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WHY ARE THERE MERGER WAVES?

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Abstract

This paper develops a model of the timing of merger waves based on the investment opportunity synergy (IOS) hypothesis. The model reveals some important weaknesses on the presumed implications of IOS and suggests that changes in the institutional framework may be responsible for the long-term changes in merger activity. The analysis of FTC "Large Firm" Merger and Acquisitions time series gives additional support to these conclusions.

Key Words
Merger waves, Investment opportunity synergy hypothesis.

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Comments welcome.

1. INTRODUCTION.

Merger activity fluctuates along the business cycle. The empirical evidence shows that both the number of mergers and the volume of assets merged are positively related to the rate of growth of GDP and negatively related to the interest rate. There is also some less conclusive evidence pointing to a positive relationship between merger activity and risk. Weston, Chung and Hoag (1990) review the empirical evidence on the determinants of aggregate merger activity.

The purpose of this paper is to examine several competing explanations of these facts. Specifically, we develop a model of the timing of mergers and consider various alternative explanations of merger waves in this framework. Our main insight is that financial variables alone might be insufficient to explain the occurrence of merger waves. Alternatively, institutional changes described in the managerial literature may be largely responsible for the observed behavior of merger activity.

This paper also examines the empirical evidence. Financial theories of merger waves imply a merger cycle of about four years, similar to the length of the business cycle. Institutionalist arguments imply a much larger and not necessarily regular period. Econometric analysis of the Large Merger Series of the FTC revels an average period of 17 years. This provides further support to the institutional or managerial view.

We have identified four different arguments relating merger activity to macroeconomic conditions: the investment opportunity synergy hypothesis, the cost of financing hypothesis, the bargain hypothesis and the institutional change hypothesis. The first and the second are roughly consistent with the available empirical evidence on U.S. financial markets; the third is contrary to it; and the last one is based on case-studies of changes in legal regulations and market conditions.

None of these theories is based on a formal explicit model, making it difficult to compare each other. The main task of this research has been to develop a model of the leading financial explanation, namely, the investment opportunity synergy hypothesis. This allows us to develop some arguments on the implications and explanatory power of this theory.

There are at least two reasons why a deeper understanding of the economic forces that produce merger waves is desirable. First, this is a necessary step in the development of forecasts of merger activity. Second, examination of aggregated merger series provides a test-bank for the (challenged) hypothesis of financial markets efficiency and, particularly, it may shed some light on the often debated question of whether mergers are generally efficient or not. A detailed consideration of these issues, with an analysis of the FTC "Large Firm" Merger time series, will be delayed until sections 4 and 5. First, in section 2, we survey the literature on merger waves, and we introduce the model in section 3. Some conclusions are given in section 6.

2. THEORIES AND EVIDENCE.

An extended survey of the theories and evidence on merger waves can be found in Weston et al. (1990)[1]. We shall concentrate on the stylized facts only. Merger activity is measured in two alternative ways: as the total number of mergers recorded or as the volume of assets merged during one year or during one quarter. In any case, merger activity series cover long periods of time (typically 30 years and more) so that the word "wave" refers in this context to changes in merger activity lasting for relatively long periods of time.

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[1] Another illuminating survey on mergers can also be found in Scherer and Ross (1987).

The stylized facts on the relationship between merger activity and macroeconomic and financial conditions in the U.S. market are the following:

- First, increases in stock prices are positively related to merger activity.
- Second, mergers are negatively related to increases in bond yields and real interest rates.
- Third, there is a positive relationship between the rate of growth of GNP and merger activity.
- Fourth, merger activity is positively related to default risks as measured by the difference between the yields on long-term corporate BAA and AAA bonds.
- And fifth, there is a positive relationship between merger activity and the tightness of external fund availability defined as the spread between short-term and long-term interest rates.

In the absence of a theory no causal relationship can be identified in these empirical findings. In summary, mergers are found to be procyclical.

It is also important to note that, apparently, acquiring firms rely heavily on borrowed funds, although we are unaware of any estimate of the proportion of mergers financed in this way. We have identified up to four explanations of all or part of this evidence. We consider each in turn.

2.1. The investment opportunity synergy hypothesis (IOS).

Roughly the IOS hypothesis considers mergers just as another form of investment. Thus any factor influencing investment will also change merger activity in the same direction. Bittlingmayer (1987) explores in depth this idea and finds a positive relationship between mergers and general investment spending for both the U.S. and the German economies. In this view mergers will occur if the expected benefits

from the merger are expected to be greater than its cost. Economic conditions may affect the benefits to mergers.

The main testable implications of the IOS hypothesis relate to interest rates and GDP growth. First, interest rates are negatively related to investment because higher interest rates increase the opportunity cost of the funds invested. Hence also merger activity should be inversely related to the interest rate. Second, if increases in the rate of growth of the economy reflect improved investment opportunities, then merger activity should be procyclical. On the other hand, the hypothesis does not bear any direct implication on the default risk and the short to long term interest rate spread although both variables are included in the empirical study.

Chung (1982) develops a regression model along these lines. The signs of the coefficients of the interest rate and GDP growth are as expected. Defaults risks and interest rates spreads are also included in the regression and are also found to have significant coefficients. However the structure of the model[2] makes it impossible to make any inference on the order of magnitude of the effects, i.e., only the sign but not the value of the coefficients can be interpreted.

In our view this is a reasonable explanation of merger waves. The question, however, is whether the magnitude of these "investment effects" is large enough to explain actual merger waves.

2.2. The cost of financing hypothesis (COF).

According to Melicher, Ledolter and D'Antonio (1983) acquiring firms rely heavily on borrowed funds. Thus, the cost of these funds, measured by the interest rate must affect merger activity.

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[2] All explanatory variables are the sum of current and two lagged values.

Golbe and White (1987) test this hypothesis in a regression model together with other variables and find that the coefficient of the real interest rate is not statistically significant in their model. This evidence, however, is far from conclusive since the tested model includes other ad hoc variables. Other measure of the cost of financing, the bond yield considered by Chung (1982), yields a significant coefficient with the expected sign.

The basic idea underlying COF is similar to IOS. However, here the emphasis is on how mergers are financed while IOS focus on how investing in acquiring a firm compares to other investment alternatives[3]. Thus, a profitable merger under the IOS hypothesis may not be realized if it has to be financed with debt. IOS and COF can be considered complementary explanations of merger activity.

2.3. The bargains hypothesis.

Golbe and White (1987) test the following "bargains" hypothesis: it is more likely to buy a firm if its price is low; thus, in times of relatively low stock prices, mergers will be more common. They test this hypothesis using Tobin's "q" as an explanatory variable of merger activity in a regression model and find a significant coefficient. However, the coefficient has a positive sign. So the data rejects the hypothesis.

This finding is hardly surprising. While cheaper firms may be more attractive to buyers, it is likely that a low price also reflects a small willingness of investors to pay for the firm. In other words, firm's stock valuations are as much a consequence as a cause of stock purchasing decisions.

2.4. The Institutional Change Hypothesis (IC).

[3] The lack of an explicit model makes it difficult to compare the hypothesis.

Finally, the fourth explanation of merger waves relates uprising in merger activity to changes in both market conditions and the regulatory framework and, specifically, to changes in antitrust policies. Shleifer and Vishny (1991) review the evidence on the two merger waves of the 60's and the 80's.

They argue that the wave of the 60's may be the consequence of managerial discretion joined to a tight antitrust policy. Conglomerate mergers were common during this period and, the evidence suggest, not particularly successful. Many of the conglomerates created during the 60's were later destroyed and the profitability of the acquired firms did not improve on average.

On the other hand, the 80's merger wave evolved after a turn in the antitrust policy, allowing related mergers to take place much more easily. In the 80's competitive conditions were harsher forcing firms to adopt restructuring plans and to specialize. In this context, mergers were typically among related firms and were followed by restructuring and divestiture. There is still little evidence on the ex-post performance of the 80's takeovers.

Shleifer and Vishny interpret these two waves as consequences of their respective institutional frameworks, suggesting that the merger wave of the 60's was probably inefficient for the economy as a whole despite the favorable stock price reaction to takeover announcements; the 80's takeover wave is interpreted, on the other hand, was an organizational adjustment during a severe crisis of american industry.

In this view, the correlation between mergers and macroeconomic and financial variables might be simply spurious.

2.5. Overview of the rest of the paper.

From this quick review of the literature we conclude that there are two main competing explanations of merger waves. One is the IOS hypothesis (into which the

COF hypothesis can be easily incorporated). The other is the IC hypothesis which focus on non-financial qualitative change.

Our objective is to compare these two alternatives. In order to do so we develop an explicit model of the merger-as-an-investment framework and ask whether in this framework, merger waves are likely to occur. We find that, while not impossible, large merger waves are unlikely to occur in this framework. This gives some additional support to the IC hypothesis as the leading explanation of procyclical merger activity.

3. A MODEL OF THE IOS HYPOTHESIS.

Our strategy in building the model is to define first profits for each of the firms involved as a function of the relevant exogenous variables suggested in the literature (financial structure and underlying economic conditions). Next, we define the value of a merger as the difference between the expected profits of the merged firm and those of the original firms. Finally, the effect of exogenous changes on the value of the merger is analyzed.

3.1. The basic model.

Consider two firms labelled 1 and 2 respectively. At time t firm i has assets valued at T_i dollars. Own resources amount to F_i and debt equals D_i.

The relationship $T_i = F_i + D_i$ holds and T_i will be occasionally regarded as the size of firm i. $e_i = D_i / T_i$ is the debt ratio. The cash-flow of firm i is a random variable x with mean $T_i\mu$ and variance $T_i \sigma^2$.

$F[(x - \mu T_i) / \sigma\sqrt{T_i}]$ is the c.d.f. of x. Debt has to be repaid after one period and is contracted at an interest rate r. One period expected profits are:

$$B(D_i,T_i,\mu,\sigma^2) = \int \max [0,x - (1+r)D_i] \, d\, F[(x-\mu T_i) / \sigma\sqrt{T_i}] \qquad (1)$$

The parameters (μ, σ^2,r) change over time μ, the average return per dollar invested measures investment opportunities and can be interpreted as can be proxies by the overall state of the economy measured as (one plus) the rate of growth of GDP. It is larger when the economy is growing and smaller during recessions. σ^2 measures economic risk. The interest rate r depends on μ,σ^2, and monetary policies.

In order to keep the model tractable it is assumed that the probability distribution of μ and σ^2 at time t, $H(\mu,\sigma^2)$, does not depend on past values of μ and σ^2. The interest rate is assumed to be a (deterministic) function of μ and σ^2. This is a simplifying assumption but it is also a convenient one. It assures that market values cannot be improved on the basis of current information. Thus, the assumption is consistent with market efficiency.

Let A_i be the average value of firm i over all the possible states of the economy (μ,σ^2), given its size T_i and assuming that all debt is repaid at the end of the period.

Since we assume that current values of μ and σ are time independent, the value of the firm is also time independent.

A_i is the sum of the expected future profits of the firm discounted by a factor p. Market instability may affect mergers since greater risks of bankruptcy can be partly compensated by means of risk-pooling through a merger.

Let V_i (D_i,T_i, μ,σ^2) be the value of firm i when the state of the economy is (μ,σ). We assume the value of a firm after bankruptcy to be equal to zero. Then the value of the firm equals expected one-period profits plus the discounted average value A_i corrected by the probability that the firm will not default:

$$V_i(D_i,T_i,\mu,\sigma^2) = B(D_i,T_i,\mu,\sigma^2) + p\,A_i[1-F[[(1+r)\,D_i-\mu\,T_i] / \sigma\sqrt{T_i}]] \quad (2)$$

If firms 1 and 2 merge, the resulting firm, labelled 0, will have assets $T_0 = T_1+T_2$, debt $D_0 = D_1+D_2$, and an average value A_0 which is exogenously given[4]. Cashflow follows the same distribution F with parameters μT_0 and $\sigma^2 T_0$. One period profits and the value of the merged firm are defined as before. Also, it is natural to assume that $A_0 > A_1+A_2$ since otherwise the merger is not profitable in the long-run.

In this context the value of a merger depends on the current state of the economy. Specifically, we define the value of the merger as:

$$M = V_0(D_0,T_0,\mu,\sigma^2) - V_1(D_1,T_1,\mu,\sigma^2) - V_2(D_2,T_2,\mu,\sigma^2) \quad (3)$$

The IOS hypothesis can now be formally stated: the merger will take place whenever $M > 0$. Since M depends on the state of the economy and the financial structure of the merging firms, mergers will tend to occur more often, at an aggregate level, in those states and debt levels in which M is larger. Thus, increases in M can be related to an overall increase in merger activity. Notice that, in this framework, mergers are viewed as an investment decision, i.e., this model captures the basic notion of IOS hypothesis.

The expression for M can be simplified, after integrating by parts each of the three integrals, to obtain:

$$M = (A_0q_0 - A_1q_1 - A_2q_2) + \sigma(S_0-S_1-S_2) \quad (4)$$

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[4] The value of A_0 is taken to be exogenous since, otherwise, one particular theory of merger decisions would have to be assumed. Our objective is to keep the model open to alternative theories of the merger decision.

Where

$$q_i = 1\text{-}F\left[\left((1+r)e_i\text{-}\mu\right)\sqrt{T_i} / \sigma\right]$$

and

$$S_i = \sqrt{T_i}\int_{-\infty}^{\left[(1+r)e_i-\mu\right]\sqrt{T_i}/\sigma} F(y)\,dy$$

By definition, q_i is the probability of survival of firm i, i.e, it is the probability that firm i will be able to repay its debt. Hence $(p.q_i.A_i)$ is the discounted expected value of the firm next period and σS_i is a measure of the value of limited responsibility for each firm. It is the expected loss transferred to third parties (bond holders and other firm's suppliers) conditional on the firm not being able to repay its debt. In other words, σS_i is the expected loss of the creditors of the firms in case of bankruptcy. The value of the merger depends on these two factors. We define

$$M_p = p\,(A_0q_0 - A_1q_1 - A_2q_2) \qquad (5)$$

as the value of risk pooling generated by a merger. It measures the value of reducing the probability of bankruptcy by means of a merger. We also define

$$M_T = \sigma(S_0\text{-}S_1\text{-}S_2) \qquad (6)$$

as the value of the change in the risk transfer to third parties generated by a merger. Notice that $M = M_p + M_T$.

Intuitively one would expect the value of risk pooling to be positive since the probability of bankruptcy is smaller for larger firms. On the other hand, M_T should be negative since the transfer of losses to third parties occurs only in case of bankruptcy which, as noted before, is smaller for larger firms.

3.2. Comparative statics.

Let's consider now the effect of changes in the underlying economic conditions on the value of a merger. It is instructive to consider M_T and M_p separately. The value of the risk transfer reacts to changes in economic conditions as follows.

PROPOSITION 1. Suppose $\mu > (1+r)e_i$ (the expected return on investment is enough to repay the outstanding debt). Then M_T is procyclical[5], i.e., it is increasing in μ and decreasing in r.

PROOF: Taking derivatives it follows that:

$$d M_T/d\mu = T_1 [q_0-q_1] + T_2[q_0-q_2] >= 0 \quad (7)$$

and

$$d M_T/dr = D_1 [q_1-q_0] + D_2[q_2-q_0] <= 0 \quad (8)$$

Notice that the assumption is innocuous.

What this proposition says is that the "immediate" effect of better expected returns on investment (larger μ) or cheaper capital (lower r) is to make more attractive any merger, the reason being that it becomes less likely that the non-merged firms will default. This is not the whole story since there is another effect, M_p, related to future profits. But, at least in the extreme case of a totally myopic firm (p=0), proposition 1 shows a procyclical tendency in our model of merger.

It can also be seen that the effect of changes in risk, σ are indeterminate and that larger debt ratios decrease the value of M_T.

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[5] It can also be shown that $dM_T / de_i < 0$

Let's turn now our attention to the value of risk pooling, M_p. Notice that the long-run values A_i of the firms appear in its definition. Thus, it may be expected that the effect of changes in the parameters will depend on A_i. As a consequence there is no general rule to be learnt from the comparative static of M_p. Consider, for instance, a change in the return on investment:

$$d\, M_p/d\mu = P[f_0 A_0 \sqrt{T_0} - f_1 A_1 \sqrt{T_1} - f_2 A_2 \sqrt{T_2}] \,/\sigma \qquad (9)$$

Where f_i is the density of F valued at $((1+r)e_i-\mu)\sqrt{T_i}\,/\sigma$

The sign of this expression depends on both, the relative values of A_i and the relative values of f_i[6]. Thus, we conclude that a procyclical merger activity is not a necessary logical implication of IOS. On the other hand, IOS may be true since it may be the case that M_T dominates M_p or the latter may be procyclical itself.

4. THE ROLE OF DEFAULT RISKS.

The results presented in the last section clearly imply that the validity of IOS is an empirical question. Some empirical estimates are roughly consistent with the IOS hypothesis. So one may feel inclined to accept it, at least as an explanation of past events. The lack of determined implications of IOS, however, prevents its use as the basis of a forecast of future merger waves. Changes in the structural parameters of the model may result in anticyclical merger waves within the IOS framework.

In any case, it is possible to push the argument a little bit further. After all, empirical tests of IOS do not take into account other competing theories, namely,

[6] For instance, if f is the Normal density and $A_0=A_1+A_2$ then M_p can be shown to be countercyclical while if A_0 is large enough relative to (A_1+A_2) then M_p can be shown to be procyclical.

the IC hypothesis. Since misspecified models may yield erroneous estimates, the empirical evidence may not be conclusive.

To evaluate the likelihood of IOS it is useful to examine the reasons why, in the model of section 3, the value of a merger is affected by the economic cycle. It can be seen that all changes occur via the distribution of F which measures the probability of default when it is evaluated at $[((1+r)e_i-\mu)\sqrt{T_i}/\sigma]$. More specifically we have the following:

PROPOSITION 3:Suppose that the probability of default during the current period is zero (i.e., $q_0=q_1=q_2=1$). Then the value of a merger is independent of current market conditions and, in particular, it is neither pro - or countercyclical.

PROOF:Simply notice that, under the assumption, $M= p(A_0-A_1-A_2)$.

According to the proposition, merger waves under the IOS hypothesis would result from transfers, both intertemporal and among economic agents, of bankruptcy risks. In the absence of these risks, the value of a merger is time-independent. Our point is that a theory of merger waves based exclusively on default risks is not plausible. While the effects identified both in the model and in the empirical analysis probably exist, we find it unlikely that the magnitude of these effects be significant enough to be responsible for merger waves.

5. THE LENGTH OF THE CYCLE

Finally, we address the empirical question. IOS implies that merger waves must be coupled to the business cycle, thus showing a periodicity of four to five years. On the other hand, the length of cycles under the IC hypothesis can be expected to be much larger. To confront both theories we estimate a simple time series model of merger activity in the U.S. and examine the length of the cycle.

Specifically, we consider the FTC "Large Firm" series. The U.S. Federal trade Commission (FTC) collected and published data on mergers in the manufacturing and mining sectors of the U.S. economy and the resulting data base is generally considered a basic source for research in merger activity. We use the "Large Firm" series which contains annual data for the number of mergers in which the acquired firm had at least $10 million in assets (book value) and for which information on the acquisition was publicly available (see Golbe and White (1987) for details). The sample is annual data for the years 1948-79[7].

As a first check we test the hypothesis of a unit root by means of several test. The importance of this is that if we reject the unit root, then the series is stationary which supports the use of standard statistics in our empirical model. We test the hypothesis of a unit root by means of the Said and Dickey (1984) Augmented Dickey-Fuller statistic, the Park and Choi (1988) G(p,q) and J(p,q) statistics and the Phillips (1987) Z_α and Z_t statistics. It is worth noting that in spite of the relatively small sample we use, it is known from the work of Perron (1991) that it is the span of data rather than the frequency of sampling which matters in estimating and testing the means of unit-root type models. In all cases, at reasonable significance levels, the tests rejects nonstationarity[8].

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[7] The optimal Box-Cox transformation was estimated by maximum likelihood. The estimated parameter lambda was 1.00065 (t-value: 16.23). Therefore no transformation seems to be needed for this data. Melicher et al. (1983) used logarithmic transformations for their quarterly data, but they did not estimate the optimal Box-Cox transformation.

[8] We used many different possibilities, changing the order of the time polynomial in the null hypothesis and the number of lagged first difference terms in the fitted regression in the ADF test, we tried several kernals in the G(p,q) statistic, various orders of the time polynomial in the null hypothesis and in the order of the time polynomial in the fitted regression in the J(p,q) statistic, and different kernals and polynomial orders in Z_α and Z_t statistics. Detailed results are available on request from the authors. All the empirical work was carried out in GAUSS.

After the usual identification process, we decided to estimate an AR(2) model using White's (1980) heteroscedastic-consistent covariance matrix. The results are in Table 1. Is interesting to note that the roots of the characteristic equation

$$1 - 1.1884B + 0.4048B^2 = 0$$

are complex, so that pseudo-periodic behavior which may be observed on the series is to be expected. The period is about 17 years. This period may be interpreted as the "mean wave length" in the merger activity in the US. Therefore, after the merger wave in the late 1960s a new wave in the mid to late 1980s should not be very surprising. Thus, the merger wave of the 1980s is not a completely new phenomenon. Our simple model predicts this wave.

There are two implications of these findings. First, our proposed test of the theory supports both the existence of merger waves and the IC Hypothesis and, thus, it contradicts the IOS Hypothesis. Notice, however, that an exact regularity is not required by the IC theory. Indeed, institutional changes may occur randomly or may be due to extra-economical reasons.

The second implication is that, in previous empirical results, there is probably a missing variable. Long run changes, like a 17 year period, in merger activity are not likely to be captured by interest rates or GDP growth rates.

6. CONCLUSIONS.

The main contribution of this paper is that it provides a formal model of the main hypothesis on the nature of merger waves found in the financial literature. Examination of the hypothesis under this light reveals some important weaknesses on the presumed implications of IOS.

In our view, qualitative changes in the institutional framework are largely responsible for the long-term changes in merger activity. Financial variables alone are unlikely to produce large merger waves even if smaller, more subtle movements, are influenced by this type of variables.

This conclusion may be criticized on the basis of the model not being able to capture some relevant aspect (unknown to us) of merger activity. Admittedly, the dynamic structure of the model is exceedingly simple. However, the model is sophisticated enough to highlight that: i) merger waves are not a necessary consequence of the IOS hypothesis; and ii) the magnitude of the intertemporal financial effects on the value of a merger may not be sufficient to explain merger waves. Furthermore, we have found some empirical evidence supporting these two claims.

The implications of this paper are the following. First, future empirical research should incorporate qualitative institutional changes into the models. Second, doubts risen in the managerial literature on the efficiency of mergers have some further support form the arguments developed in this paper. And third, it is important for future research on merger waves to explicitly specify the underlying theory being tested.

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Table 1

Estimates for AR(2) model on FTC "Large Firm" series 1948-1979

	Coefficient	Std. Error	t-Stat	P-value
Constant	16.248	5.5915	2.9080	0.0253
X(-1)	1.1884	0.1852	6.3030	0.0000
X(-2)	-0.4048	0.1829	-2.4308	0.0261

White's Robust covariance matrix.

$R^2 = 0.77$

Q_{lb} (5,10) = 2.01, 4.22

Roots of AR(2) polynomial (real) [1.39, 1.39] (imaginary) [0.68, -0.68]

Period = 17.1 Years