E C O N O M I C S B U L L E T I N

Long run relationship between entry and exit: time series evidence from Turkish manufacturing industry

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Abstract

This paper investigates the long run relationship between entry and exit using aggregate annual data from the Turkish manufacturing industry for the period 1968-2001. The time series properties of the data imply that simple OLS regressions may yield spurious results. We employ both bivariate and multivariate models to test for Granger causality. Utilizing relatively new time series techniques, we find that exit Granger causes entry in the long run, but not vice versa. However, unlike many empirical findings in the literature, past exit has a negative effect on entry. Entrants seem to be put off by past exit in the long run. Hence, our results do not seem to support the replacement effect in the Turkish manufacturing industry in general. None of the other variables included in the multivariate analysis has significant effects on entry or exit. The generalized impulse responses between entry and exit confirm Granger causality results.

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1. Introduction

There are vast numbers of theoretical and a considerable amount of empirical studies in the literature that examine the entry and exit dynamics in both developed and developing country industries. The empirical studies are conducted for well defined industries. Although the breadth of definition seems to vary across studies, they sometimes yield similar results. There is also considerable amount of contradiction with respect to how entry and exit influence each other.

Church and Ware (2000, p. 439) criticize the SCP studies on the nature of assumed causality in their analyses. They argue that most of the studies in the literature run regressions by assuming the exogeneity of explanatory variables. Roberts and Thompson (2003) extend the typology of Carree and Thurik (1996) to four cases:

1. displacement: entry of i leads to exit of j
2. replacement: exit of i leads to entry of j
3. demonstration: entry of i leads to entry of j
4. shakeout: simultaneous entry and exit by i and j leads to simultaneous exit of both.

Hence, this typology suggests a dynamic inter-temporal relationship between entry and exit. The inter-temporal link may be denoted in its simplest format as, $EN_t = f(EX_t)$ and $EX_t = g(EN_t)$. Note that, this relationship may be lasting for more than one lag. According to the 4 cases listed in Roberts and Thompson (2003) the direction of causality may go from entry to exit as well as from exit to entry. Not only that, but there may be bidirectional causality (or lack of causality) between the variables, possibly indicating simultaneity.

To the extent of our knowledge none of the studies in the literature check for this inter-temporal-link that is commonly referred to as Granger causality (hereafter "causality" is used in the sense of Granger). Granger causality does not mean causality in the common sense. We say that X Granger causes Y if lagged values of X explain the level of Y (Granger, 1988).

In this paper we attempt to augment the empirical literature on entry and exit. In doing so firstly we use recent time series techniques that are more flexible in determination of the lags through which entry and exit may influence each other. The procedure developed by Toda and Yamamoto (1995) (TY hereafter) is simple and has a number of advantages over alternative methods. Secondly, we employ aggregate entry and exit data in the Turkish manufacturing industry. This is partly due to the problems in defining the borders of sub-industries, and partly due to the fact that aggregate entry and exit behavior is not studied, especially in Turkey. Furthermore, the time period covered in this study is relatively larger than the ones in the literature. Thirdly, we test for Granger causality between entry and exit, which is not commonly tested in the literature. We find unidirectional temporal causality running from exit to entry. However, since exit negatively influences entry in the long run, our result does not seem to support any case in Roberts and Thompson (2003). The generalized impulse responses also confirm the long run Granger causality results. Our findings also show that empirical analysis in the aggregate level may also reveal important information regarding entry and exit dynamics.

In the next section we introduce a brief discussion of the relevant literature. Then we discuss the data and methodological concerns in section 4. We then discuss empirical results. The last section concludes.

2. Literature Review

Geroski (1995) surveys the earlier literature on entry and Caves (1998) on turnover and mobility. Most of the earlier work examines entry and exit dynamics in panel settings in relatively short time periods. Love (1996) examines the determinants of entry and exit rates in UK based on county data. He finds that entry and exit rates have significantly positive effects on each other. He argues that this is due to revolving door phenomena. More recently, Ilmakunnas and Topi (1999) study the effects of both microeconomic and macroeconomic factors on entry and exit dynamics in a cross section of Finnish manufacturing industries that cover five years of panel data. They find that macroeconomic variables have significant affects on entry and to a lesser extent on exit. Further more, past entry appears significantly in the exit equation implying a significant displacement effect. Amel and Liang (1997) estimate entry and profit rate equations for local banking markets in the U.S. over a nine year period. They find that profits attract new entry and entry directly reduces profits. They do not include exits in their analysis. Employing eight years of data on Japanese manufacturing industries, Doi (1999) studies firm exits and finds that many structural factors influence exit levels. These factors include capital intensity, profits, industry growth, concentration, and R&D opportunities. He does not consider entry in his model. Lay (2001) studies the relationship between entry and exit in the manufacturing sector of Taiwan for the period 1987-1998. She argues that the effects of factors on entry and exit are not symmetric. Furthermore, she finds some evidence pointing out a displacement effect of entry, as in Ilmakunnas and Topi (1999). Roberts and Thompson (2003) study Polish 3-digit industries over a five year period. They find that structural entry barriers do not play an important role in determining gross entry and exit. Hence, their results seem to contradict Lay (2001), but seem to support replacement and to a lesser degree demonstration effects. Disney et al. (2003) examine the determinants of entry and exit in the U.K. manufacturing industry, but their focus is mostly on survival of the firms. They argue that the UK manufacturing industry exhibits entry and exit patterns that closely match those in North America and Europe.

Most of the earlier works seem to employ either a cross sectional or a pooled cross section, time series approach. However, the empirical evidence implies a dynamic inter-temporal link between entry and exit as well as between lagged values and future values of both variables (Audretsch, 1995; Johnson and Parker, 1994; Love, 1996; Fotopoulos and Spence, 1999; Ilmakunnas and Topi, 1999, Roberts and Thompson, 2003). Geroski (2001) implies the need for long run analysis in the population number of firms in industries. He criticizes the fact that the literature is dominated by cross-section analyses of the determinants of entry and exit. Mathis and Koscianski (1996) point out that focusing on an individual industry time series will eliminate the problems faced by cross-section and pooled time series cross-section models. Although, the potential of longitudinal analysis is not completely overlooked (Klepper and Graddy, 1990, Jovanovich and MacDonald, 1994, Mathis and Koscianski 1996, and Geroski and Mazzucato, 2001), the studies did not specifically focus on the long run relationship between entry and exit.

3. Data and Methodological Issues

We employ annual data that covers the period 1968-2001 and is sourced from the Statistical Indicators 1923-2002 publication of the State Institute of Statistics in Turkey. EN and EX denote number of new establishments (companies that are registered in the Turkish Trade Register) and number of liquidated establishments (companies liquidated as indicated in the Turkish Commercial Code) in the manufacturing industry. We first examine the suggested link between EN and EX via bivariate models as in equation 1, and then introduce other determinants to check the robustness of our results. The bivariate equations are as follows:

Entry/Exit = f(Exit/Entry) (1)

Studies in the literature consider a wide variety of variables in their entry and/or exit equations. These range from labor productivity (Kaya and Ucdogruk, 2002) to subcontracting ratio (Doi, 1999), from export orientation and import penetration (Fotopoulos and Spence, 1999) to standard deviation of profit margin (Roberts and Thompson, 2003), and from macroeconomic variables like real GDP (Ilmakunnas and Topi, 1999) to real capital to labor ratio (Lay, 2001). However, in our time series study we do not have many degrees of freedom to account for all of the variables considered in the literature. Furthermore, since the lagged terms of both entry and exit will also be considered, we can quickly deplete the limited degrees of freedom we have. Instead, we employ a limited number of independent variables to overcome omitted variables bias.

Fotopoulos and Spence (1999) argue that the mechanization variable fuel or electricity consumption per output may represent both capital intensity and capital requirements. Kaya and Ucdogruk (2002) utilize {(VA – payroll)/sales} as a proxy for profit margin (PM). In the absence of sales data we adopt a similar proxy {(VA-Payroll)/output}and adjust it for inflation (using wholesale price index from the State Planning Institute, DPT) to get real PM. Although concentration is an essential variable in entry and exit equations, Roberts and Thompson (2003) argue that including concentration measures along with profit margin may cause collinearity problems. Furthermore, concentration measures are not available for the Turkish manufacturing industry (at least for the entire period). Based on the arguments in the literature, we use electricity intensity (electricity consumption in manufacturing per manufacturing output) as a proxy for capital intensity (KI) –also referred to as "mechanization" in Fotopoulos and Spence (1999)- to represent entry barriers, the inflation adjusted ratio of the difference between Value Added in manufacturing and Payroll in manufacturing to the manufacturing output as a proxy for profit margin (PM) to account for real profit opportunities, and number of firms in the industry (N) as a control variable. The manufacturing output is measured via the real manufacturing GNP. We also examined the affect of the 1994 financial crisis in Turkey on entry and exit behavior, via employing a dummy variable that takes on a value of 1 after 1993 and zero otherwise. Roberts and Thompson (2003) argue that using the log of entry and exit numbers is a common practice in the literature. Note that in this study we focus on the relationship between entry and exit through time rather than the determinants. The dynamic link between entry and exit is also taken into account by allowing lagged values of both to enter each equation. The methodology allows testing for the optimal lag length; hence we consider the possibility of a relationship that lasts for more than one lag. Following Shapiro and Khemani (1987) and Roberts and Thompson (2003) one can characterize the entry/exit equation as follows:

Entry/Exit = f(Exit/Entry; Entry barriers; Current opportunities; Controls) (2)

The structural characteristics that may be considered as entry barriers include economies of scale/ minimum efficient scale (MES), product differentiation/advertising, R&D, capital intensity, concentration, and sunk costs. Current opportunities may be reflected via variables like industry growth and profitability; whereas, control variables may include industry size (reflecting changes in the number of incumbent firms), and the nature of foreign competition (Roberts and Thompson, 2003). One major problem with earlier SCP studies may be that the levels of industrial variables may not be stationary. Hence, using OLS yields spurious results. Using stationary first differences instead results in the loss of information due to differencing. However, in the Toda-Yamamoto procedure (Toda and Yamamoto, 1995) there is no loss of information and the stationarity problem is also accounted for. The methodology that we will utilize also allows us to be flexible regarding the lag lengths of the variables. Another benefit from such a methodology may be the ability to observe feedback effects between the variables. In the next section we discuss the unit root test results. Then we assess the direction of causality between entry and exit in the long run employing the Toda-Yamamoto tests in both bivariate and multivariate frameworks.

The Granger causality tests may be viewed as endogeneity tests. The results imply whether the series may be endogenous on one extreme or exogenous on the other. However, the test results do not consider how variables in general respond to innovations in other variables. In order to assess impact of a shock in one of the variables to the other we conduct *generalized* impulse response analysis developed by Koop et al. (1996) and Pesaran and Shin (1998). The generalized technique does not rely on Choleski decomposition and is not sensitive to the ordering of variables in the underlying VAR.

4. Empirical Results

4.1 Unit Root Tests

The traditional Granger causality tests are sensitive to the stationarity of the series. Hence, we employed augmented Dickey-Fuller (1979) (ADF), Phillips-Perron (1988) (PP), Kwiatkowski, Phillips, Schmidt, and Shin (1992) (KPSS), Elliot, Rothenberg, and Stock's (1996) GLS-detrended Dickey-Fuller (DF-GLS), and Ng and Perron (NP) (2001)[1] unit root tests to examine the stationarity properties of the variables. To be able to assess the robustness of our results in this paper we examine both the level and the logged variables for existence of unit roots. The results of the unit root tests are reported in Table 1.

(Table 1 about here)

When we examine the unit root test results, although there are slight discrepancies among alternative unit root test results, an important outcome emerges that holds for all variables including entry and exit. All series seem to contain at least one unit root. Hence, OLS regressions employing the levels of these variables will yield spurious results and the test statistics will not be valid. Note also that the highest order of integration is 1, implying that the series become stationary after first differencing. Since all series are I(1), the well known Johansen-Juselius cointegration test is applicable. However, TY procedure for long run Granger causality does not need information on whether cointegration exists or not. Hence, the TY procedure avoids pre-test biases that may be introduced by cointegration tests. Furthermore, in TY no information loss occurs, since levels and not the first differences are used.

4.2 Granger Causality Results

Sims et al. (1990) show that when the variables are integrated inferences based on level VARs are not valid since the test statistics do not follow standard distributions. Toda and Yamamoto (1995) show that the modified Wald test to test restrictions on the parameters of the VAR(q) model follows an asymptotic Chi-square distribution with k degrees of freedom ($\chi^2(q)$). Furthermore the procedure does not require pre-testing for cointegration and that can be applied when variables are integrated of different orders (Zapata and Rambaldi, 1997). Therefore, we employ the TY procedure to conduct the Granger causality tests.

We first conduct unit root tests to find orders of integration of all variables (p = maximum order of integration). Then we determine optimum lag length q of VAR via some criteria and estimate VAR(q+p) in levels. We conduct diagnostic tests to check robustness of VAR equations. If there are no problems we utilize a modified Wald test on the first q parameters of the other variable in the VAR(q+p). If significant, we reject the null of non-causality. Note that the TY results show only long run causal relation since all variables are in levels (and there is no error correction term in the model). According to the results in Table 1, we have determined the maximum order of integration (p) to be 1. In determining the optimum lag length for the VAR we employ 5 different criteria, the final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan-Quinn (HQ), and sequential likelihood ratio (LR). When we consider the bivariate case (only EN and EX enter the VAR) restricting the maximum lag to 3, all criteria indicate a lag length of 1. Hence, we determine the optimum lag

[1] See Maddala and Kim (1998) for an excellent treatment of ADF, PP, KPSS, and DF-GLS; and Ng and Perron (2001) for NP.

length to be 1. Similarly VAR all criteria (except AIC pointing out 3) show that a lag length of one is optimal for the multivariate case. Both the bivariate and multivariate VAR(2)s satisfy the stability condition in that all roots are within the unit circle. Furthermore, there is no evidence of autocorrelation in both VARs. Diagnostic test results for both the bivariate and multivariate equations do not appear to indicate serious violations of the common assumptions (available upon request). Since diagnostic test results do not seem to be pointing out serious violations of the common assumptions we can proceed to the Granger causality tests. Table 2 summarizes the Granger causality test results.

(Table 2 about here)

The Wald statistics suggest that exit Granger causes entry. The results from the multivariate analyses confirm the unidirectional causality running from exit to entry in the Turkish manufacturing industry. However, this result does not comply with the replacement effect discussed in Roberts and Thompson (2003). The reason is that both in the bivariate and multivariate cases the impact of exit on entry is negative[2]. Hence, in the long run exit appears to negatively influence entry. This result also contradicts Love (1996) findings of a positive impact of entry/exit on exit/entry, and displacement effect found in Ilmakunnas and Topi (1999) and Lay (2001). Furthermore none of the other variables (KI, PM, and N) employed in our study appear to significantly influence entry or exit in the long run. This seems to be in line with Roberts and Thompson (2003) findings that structural factors do not influence gross entry and exit. Keeping in mind that the variables used in our study may be imperfect proxies, it seems that entrants do not rely on observed need for investment, profitability, and total number of firms in the industry in making their long run decisions on whether to enter or not. Instead, they seem to be put off by increased exit from the industry in the previous year.

4.3 Generalized Impulse Responses

This analysis requires all variables in the VAR to be stationary; therefore we take the first differences of entry and exit. Hence, we investigate how the shocks in the changes of a variable influence the changes in the other variable. In the light of the Granger causality results, we do not consider other variables in this analysis. The generalized impulse responses of entry and exit to a shock in themselves and to each other are shown in Figure 1.

(Figure 1 about here)

As it can be seen from Figure 1, a one standard deviation shock in a variable causes a positive response in the variable itself. The impact of an innovation in entry on exit is not significant over any horizon. However, an exit shock appears to have a slightly significant negative impact on entry over the second period. Hence, the generalized impulse responses confirm the Granger causality results.

5. Conclusions and Implications for Further Research

In this study we examine the inter-temporal link between entry and exit in Turkish manufacturing industry, employing aggregate time series data. The findings in this paper imply that in the long run exit Granger causes entry and not vice versa. Therefore, including exit in forecasting models would improve the forecasts of new firm entry into the Turkish manufacturing industry. However, this does not provide support for the replacement effect as it might have seemed, since lagged exit negatively affects entry. One may argue that in the long run entrants view increased exit in the previous period as a more reliable indicator of risk than the profit margins and the extent of mechanization in the industry. The total number of firms in

[2] All VAR results are available upon request.

the industry also does not seem to have an affect on the entry/exit decisions. The generalized impulse responses seem to provide further support for the negative impact of past exit on entry.

There may be several reasons why our results do not exactly comply with other empirical studies. First of all, Turkey is a developing country and dynamics of entry and exit in her manufacturing sector may show different time dependencies than the ones in other countries. Secondly, since we employ aggregate entry and exit data for the entire manufacturing industry, the dynamics of entry and exit may differ from more specifically defined industries. Whether the negative effect of past exit on entry holds for more specifically defined industries in Turkey or not needs to be studied further. Furthermore, to the extent of our knowledge, there is no theoretical work in which negative effect of exit on entry is allowed, and therefore our results may be pointing out a need for further theoretical study as well. Thirdly, most of the empirical studies employ panel data that do not cover long periods of time. Our results may be suggesting a need to study the entry and exit dynamics over longer periods while considering longer lags of all variables in concern, since the entry and exit dynamics in an industry may be driven by the explanatory variables through longer periods of time. Fourthly, to the extent of our knowledge there are no studies that investigate the Granger causality relationship between entry and exit in a time series framework. Our study seems to be augmenting the literature in that respect.

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Table 1. Unit root test results

PANEL A		LEVELS				
		ADF	DF-GLS	PP	KPSS	NP (MZ_{α})
Intercept	EN	2.194848 (6)	-1.009268 (7)	-1.491785	0.557072[b]	-8.70623[b] (7)
	EX	-0.415299 (0)	-0.738953 (0)	-0.262436	0.192027	-2.67046 (0)
	N	-1.823639 (0)	-0.631790 (0)	-2.052686	0.738949[b]	-0.23774 (0)
	KI	-0.864223 (0)	0.513763 (0)	-0.856618	0.660145[b]	1.44658 (0)
	PM	-0.969320 (0)	-0.835442 (0)	-0.932652	0.556820[b]	-1.53744 (0)
Intercept and trend	EN	-0.044055 (6)	-1.648472 (7)	-2.031653	0.099051	-3.30435 (7)
	EX	-0.553047 (0)	-1.101894 (0)	-0.553047	0.158529[b]	-3.72065 (0)
	N	-2.903141 (0)	-2.794273 (0)	-2.830568	0.163612[b]	-9.84595 (0)
	KI	-2.148304 (0)	-2.106423 (0)	-2.080722	0.156825[b]	-6.68887 (0)
	PM	-2.288251 (0)	-2.183442 (0)	-2.187486	0.126103[c]	-6.91519 (0)
PANEL B		FIRST DIFFERENCES				
		ADF	DF-GLS	PP	KPSS	NP (MZ_{α})
Intercept	EN	-1.939678 (6)	-1.602526 (6)	-4.370045[a]	0.093763	-16.9522[a] (6)
	EX	-5.980385[a] (0)	-6.052491[a] (0)	-5.980849[a]	0.448404[c]	-18.3562[a] (0)
	N	-7.010977[a] (0)	-7.062929[a] (0)	-7.664012[a]	0.321845	-18.8550[a] (0)
	KI	-5.765579[a] (0)	-5.860174[a] (0)	-5.938417[a]	0.163437	-17.4340[a] (0)
	PM	-5.860581[a] (0)	-5.237205[a] (0)	-6.027058[a]	0.197268	-14.0613[a] (0)
Intercept and trend	EN	-6.300654[a] (5)	-1.536542 (6)	-4.320100[a]	0.092927	-38.3455[a] (6)
	EX	-6.645219[a] (0)	-6.847015[a] (0)	-6.645219[a]	0.115114	-16.0501[c] (0)
	N	-7.171557[a] (0)	-7.313716[a] (0)	-11.95498[a]	0.273507[a]	-15.5024[c] (0)
	KI	-5.696483[a] (0)	-5.791479[a] (0)	-6.122491[a]	0.163271[b]	-16.2244[c] (0)
	PM	-5.714605[a] (0)	-5.815606[a] (0)	-5.834076[a]	0.196871[b]	-15.9545[c] (0)

[*]Entries are test statistics. Lag lengths are determined via SIC and are in parentheses. Superscripts a, b, and c represent significance at the 1, 5 and 10% respectively. Panels A, B, and C refer to the levels, first and second differences of the series respectively. Based on panels A and B, the integration of only EX and PM seem to be above 1, hence the second differences of only two variables are checked for stationarity in panel C.

Table 2. Granger causality results

	Equation	Wald statistics	Hypothesis
Bivariate	EN (2)	3.418886[c]	EX does not Granger cause EN
	EX (2)	0.053475	EN does not Granger cause EX
Multivariate	EN (2)	3.243101[c]	EX does not Granger cause EN
	EX (2)	0.133117	EN does not Granger cause EX

*Lag lengths (q+p) are in parentheses. Superscript b represents significance at 5%

Figure 1. Generalized Impulse Response Graphs