results

	Share of export income in total income		
	0%	50%	100%
Cost of financing			
2%	3.84%	4.00%	4.18%
3%	3.70%	3.85%	4.01%
4%	3.57%	3.70%	3.85%

Greater the share of export income in total income of a firm, marginal effect of 0.351 p.p. means greater relative reduction in interest rate.

4. Conclusion

This model attempts to quantify the impact of reduction of regulatory burden on an interest rate charged to private sector. In the environment of high uncertainty where previous changes of monetary instruments are uninformative of future interest rate movements, a cross-section dataset is used to simulate the effects. In the random effect tobit model, the reduction of cost of bank financing has statistically significant impact on the interest rates. The impact is ***relatively*** greater for exporters, for bigger firms and for firms at banks with lower cost of financing. As the intention of monetary instrument change is primarily a reduction of interest expenses paid by exporters in order to promote growth and external competitiveness, results of the model support the intended policy goals, and offer some benchmark against which the results of the program can be gauged.

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