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Firm entry and liquidity

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Abstract

This paper shows that fewer firms enter after a contractionary liquidity shock and that firm entry reacts quicker to liquidity than the economic activity indicator. The results are obtained by using Estonian data for the period 1995M1–2006M7. Various structural VAR and VECM models are exploited to identify the liquidity shock.

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Non-technical summary

The main objective of the paper is to know, does firm entry react to a change in the liquidity in Estonia? The answer is definite yes.

In the recent years firm entry has become an important topic in the macroeconomic literature. Potentially it gives an additional mechanism for policy transmission, which can help giving further insights into amplification of shocks. Various models for closed and open economy have been built to show how firm entry and exit can be incorporated into macroeconomic models.

The effects of monetary policy shocks is a literature in its own rights. If one believes that new firms are on average more productive and grow faster than old, then it is very easy to see why monetary authority should be interested in the effects of interest rate on firm entry. However, it is not clear if firm entry should react to monetary policy, because the decision to create a firm should mainly depend on the future expected profits and not temporary economic conditions. Recently Bergin and Corsetti (2005) and Mancini-Griffoli (2006) have developed models where firm entry does react to liquidity shocks.

In order to confirm or reject the theoretical hypotheses, empirical analysis has been based on scarce data on firm entry time-series. There are only a few available datasets that can be used to understand how entry behaves over the business cycle and how does it react to shocks. This paper uses a new high quality source of data from Estonia. The data comes from Estonian Enterprise Registry and is available even at daily frequency for the period from January 1995 until July 2007.

The empirical analysis concentrates on the identification of the liquidity shock. For that end I use various structural vector autoregression and vector error correction models.

The initial data analysis shows that firm entry in Estonia is strongly procyclical, having a lead of approximately 3 months before economic activity. The empirical estimation shows that firm entry does react to changes in the liquidity. Firm entry reacts after 2 months from the shock and stays statistically significantly different from zero for more than a year. Economic activity reacts with longer lag, and also stays significant longer. The results are robust to various changes in the identification, data in levels and differences and various lags used, however exact quantitative properties differ.

Contents

1. Introduction

The main result of the paper is that firm entry reacts to liquidity shocks and is leading in the impulse response functions the economic activity indicator. The results are obtained using structural vector autoregression (SVAR) and vector error correction models (SVECM) for the period 1995M1–2006M7 for Estonia. The variables in the VAR are economic activity or gross domestic product (GDP), interest rate and firm entry measure. Liquidity shock is identified by standard recursive short-run restrictions.

The paper is mainly data-driven, trying to learn about the behaviour of entry, and restricting attention to only impulses of liquidity shocks. Fortunately, there is a lot of literature on how to identify liquidity shocks in the data by using statistical and/or macroeconomic theory (Christiano et al., 1998). Therefore it is possible to leave other shocks aside, including the effect of entry on macroeconomic variables[1]. The main contribution of this paper is thus to give additional evidence on the effects of an identified liquidity shock in a traditional SVAR framework to entry by using high quality data from the Estonian Enterprise Registry. Firm entry is aggregated to the whole economy, but also the industrial sub-sample is considered separately.

The empirical results are in large terms in accordance with previous findings for other countries. The reaction of entry to liquidity has been documented before, but the quick reaction has not always granted. Using similar methodology as in this paper, Bergin and Corsetti (2005) find that entry reacts only to the innovation in the non-borrowed reserves and not to interest rate. The impulse responses of other variables are not presented, but the entry reacts with a significant lag. In Lewis (2006) sign restrictions based identification scheme the net entry reaction is slower than output. Both of the papers used data on U.S. Ilmakunnas and Topi (1999) use Finnish plan creation data and show that an increase in the interest rate leads to lower entry, but they do not look a the dynamic effects. In the paper by Bilbiie et al. (2006), authors find that the strongest correlation of entry to GDP in the U.S. is also with one period lead.

The existence of the causal link between liquidity and firm entry is a controversial finding for macroeconomic theory. In a standard theoretical model,

[1]It must be underlined that the nature of the entry shock to the macroeconomy is still a matter of debate in the literature. Some authors stress the importance of the love of variety (Bergin and Corsetti, 2005; Bilbiie et al., 2006). Both of these papers also use the number of firms to determine mark-ups — the second, simple way of including the possible effect of changes in competition. A third way is to see entry as the impact on productivity because new firms are more productive than the existing firms (Bartelsman and Dhrymes, 1993; Campbell, 1998). These different views complement rather than substitute the understanding the data.

firms are infinitely living, maximizing their discounted future profits. The entry and exit of firms is rarely included in the models. However, there are various ways to model the effect of monetary policy to liquidity (Bergin and Corsetti, 2005; Mancini-Griffoli, 2006).

By including firm entry and exit into theoretical and empirical macroeconomic models can improve our understanding of the transmission mechanism of liquidity shocks — shedding some light into the black box, but also helping to understand many other shocks. Another motivation for looking at the firm entry and exit rates is that it has been shown that new firms are important in introducing new technologies and have a significant share in the number of hirings (Geroski, 1995). In theoretical literature, entry is often viewed much different from firm birth rate — for example it can be understood as introducing new products, production lines or plants. In international macroeconomics, it can include the decisions about entering a foreign market, either by exporting or investing in production facility, but in nature, the questions remains unchanged.

I continue the paper with a short overview of the literature, gathering the stylized facts concerning firm entry that have been agreed upon. The third section includes a description of the data and an analysis of the stationarity and cointegration properties of these variables. The fourth section introduces VAR and VECM models, and the various identification schemes used in the VAR and VECM framework are discussed. The fifth section demonstrates the dependence of firm entry on liquidity using impulse response functions for analysing the dynamics and using the forecast error variance decomposition to measure the importance of liquidity shocks in explaining output and entry. The sixth section concludes.

2. Literature

A large proportion of the existing literature concentrates on the dynamics of firm entry over the business cycle. A good overview of stylised facts is given by Geroski (1995). It would be preferable to separate factors that are influence entry and exit, from the variables that entry and exit influence. Unfortunately the literature mainly documents correlations. First I will present empirical papers and then discuss some of the theoretical results.

Entry is common — a large number of firms are created every period (Geroski, 1995). Net entry rates are strongly pro-cyclical (Geroski, 1995; Ilmakunnas and Topi, 1999; Campbell, 1998). It is interesting to analyse firm entry together with imperfect information and entry barriers. It has been found that barriers to entry, measured as the average size of the company or high concentration of the top 5 firms, have a negative effect on entry (Ilmakunnas and Topi, 1999). That means that if the optimal size of the firm is large, then there are fewer firms created. In accordance with the previous finding, entry is slow to react to high prior profits in the sector (Geroski, 1995; Ilmakunnas and Topi, 1999). Higher profits would indicate that it is more profitable to start a new firm in the sector, but if the concentration is high and the firms in the sector are large, then it is more difficult to enter the market. However, the literature presents puzzling evidence indicating that although entry related sunk costs are significant, entry and exit rates are high (Geroski, 1995).

By using Finnish plant creation and destruction data, Ilmakunnas and Topi (1999) find that higher entry rates lead to higher exit rates in the near future. The explanation for entry leading exit is that many of the new firms turn out to be unprofitable and hence are soon liquidated. This is supported by the fact that the probability of survival increases with the firm age and a lot of firms close in their first years of activity.

Campbell (1998), by analysing U.S. plan creation and destruction data, finds that the reverse is true: higher exit rates lead to entry in the near future. He documents that entry rates follow GDP growth with a one-quarter lag, while exit rates follow GDP growth with one to four-quarter lags. GDP is positively correlated with exit for 2 to 8 quarters in the future. In addition, entry is positively correlated with contemporaneous total factor productivity growth, but even more strongly correlated with productivity growth one period before. This could be explained by the vintage capital theory, conjecturing that higher exit rate leads to more business opportunities, which the new firms can use. The correlations are not directly comparable to the results in this paper because of the different types of data Campbell (1998) and Ilmakunnas and Topi (1999) were using (number of new plans and not a plan of creating a firm).

Liquidity has not been of interest to many, but Ilmakunnas and Topi (1999) found that an increase in the Euribor has a negative contemporaneous effect on entry, but no statistically significant effect on exit. Equally, the rise in bank loans to enterprises increases the number of entering, but not exiting firms.

Bergin and Corsetti (2005) introduce entry and net entry in a recursive identification SVAR as not being part of the central bank information set: entry measure is placed after the liquidity variable. They use the data for the U.S. over the period 1959 to 1997. The results show that interest rate has a statistically significant impact only on the net entry, but not on the number of new enterprises. For the alternative liquidity measure — non-borrowed reserves — entry as well as the net entry react to a monetary shock. So the number of new enterprises is influenced, but the impact on exit is unknown. For a shock in the non-borrowed reserves, both entry and net entry are affected.

The identification of the liquidity based on the sign restrictions by Lewis (2006) shows that net entry is affected by a liquidity shock, but only after 4 quarters. The number of new enterprises is not used in the estimation of the VAR and impulse responses. The same data for the U.S. was used as in Bergin and Corsetti. The data has been shown to have several deficiencies. The data was collected by a private company Dun&Bradstreet Inc. Signing up in at the Dun&Bradstreet Inc. was voluntary and entry is only recorded when firm decided to join the database and not when it was actually established. Therefore the data contains a significant amount of noise (Uuskula, 2007).

The initial theoretical papers are written by such authors as Howrey and Quandt (1968), Myers and Weintraub (1971), Smith (1974), and the seminal paper on firm entry and exit in a dynamic stochastic general equilibrium framework from Hopenhayn (1992). Two country model with entry and exit is due to Ghironi and Melitz (2005). A more applied model of entry and exit with embodied technology is by Campbell (1998), where he shows that a large share of the fluctuations in the US economy could be explained using vintage technology combined with entry and exit. The most recent papers of entry in the literature on macroeconomics are from Bilbiie et al. (2006), Bergin and Corsetti (2005), Mancini-Griffoli (2006) and Lewis (2006), out of which the last three papers also analyse monetary policy.

The model by Bergin and Corsetti introduces entry and exit as a firms' every period decision whether to enter the market or not in the next period. In order to enter, firms must pay a fixed sum in advance. A monetary shock that leads to lower interest rate and discounting, increases future discounted profits and hence more firms decide to enter. Also, Mancini-Griffoli (2006) introduce entry by setting up an entry cost and a time lag between the decision to enter the market and actual operation in the market. Unlike in Bergin and Corsetti, only a share of firms are hit by the death shock, which makes room for new entrants. The monetary shock as real effects because of the sticky prices in the sector, which creates firms. Expansionary monetary policy makes creation of firms cheaper because the sector, where firms are created, cannot change prices to the optimum level. Lewis (2006) uses sticky wages to get real effects of monetary policy. All three papers find that entry plays (an important) role in the monetary transmission mechanism. These papers offer sufficient theoretical background for looking at the the relationship between firm entry and liquidity, but there remains much to be done for a realistic model of entry and exit that describes the dynamics of the data.

The only paper which has estimated the impact of an entry shock is Lewis (2006). Based on the dynamic stochastic general equilibrium model the author imposes sign restrictions in VAR to find out the impact of an entry shock. Based on the model, supply, demand and monetary shocks are identified with sign restrictions, the remaining shock is an entry cost shock. Using U.S. data, she finds that lower entry costs lead to higher entry rates, which is, however, not statistically significant. She also finds that profits fall, output and inflation increase, which in turn, is also accompanied by an increase in the interest rate. Most of the impulses are as expected, but the increase in inflation seems counter-intuitive: increase in the monopolistically supplied labour wage overtakes the decrease in the entry costs, and there is no competition effect to slow down the inflation.

3. Data description

The main variables used in the paper are the following: firm entry (Fentry), firm exit (Fexit), interest rate (EEKintr), economic activity (Econact), real gross domestic product per capita (rGDP) and consumer price index (CPI). Firm entry and exit statistics come from the Estonian Enterprises Register. The period is from 1995 M1 to 2006 M7 with the exception of firm exit. The firm entry and exit data is constructed by aggregating the firm birth and closing dates monthly. This includes also share of firms, which are created by the law firms in order to sell them "on the shelf" products. The exit of firms in Estonia is difficult variable to deal with because of changes in registries and mandatory increase in minimum capital requirements, therefore the exit rates are strongly clustered around certain time periods. For that reason exit data is only used in aggregate numbers and not in the correlation analysis and impulse responses. All the data, with the exception of GDP is monthly.

In total 81187 firms were created over the sample period, 584 firms on average every month (see Table 1). For the period since 1998, for which both, entry and exit data are available, on average 636 firms were created and 190 firms closed every month. This period data for Estonia differs from the typical developed country by having a high entry and low exit of firms. The highest number of firms were created in the wholesale and retail trade sector. This includes also firms which may have been created for only a few transactions. The sectors included in the economic activity cover 16.1% of the total firms created.

When comparing the relative number of entries with respect to exits, the largest growth is in the construction sector, where exit relative to entry was the smallest. Constructions was followed by financial intermediation and real estate, rentals and other business activities.

The economic activity indicator is from the Ecowin database. It includes industrial production, transportation and production of energy. It is broadest variable available reflecting economic activity in Estonia at monthly fre-

Table 1: Entry and exit of firms by sectors

	Exit 1998M1 2006M7	Entry 1998M1 2006M7	Entry 1995M1 2006M7	Entry to exit ratio	Exit 1998M1 2006M7	Entry 1998M1 2006M7	Entry 1995M1 2006M7	Entry to exit ratio
	Number of firms				Percent of firms			
Agriculture, hunting and forestry	867	2515	3194	2.90	4.42	3.84	3.93	0.87
Construction	958	4821	5766	5.03	4.89	7.36	7.10	1.51
Wholesale and retail trade	9181	24967	31198	2.72	46.83	38.14	38.43	0.81
Hotels and restaurants	753	1879	2485	2.50	3.84	2.87	3.06	0.75
Transport, storage and communication	1159	3739	4945	3.23	5.91	5.71	6.09	0.97
Financial intermediation	341	1603	1845	4.70	1.74	2.45	2.27	1.41
Real estate, renting and business activities	3632	17415	20607	4.79	18.52	26.60	25.38	1.44
Others	2716	8524	11147	3.14	13.85	13.02	13.73	0.94
Total	19607	65463	81187	4.43	100.00	100.00	100.00	1.00
Total_EA	3842	10329	13122	2.69	19.60	15.78	16.16	0.81

Note: Total_Econact covers sectors that are included in the economic activity indicator

quency. Separate entry and exit variables that include only the sectors of the economic activity indicator are calculated to have direct fit between the two variables (Total_EA). GDP is used to cover the economic activity in the whole economy at the quarterly frequency. The GDP data comes from the from the Estonian Statistics database.

CPI data is from Statistics Estonia and interest rates on Estonian kroon loans from the Bank of Estonia. The interest rate includes also loans to the households. This broad credit measure is used to capture the effect of overall liquidity available in the economy and it is also the sole series available for the full period starting 1995. There are only a few firms large enough to borrow directly from abroad and hence this would not change results much. However, the inclusion of household loans reflects the possibility that initial capital for firms can be often borrowed on the a household account.

Economic activity, firm entry, interest rate and inflation levels are presented in Figure 1. Economic activity and entry both have positive trends, and it is possible that they share a common trend, which could be estimated by a co-integration relationship. Interest rate and inflation have a downward trend, especially because of the high interest rate and inflation in the beginning of the period, but at the end of the sample, a slight increase can be noticed.

Yearly differences can be found in Figure 2. The relationship between entry and liquidity is not as strong as to the economic activity indicator, but some negative correlation can be observed. Cycle peaks are the following: high firm

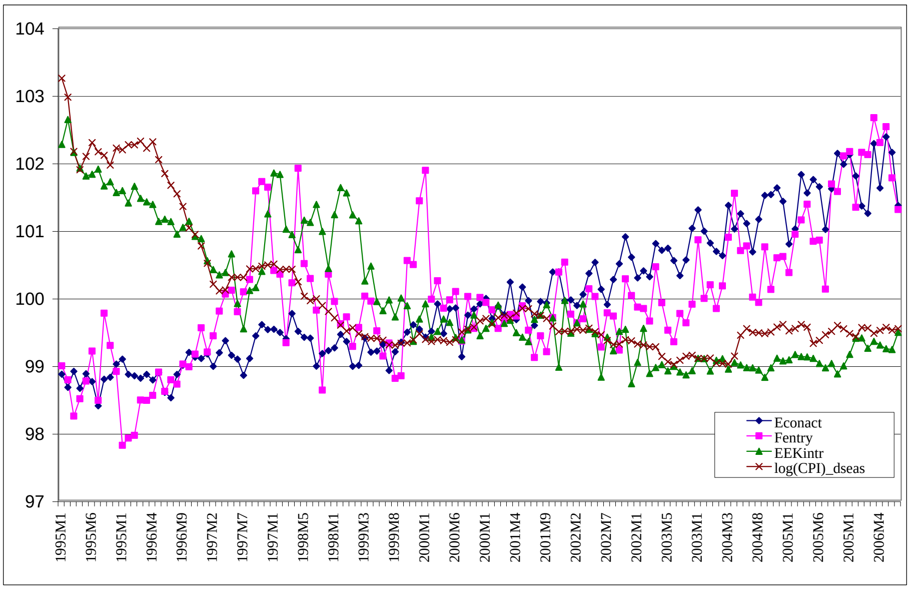

Figure 1: Firm entry, economic activity, interest rates and CPI at levels, mean and s.e. adjusted

entry September and October in 1997, January 2000, which coincide with low interest rates just before these times. Low levels of entry were experienced in November 1998, and January 2001. The last drop does not coincide with a drop in economic activity and is probably due to changes to the laws governing business registration the year before. A high correlation can be observed even at monthly frequency, especially for the beginning of the period. Firm entry was leading the economic activity indicator by approximately one quarter.

Over the whole sample, the contemporaneous correlation between economic activity and firm entry is almost 0.5 (correlations are presented in the figure 3). However, the correlation is strongest when entry has 3 months lead on economic activity. The strongest correlation is, with retail and wholesale companies, but the correlation is over 0.2 with all the major sectors, and the leading property of entry is robust. The results are comparable to the correlation analysis of the U.S. data, where firm entry also leads industrial production

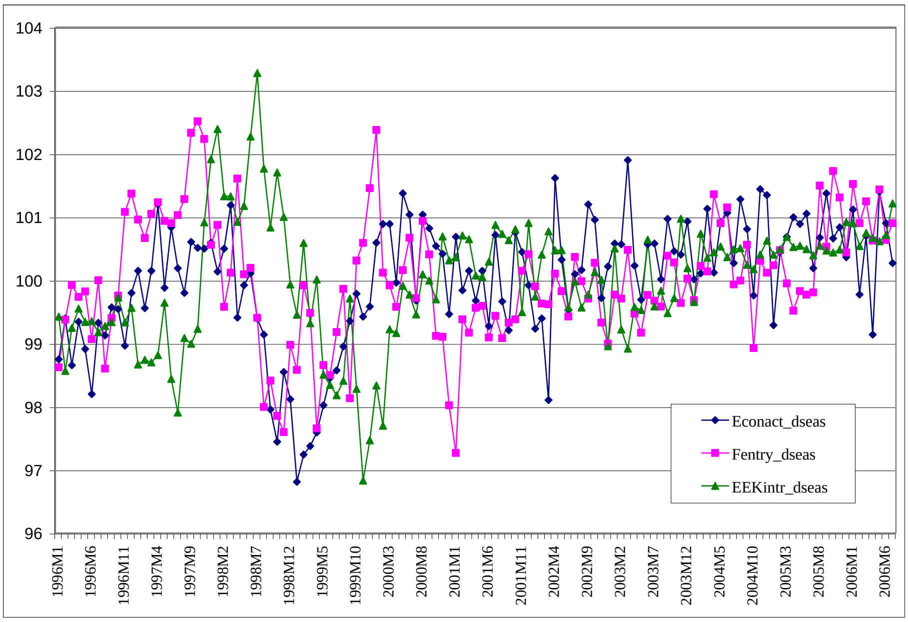

Figure 2: Firm entry, economic activity and interest rate in yearly differences, mean and s.e. adjusted

or GDP by approximately one quarter (Bilbiie et al., 2005).

The correlation of economic activity and entry to interest rate are close to zero. The outcome is similar to that of Bergin and Corsetti (2005), who explain that given the small share of liquidity shocks to economic activity, only a conditional correlation could show the effect. This can be done by using VAR analysis.

According to the Figure 1 on the variables in levels, it is reasonable to assume that none of the indicators is stationary in levels, but possibly stationary in differences (as presented on the Figure 2). Economic activity and firm entry clearly exhibit a positive trend, interest rate and inflation a negative trend. Formal testing by using an augmented Dickey-Fuller (ADF) test shows that on levels they are I(1) processes, with the exception of CPI, where non-stationarity was rejected at log-levels. However, the KPSS test of the

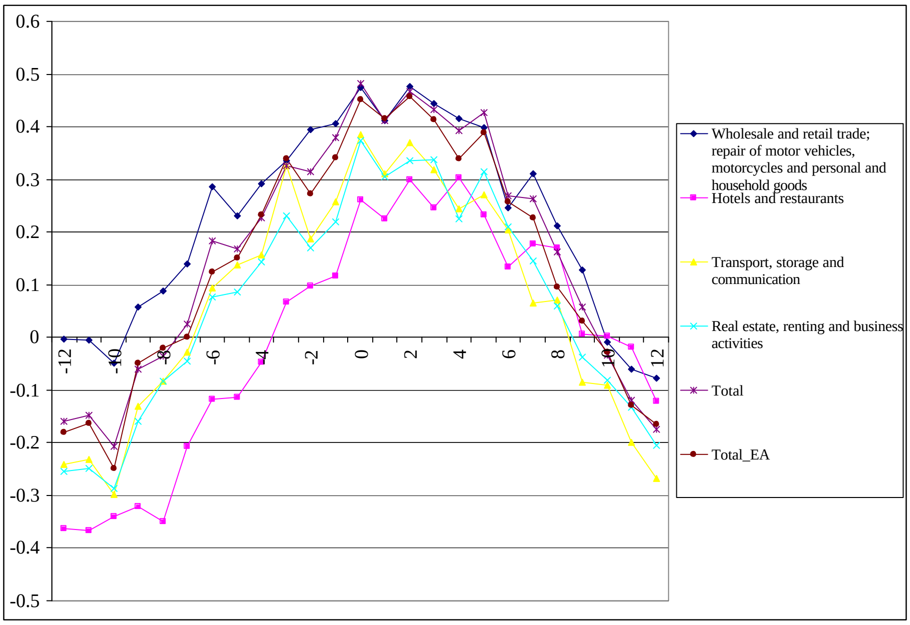

Figure 3: Correlation between economic activity and entry by sectors - entry fixed at zero, future and past (respectively + and -) for economic activity

trend-stationarity with four and eight lags showed that the stationarity of the variable can be rejected at any conventional significance level. The formal test results are presented in the Table 2.

Cointegration analysis results show the same problem with CPI as in the stationarity analysis (see Table 3). All the cointegration test results become non-robust when CPI is included in the system, either pair-wise or with 3 or 4 variables. The tests for cointegration without CPI are more stable and show that the three variables are cointegrated and form either 1 or 2 cointegrating relationships depending on the deterministic terms included in the relationship. The economic meaning and importance of the number of cointegrating relationships will be discussed in the next section. The results on the cointegration properties of the quarterly data are not presented here as not used in the VECM analysis.

Table 2: Stationarity analysis results

Variable	Test	Lags	Const	Trend	Test stat		5% crit.
Econact	ADF	12	y	y	-0.86		-3.41
Econact_dseas	ADF	11	y	y	-4.5	*	-3.41
rGDP	ADF	4	y	y	-2.75		-3.41
rGDP_dseas	ADF	2	y	n	-3.25	**	-2.86
Fentry	ADF	4	y	y	-2.19		-3.41
Fentry_dseas	ADF	11	y	n	-4.68	*	-2.86
Fentry_EA	ADF	6	y	y	-3		-3.41
Fentry_EA_dseas	ADF	11	y	n	-5.47	*	-2.86
EEKintr	ADF	4	y	n	-2.06		-2.86
EEKintr_dseas	ADF	0	y	n	-3.98	*	-2.86
EEKintr_dseas	ADF	12	y	n	-3.22	*	-2.86
CPI_log_dseas	ADF	12	y	n	-6.29	*	-2.86
CPI_log_dseas	ADF	1	y	n	-3.19	*	-2.86
CPI_log_dseas	KPSS	8	y	y	0.34	*	0.146
CPI_log_dseas_d1	ADF	11	y	y	-6.44	*	-3.41
CPI_log_dseas_d1	ADF	0	y	y	-7.97	*	-3.41
CPI_log_dseas_d1	KPSS	8	y	y	0.08		0.146

Note: Respective null hypothesis rejected at ** 5%, * 1% significance interval. All series, except rGDP, are monthly, for GDP, seasonal dummies are used

Table 3: Cointegration analysis results

Variables	Test	Lags	Con	Trend	Rank	R0 p-val	R1 p-val	R2 p-val	R3 p-val
Econact, Fentry	Joh	12	y	n	1	0	0.3541		
Econact, EEKintr	Joh	12	y	n	1	0	0.3037		
EEKintr, Fentry	Joh	5	y	n	-	0.2823	0.3219		
	Joh	1	y	n	1	0.0011	0.1120		
Econact, CPI_log	Joh	12	y	n	-	0	0.0026		
	S&L	12	y	y	1	0.0251	0.5763		
EEKintr, CPI_log	Joh	2	y	n	-	0	0.0289		
	S&L	2	y	n	1	0.0194	0.8581		
Fentry, CPI_log	Joh	6	y	n	1	0.0088	0.3203		
	S&L	6	y	y	0	0.3750	0.2297		
	S&L	2	y	y	1	0.0553	0.9382		
Econact, EEKintr,	Joh	12	y	n	1	0	0.1343	0.1795	
Fentry	Joh	12	y	y	2	0	0.0171	0.1190	
Econact, intr,	Joh	12	y	y	-	0	0.0010	0.0358	0.0422
Fentry, CPI_log	S&L	12	y	y	2	0.0003	0.0285	0.6852	0.0206

Note: Rank refers to the highest rant not rejected at standard confidence intervals

However, because of the problems with CPI, it is excluded from the following analysis and nominal interest rates are used. The first reason for this is, as mentioned, statistical. The second reason is that it is not clear how the correct price index should be constructed as many firms use loans for import and export activities, hence inflation in Estonia might not be correct due to the high nominal interest rate, because a low real rate with respect to domestic inflation still leads to low competitiveness abroad since the real interest rate for activities abroad is high.

4. Identification of the liquidity shock

In the multivariate time-series analysis, two modelling strategies were followed: SVAR and SVECM. The main issue in VAR literature is that the error terms are correlated with each other, and hence, the task is to identify the structural shocks, possibly different from the innovations in the variables. As only liquidity shocks are of interest here, the other shocks are not identified because the impulse response to that identified remains unchanged (Christiano et al., 1998).

4.1. Identification in VAR

The reduced form VAR is the following:

$$y_t = A_1 y_{t-1} + ... + A_p y_{t-p} + u_t, \tag{1}$$

where, y_t is the vector of the variables, A_i are the coefficient matrices, and u_t is the residual matrix.

There are several approaches to setting contemporaneous restrictions. The first is to test which variables have a contemporaneous effect on each other. For example, if a test for instantaneous causality shows that entry and economic activity do not move together with interest rate, then an interest rate shock has been identified, which could be analysed here as the liquidity shock. However, if this is not the case, the direction of the effect must be identified. In this case, a structural VAR is used, where it is frequently assumed that monetary authority knows output and inflation at the time of setting the interest rate, and hence takes them into account, but output and inflation cannot be influenced by contemporaneous changes to the interest rate (Christiano et al., 1998).

Loosely speaking, Estonia does not have its own monetary policy. The Estonian kroon exchange rate was pegged to the German Mark up to 1999, and after that to the euro by the currency board arrangement. The kroon interest rate is mainly influenced by the monetary policy of the European Central Bank and to some degree by domestic financial conditions. Hence the interest rate should influence Estonian economy, and only to lesser extent Estonian economy should have impact on the interest rate. Hence the change in the interest rate should be exogenous and therefore the liquidity shock could be identified statistically.

The short run A model $Ay_t = A_1^* y_{t-1} + ... + A_p^* y_{t-p} + \epsilon_t$, such that $\epsilon_t := Au_t$ has a diagonal covariance matrix and A^* are new coefficient matrices. The short run B model is $\Sigma_u = BB'$ so that $u_t = B\epsilon_t$. The short run AB model $Au_t = B\epsilon_t$, which is used in the next section, combines the two previous models and the possible restrictions.

4.2. Identification in VECM

The following equation is estimated in the VECM form:

$$\Delta y_t = \alpha\beta' y_{t-1} + \Gamma_1 \Delta y_{t-1} + ... + \Gamma_{p-1} \Delta y_{t-p+1} + u_t, \tag{2}$$

where, y_t is the vector of the variables used in the analysis, Δ is the difference operator, α is the loading matrix, β is the cointegration matrix, and Γ_i-s are the short-run coefficient matrixes.

There are two ways to put restrictions in the structural estimation: short-run restrictions and long run restrictions. Short-run restrictions can be imposed the same way as for VAR models. There is greater choice when it comes to long-run restrictions. When the cointegration rank is one, then there is at most 1 temporary shock, and at least 2 permanent shocks. When the cointegration rank is two, then at most 2 temporary shocks might exist in the system, and the liquidity shock has to be determined using short-run restrictions. The other temporary shock could be competition, a love of variety, etc. In the system of economic activity, entry and interest rate, one shock should be temporary — a demand shock, including monetary one. One shock should could be permanent — productivity. Shock related to the third equation could be interpreted as: competition, productivity (vintage capital), a love of variety, etc. However, it is not clear if this shock should be temporary or permanent in nature.

When the cointegration rank is one, there is at most 1 temporary shock, which should be identified as demand. However, if the cointegration rank is two, it is not known if the other shock is temporary or permanent. Subsequent short-run restrictions must be imposed to identify the shocks. In this context, if there is only one temporary shock, it might not be liquidity shock, therefore it is expected that the VECM model with 1 permanent shock together with short-run restrictions gives more accurate measure for the liquidity shock.

4.3. Technical aspects of the estimation

Lag length is tested using various information criteria: Akaike Information Criteria (AIC), Final Prediction Error (FPE), the Hannan-Quinn Criterion (HQC) and the Schwarz Criterion (SC). The median value of the lag length is taken from the recommendations of the criteria. High number of lags leads to low efficiency in the estimates and complications in the estimation of the structural shocks: a low number of lags does not include sufficient data dynamics.

The residuals are then tested for contemporaneous correlations and long-run causality, which is used to identify the liquidity shock. The residuals are plotted, tested for autocorrelation and normality. Also forward recursion test on the stability of the parameters is performed.

Impulse response functions (IRF) are used to quantify the impact of the shocks. The IRF are used to measure if and how liquidity effects firm entry. Confidence intervals of the IRF are based on Hall studentized bootstraps. In this paper the confidence intervals are based on 1000 bootstraps inside each 1000 bootstrap of standard errors. Confidence intervals of 95% are presented in the figures. Estimation is carried out using the econometric package JMulti (www.jmulti.de).

5. Results

5.1. Impulse response analysis

The order of the variables in the estimated regression and impulse responses is economic activity indicator, firm entry and interest rate. For the monthly SVAR, 3-lag model was estimated. Intercepts are included in all of the estimated regressions.

A contractionary monetary shock leads to quick decrease in the entry rate and a fall in economic activity followed 3 months later (see Figure 4). The effect on entry lasts 15 months and for output 20 months. This along with the initial months of the response, is consistent with the leading property of entry to the economic activity.

There are several explanations for why it is possible to have in the same time lower number of entering firms and fixed production. First, the confidence intervals around production are large enough to accommodate a decrease in production, which would keep production per firm the same. Second, entry is defined here as a data of registration at the of enterprises and it is

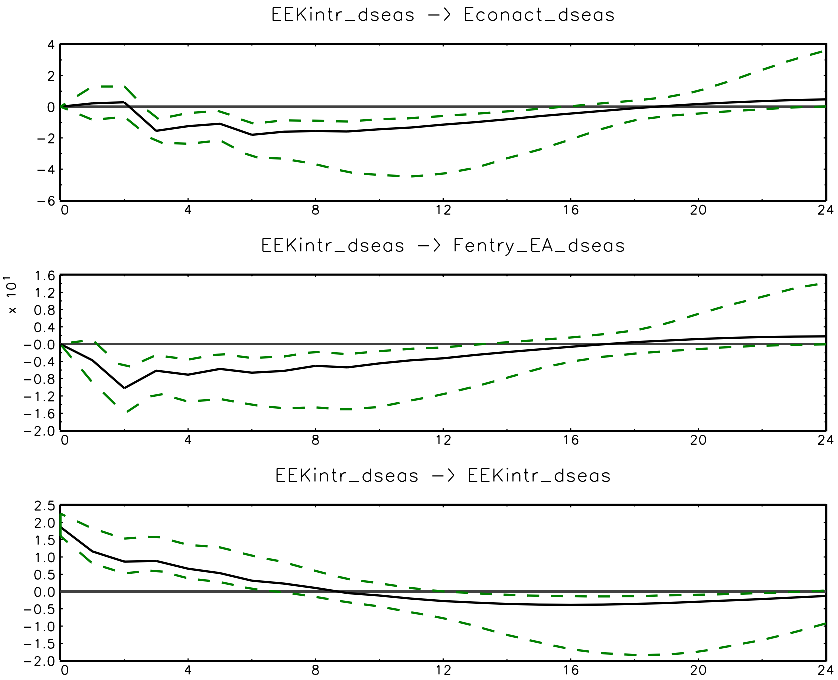

Figure 4: Reaction to an identified liquidity shock, monthly SVAR with 3 lags.

reasonable to assume that it takes time before production takes place, so this allows the previously existing firms' production to be unchanged. Third, the exit of firms is not controlled for in this regression. If a contractionary liquidity shock would lead to a decrease in the exit rate, it would be possible that the actual number of firms unchanged. The last point is however unlikely and not true for the case of the U.S. data (Uuskula, 2007).

Causality analysis did not reject the null hypothesis of no contemporaneous correlation between economic activity and firm entry with respect to interest rate with $p - value = 0.32$. This is an encouraging result for the rest of the analysis as the liquidity shock can be related to the innovation in the interest rate variable. Due to the fact that the liquidity shock is orthogonal, the results are also robust for different orderings of variables, however the ordering I use is consistent with the standard identification scheme of Christiano et al. (1998) and many others.

The estimation of the monthly VAR model shows that the optimal lag length according to AIC is 12, FPE – 7, HQC – 3 and for SC a lag of 1. There are two good reasons to estimate the model also with higher lags. First, the 12-lag model would be more in line with the standard macroeconomic literature, where 4 lags with quarterly data are used (for example this is the case in Gali (1999) and Altig et al. (2005)). Second, the results with the three lags could potentially be inconsistent. Therefore results with the 12 lags (AIC choice) are presented in the Figure 5.

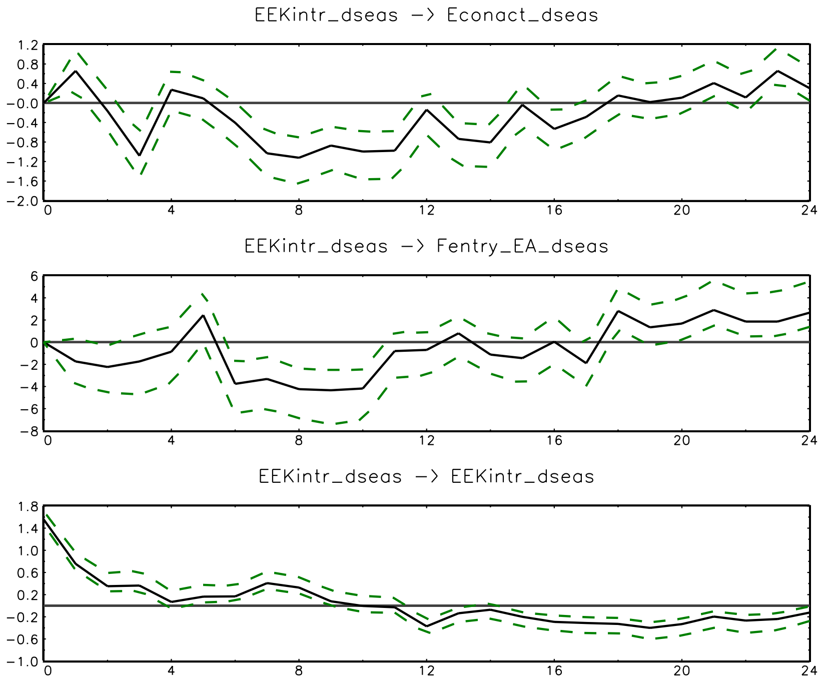

Figure 5: Reaction to an identified liquidity shock, monthly VAR with 12 lags

The initial effect of the shock is the same as for the model with three lags, entry decreases faster than economic activity. However, there are increased dynamics in the impulse responses. The negative effect disappears and reappears. The last period of statistically significant impact is still at around 9 months for entry and 15 months for output. From the estimated coefficients, it can be seen (results not presented here) that most of the high-lagged coefficients are insignificant, leading to difficulties in estimating due to multicollinearity. Therefore, As expected, the multicollinearity problem becomes significant — imprecise estimates of the coefficients leads to unsmooth impulse responses.

These results are similar to the results from Bergin and Corsetti (2005), who used a similar monthly VAR. In their results, firm entry reacted 5–6 months after an initial monetary shock. The results for industrial production were not reported. Analysis of that U.S. data showed that the reaction of entry preceded the reaction of industrial production by approximately 6 months, which also provides confidence to the results on the basis of Estonian data.

Robustness checks with the variables in levels and first differences gives confidence on the qualitative aspects of the results. The exact results however differ to a significant extent. Ignoring the stationarity properties of the data and running the VAR on log-levels of entry and economic activity and level of interest rate confirms the result obtained using the seasonal difference specification. Entry reacts quickly after the shock, but it takes approximately 4 months before economic activity indicator becomes negative. Use of the first differences in the estimation with the monthly data leads to higher volatility in the responses. The number of lags included in the system needs to be higher to take into account the seasonality in the data. The main difference is that the time when the impacts become statistically significant is longer, for example the model with 10 lags, it takes 4 months for the entry and 8 months for the economic activity to have statistically significantly different impact from zero at 95% confidence. For both, levels and first differences, the convergence to the initial levels is very slow or in some instances the liquidity shock has long-run effects.

The IRF of the quarterly model provides qualitatively the same results as the monthly model (see Figure 6). There is no particular difference when from moving from economic activity data to economy-wide data, hence the service sector does not differ in entry and output reactions to an identified monetary shock. The preceding dynamic effect of entry, which was strong in the monthly model, is not as clearly visible in the quarterly model, but the impact of the shock lasts a bit more than one year, as was the case for the monthly model. The impact on entry occurs in the first quarter, and then slowly decays, but for the GDP, traditional hump-shaped response can be observed.

The levels and first difference specification for the quarterly data with four lags give similar results, but the effect on entry becomes statistically significant after 3 quarters and for the economic activity more than 4 quarters. Again here, the convergence is slow and the liquidity shock can have permanent effects on economic activity.

For the VECM analysis, the AIC and FPE recommended 11 lags, HQC – 5 or 2, depending on whether seasonal dummies are used and SC – 0. For the model with 2 lags, there is no contemporaneous correlation as before, p value is 0.75 (with seasonal dummies), for the model with 5 lags $p = 0.31$ and in the case of 11 lags $p = 0.30$. Hence, the same contemporaneous restrictions can be used as for the VAR model to identify liquidity shock.

The benchmark case in VECM has a rank equal to 2, 2 lags, 2 long-run restrictions (firm entry and interest rate cannot have permanent effects) and one short-run restriction (no contemporaneous effect of interest on output) im-

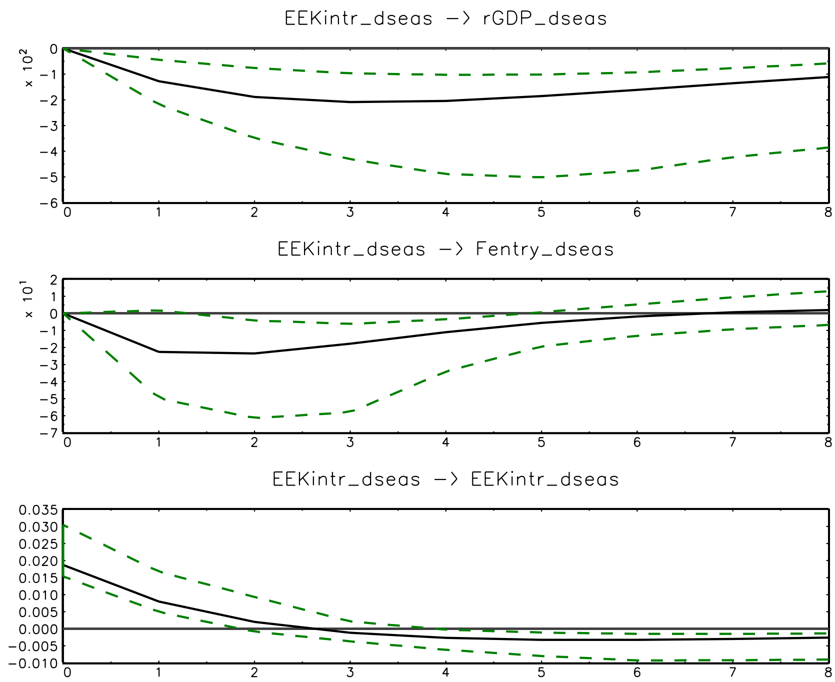

Figure 6: Reaction to an identified liquidity shock, quarterly VAR with 1 lag

posed. The impulse response functions provide similar results to the standard VAR set-up. As can be seen from Figure 7, the contractionary liquidity shock leads to a drop in entry in the short run. The effect on output is statistically insignificant at 95% confidence level. The effects are considerably shorter than in the data with yearly differences.

The estimation with a cointegration rank equal to 1 turned out to be restrictive for the analysis of impulse responses. The reason for this might be that in this system, the sole transitory shock cannot be taken as a monetary shock, because there might also be shock to short-term productivity, labour supply or other type of demand.

Cointegration based long-run restriction confidence intervals did not converge for the 11-month lag model. This was expected as many coefficients must be estimated at the same time. For the model with shorter lags, the estimation faced similar problems as for the long-run restrictions of the VAR model — the initial impact on output was positive.

The results are also robust for the estimated sub-samples of 1995–2000 and 1999–2006. The qualitative responses are the same, but due to the lower num-

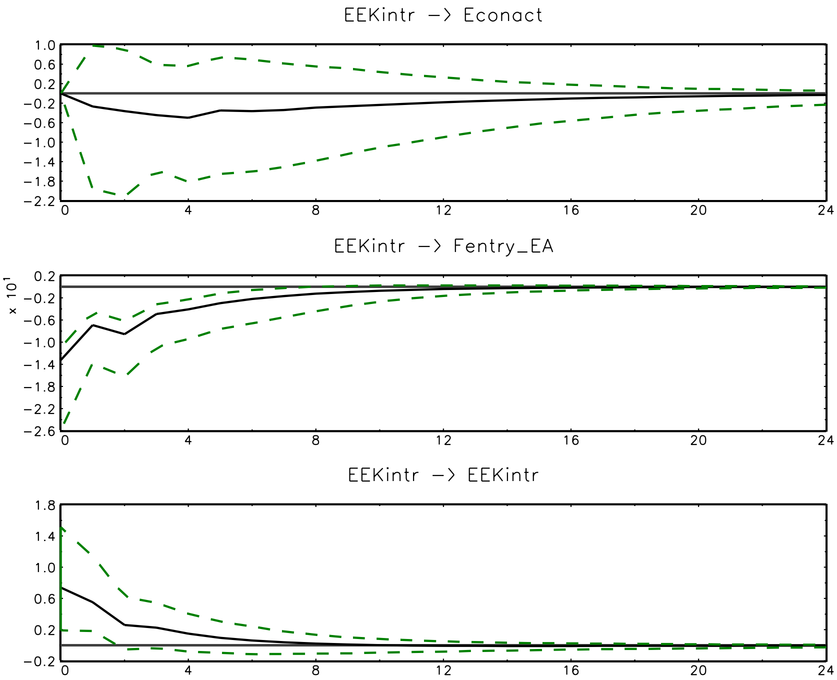

Figure 7: Reaction to liquidity shock, VECM, rank=2, with 2 lags

ber of observations, the standard errors become higher, which results in low significance of impulse response functions. Finally, it must be noted that the VAR and VECM results are consistent only when the system is correctly specified. In this paper, a small system was used because of the short data period and some variables, such as the CPI, having non-standard properties, which could in turn lead to some mis-specifications. Short data is also main reason why the quantitative impacts are significantly different in the VAR specifications.

5.2. Forecast error variance decomposition

The main forecast error variance decomposition (FEVD) results are based on a previously estimated monthly VAR model with 3 lags. The results show that 20% of the variance of the entry and 25% of the economic activity can be explained by the liquidity shocks (see Figure 8) in the medium-run. In the short-run, ability to explain entry is higher. This is in accordance with the impulse responses, which showed that entry reacts quicker to liquidity shocks than economic activity. The explanatory power of the liquidity shock in the model with 12 lags is smaller, respectively 10% for entry and 16% for economic activity after 2 years.

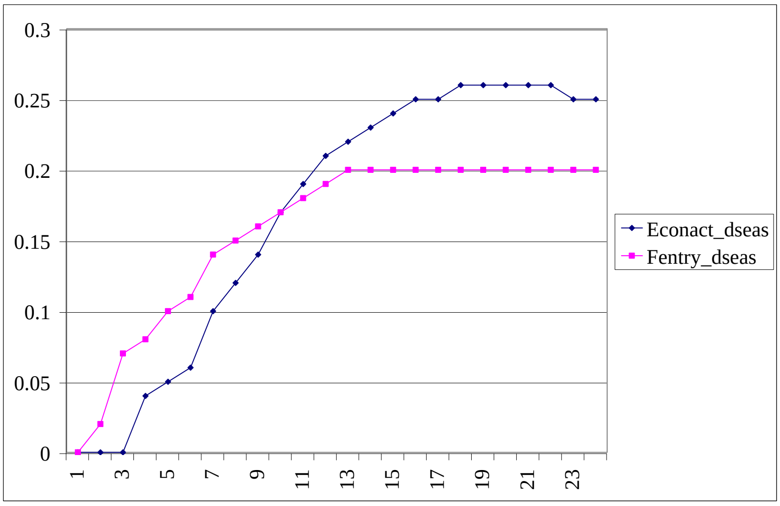

Figure 8: FEVD for firm entry

The share of liquidity shocks is as expected and is in line with the previous findings. For example Altig et al. (2005) find that monetary shocks explain 14% of the variance in output in the U.S. The division to entry and economic activity shocks cannot be analyzed as the shocks were not identified. The same results hold for the FEVD of the quarterly model with total entry and GDP. Monetary shock explains approximately 6% of the variation in the entry and approximately 16% of the variation in output after 1 year. This provides confirmation that the liquidity shock identified is comparable to those in other countries, and entry is one of the variables to be analysed with liquidity shocks.

6. Conclusions

Entry is also procyclical in Estonia. There are a lot of firms created during good times and less in bad times. This is true for the overall correlation of created firms, but also for the sectoral divisions. Entry can be one of several early indicators of economic activity in Estonia.

The results of the VAR analysis show that entry is influenced by liquidity. The effect begins after one month and dies out after 15 months. The effect on output starts after 4 months and lasts until the 20th month after the initial shock.

The economic results are in line with the previous literature, but some differences emerge. In Campbell (1998), economic activity is leading entry, but here the reverse is true. One possible explanation is the use of data. Here, business registration was used, but Campbell used plant creation data which this takes place after the firm has been registered. If this is true, then it is important to note the time between the decision to start production and actual start of production, supporting the models with time to build.

The question of which type is an entry shock is still unclear. The results in this paper did not conclude whether in the system of 3 variables, where one shock is clearly permanent and one temporary, the third shock, possibly related to entry might still be either temporary or permanent (as the cointegration results showed). The difficulties estimating two permanent shocks point towards entry shock begin a short-run shock, at least in Estonia, in this period. Literature in the future should pay more attention to the identification of the entry shock.

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