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Corporate Distress and Restructuring with Macroeconomic Fluctuations: The Cases of GM and Ford[1]

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Abstract. Traditional methods for evaluating corporate credit risk rarely consider the impact of the macro economy on corporate value and performance. We argue that lenders and management can obtain valuable information about the need for and approach to restructuring by decomposing default predictions into "intrinsic" and macroeconomic factors. We apply a method previously used for measuring macroeconomic exposures on default predictions in order to filter out macroeconomic factors. In this paper the method is applied on an analysis of the Z-scores for GM and Ford for the period 1996-2005. The macro economy has affected the two firms in different ways with implications for managements' and creditors' approaches to restoring their financial health.

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Corporate Distress and Restructuring with Macroeconomic Fluctuations: The Cases of GM and Ford

1. Introduction

The Basel Capital Accord of 2004 has focused attention on credit risk evaluation based on quantitative models for credit scoring and estimation of the probability of default for firms. Banking crises in a number of countries during the 1990s triggered research on the role of the macroeconomic environment in corporate defaults. Since macroeconomic effects on firms' cash flows as well as values are uncontroversial, it can be expected that macroeconomic fluctuations affect the probability that a particular firm will default in the near future. Furthermore, it is well known that default rates fluctuate with the business cycle.[2]

Although it is accepted that the macro-economy affect default rates and the degree to which credit risk can be diversified, it does not follow that default prediction models on the firm level and credit risk-scoring models will be improved by inclusion of macroeconomic factors.[3] Several of the most used default prediction models reviewed below employ factors that themselves depend on macroeconomic conditions along with firm and industry specific conditions[4]. There is little doubt, however, that predictions of the default rate in an industry or the economy as a whole can be improved by inclusion of macroeconomic factors.

One difficulty in using macroeconomic factors for predictive purposes on the firm level is that firms differ greatly in their sensitivities to macroeconomic events both in terms of type of events they are sensitive to, and in terms of strength. There is not yet

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[2] See, for eample, J. Jonsson and M. Friden "Forecasting Default Rates on High-yield Bonds", *Journal of Fixed Income*, June, (1996), pp. 690-77, S. Chava and R. Jarrow, "Bankruptcy Prediction with Industry Effects", *Review of Finance* 8 (2004), pp. 537-569 and D. Duffie, L. Saita and K. Wong, "Multiperiod Corporate Default Prediction with Stochastic Converters, *Working paper*, Stanford University (2005). E. I. Altman, B. Brady, A. Resti and A. Sironi, "The Link Between Default and Recovery Rates – Theory, Empirical Evidence and Implications" , ISDA Website (2002), NYU Working Paper # S-03-4 (2003) and *Journal of Business* 78, (2005), pp. 2203-2227 find a negative correlation between the business cycle and default rates, as well as between the business cycle and loss given default.

[3] See L. Allen and A. Saunders, "Incorporating Systematic Influences into Risk Measurements: A Survey of the Literature", *Journal of Financial Services Research*,, (2004) for a review of models of credit risk and systemic effects.

[4] See e.g. S. Nandi, "Valuation Models for Default-risky Securities: An Overview*", Federal Reserve Bank of Atlanta Economic Review*, Fourth Quarter (1998), pp. 22-35 and M. Crouhy, D. Galai and M. Robert, "A Comparative Analysis of the Current Credit Models", *Journal of Banking and Finance*, 24 (2000), pp. 59-117 for a review.

much analysis of whether the most widely used default prediction models like Altman's Z-score models, and the KMV-model based on option pricing theory, would improve by inclusion of independent macroeconomic factors. The relevant macroeconomic factors would most likely vary across firms or, at a minimum the weights of different factors would be firm-specific.

In this paper we take a commonly used default prediction model and ask whether and how the firm-specific scores produced by the model can be decomposed into components explained by macroeconomic factors, and components capturing "intrinsic factors". By intrinsic we mean that the factors reflect firms' inherent competitiveness based on firms-and industry specific conditions. The objective of the decomposition is to provide information to a lender or corporate management about the relative weights of macro-economic and intrinsic factors in the default prediction. This information could be useful for management considering different strategies for restructuring, as well as for creditors trying to evaluate the long-term viability of the firm's operations. We argue that if distress is caused primarily by macroeconomic factors, a firm's intrinsic capacity to survive in the market place in the longer term is high in most cases and restructuring should enhance the value of existing operations. On the other hand, if macroeconomic factors do not play a strong role the appropriate response to distress may be more radical transformation or shutting down of operations.

The idea of decomposing proxies for default risk has been pursued by Pesaran et al. focusing on measures of probability of default.[5] Dufresne et al. explain credit spreads incorporating macroeconomic variables.[6] There is also a literature incorporating macroeconomic state variables in dynamic stochastic models of yields, spreads and the term structure. Yang in 2003 and D'Amato and Luisi in 2006 examine how aggregate output and inflation affect the term structure of credit spreads.[7]

We suggest an approach to decomposition of default predictions based only on observable price variables. These variables are easily observed and they signal or reveal

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[5] See M.H. Pesaran, T. Schuermann, B.J. Treutler and S. Weisner, "Global Business Cycles and Credit Risk", in M. Carey and R.M. Stultz (eds.), *The Risk of Financial Institutions* (Chicago: University of Chicago Press, 2005).

[6] See C. Dufresne, P.R. Goldstein and J.S. Martin, "The Determinants of Credit Spread Changes" *Journal of Finance*, 56 (2001), pp. 2177-2207.

[7] J. Yang "An Empirical Investigation of the Effects of Macroeconomic Variables on Default Risk", *Working Paper*, (2003) University of Toronto and J.D. D'Amato and M. Luisi "Macro Factors in the Term Structure of Credit Spreads", *Working Paper*, No. 203 (2006), Bank for International Settlements, March.

information about underlying disturbances. Non-price variables, like aggregate output, are observable only with a substantial lag. Since up to date information about changes in default predictions is likely to be essential for management in times of approaching distress, there is value to using price variables as signals to the extent possible. The approach is based on MUST (Macroeconomic Uncertainty Strategy) analysis, a tool for assessing a firm's intrinsic competitiveness and macroeconomic exposures.[8]

In the empirical analysis we have chosen to decompose the commonly used Altman's Z-scores as predictor of default into macroeconomic and intrinsic components but the approach can equally well be used for other predictors. The changes in Z-scores for GM and Ford are used to illustrate the approach and to show how the decomposition provides information about the appropriate approach for a lender or management to resolve a distress situation.

The remainder of the paper is organized as follows. In Section 2 we discuss how macroeconomic and intrinsic factors affect near-term relative to long-term default probabilities to different degrees and implications for approaches to distress resolution. Section 3 contains a review of different types of models for forecasting default and the role of macroeconomic factors in these models. The approach to decomposition of changes in credit risk into macroeconomic and intrinsic components is discussed in Section 4. The case studies of GM's and Ford's Z-scores are presented in Section 5. Conclusions follow in Section 6.

2. Macroeconomic Factors in Distress Prediction and Resolution

Any proxy (DP) for the default probability of a firm must refer to a certain time horizon. In general this horizon is relatively short. Over a time horizon up to a year it makes little difference for the accuracy of the DP whether a firm's potential distress is caused by intrinsic factors reflecting the long run competitiveness of the firm or by macroeconomic factors that over the long run average to zero. Over the longer term current macroeconomic conditions are likely to be reversed and change independently of management's actions. Thus, if a high near-term DP is caused primarily by macroeconomic factors, the longer term default probability need not be very high while, if the high near term DP is caused by intrinsic factors, the longer term default probability

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[8] Developed in L. Oxelheim and C. Wihlborg, *Managing in the Turbulent World Economy: Corporate Performance and Risk Exposure* (Chichester, UK: Wiley, 1997).

is likely to be even higher unless management initiates substantial restructuring of the firm's assets.

We assume that there is a proxy, DP, for the probability of default of a firm for a specific time horizon and this proxy reflects the value of the firm's equity with an error.

$$(1) \quad DP = f(V) + \varepsilon,$$

where V is the market value of equity. Time subscripts are suppressed.

The value of equity, V, depends on intrinsic factors (I) and macroeconomic factors (M). Intrinsic factors reflect the long run competitiveness and viability of operations and depend on, for example, strategy, operational efficiency, know-how, product development as well as capital structure. The development over time of these factors depends strongly on managerial decisions. Any shift in I as result of managerial decisions and changes in the competitive environment can be considered permanent. Macroeconomic factors, on the other hand, are not subject to control by management. They are also mean-reverting and on average their influence on V is zero. This assumption is consistent with observations of mean reversion in stock markets.

Expressing the proxy for default probability as a function of intrinsic and macroeconomic factors, provides

$$(2) \quad DP = f(I, M) + \varepsilon,$$

Where the weights of I and M in DP depend on the time horizon of the default prediction. M can be a major factor in the short term but the longer the time horizon the lower is the weight of M likely to be. In this expression positive values for both I and M should be interpreted as negative factors from the point of firm value and probability of default. Thus an increase in I could be caused by a decline in operational efficiency and an increase in M could be caused by a decline in aggregate output in the economy. We can think of he default probability over a specific horizon as depending on a weighted average of I and M. Thus, the proxy DP can be expressed as follows:

(3) $DP = aI + (1-a)M + \varepsilon$.

The weight, a, would be increasing the longer the time-horizon of the prediction. Considering that I is subject to permanent shifts while M tends to revert to zero we can write the expression for DP as

(4) $DP_t = a(I_{t-1}+w_t) + (1-a)(\delta M_{t-1}+v_t) + \varepsilon_t$,

where w and v are shift variables and δ is the serial correlation coefficient. The change in DP from one period to another can be expressed as

(5) $\Delta DP_t = aw_t + (1-a)v_t + (1-a)(1-\delta)M_{t-1} + \Delta\varepsilon_t$.

.   This expression states that an observed unanticipated change in the proxy for default probability may have been caused by a shift in the intrinsic factor, w, a shift in the unanticipated component of the macro-factor, v, or a change in the random error term. In addition, anticipated changes could have been caused by anticipated changes in macroeconomic conditions.

In general DP is based on market and accounting data for a firm and these data reflect both intrinsic and macroeconomic conditions. Observation errors (ε) also affect the observed DP relative to the actual default probability. Even if an observed DP based on market and accounting date captures default probability with reasonable accuracy over the near term the long run implications depend on the source of the observed change. To the extent an observed change in DP depends on macroeconomic factors, a reversion can be expected over the longer term.

In Section 4 we will decompose observed changes in a proxy for DP into intrinsic and macroeconomic components. Any change in DP can be considered a signal to management, as well as to shareholders and creditors, that action is necessary. The appropriate action may depend on the cause of the change in DP, however.

In order to discuss implications of a decline in DP for management and other stakeholders we consider the following types of possible methods for distress resolution or reduction in default probability:

1. Bankruptcy with liquidation of assets as under Chapter 7 in the US Bankruptcy Code.

2. Bankruptcy under rehabilitation procedures such as Chapter 11 in the US Bankruptcy Code.

3. Change of management through hostile takeover, shareholder or board action

4. Substantial asset restructuring involving, for example, sale of assets, reorientation of strategy, partial closing of operations, etc.

5. Liability restructuring involving substantial changes in capital structure including reduced dividend pay-out, debt rescheduling and debt forgiveness.

In the following we discuss how information about intrinsic and macroeconomic sources of change in the default probability in combination with leverage can be used by management, shareholders, creditors or courts to assess which approach to distress resolution is appropriate or, under less critical circumstances, how a further increase in the default probability can be avoided. The approaches are not all mutually exclusive.

One may argue that any firm should deploy assets, choose strategy and choose a capital structure in accordance with shareholder wealth maximization. If markets for credit also work well creditors' and shareholders' interests are aligned. However, conflicts of interest arise as a result of information and monitoring costs. Asset deployment decisions, as well as capital structure decisions are often irreversible to a degree in the sense that changes are associated with substantial costs. Even if they are not irreversible, management may have a vested interest in current strategies and decisions it has made. If insolvency is associated with costs for shareholders and management an increase in the default probability can induce the board or management to reevaluate the costs and benefits of the current course.

1. Bankruptcy with liquidation. Bankruptcy occurs when the present value of the cash flows generated by a firm's assets is less than the value of the firm's debt. In the bankruptcy literature "financial distress" is described as the situation when the present value of a the cash flows generated by a firm's assets is greater than the scrap value of the assets but less than the value of debts.[9] Under this condtion the firm is insolvent and the value of equity is negative. Thus, creditors cannot be expected to be paid back fully. It is

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[9] See, for example, C. Wihlborg, S. Gangopadhyay and Q. Hussain, "Bankruptcy Infrastructure" in *Brookings-Wharton Papers on Financial Services* (2001)

in their interest, however, to maximize the value of the assets by having them redeployed and managed in such a way that the present value of future cash flows are maximized.

If the present value of the cash flows generated by the assets is less than the value that can be obtained by piece by piece sale of the assets, liquidation is clearly the only efficent resolution of distress. In the literature this situation is sometimes denoted "economic distress." Even the debt-free firm is insolvent in this situation. It is naturally a situation creditors in a leveraged firm would like to avoid but as soon as insolvency is reached shareholders with limited liability do not have incentives to avoid a further deterioration of the firm's situation. As a result, it may lie in the interest of creditors to force a firm into bankruptcy with liquidation already in financial distress. In this situation the whole business or viable parts of it can be sold to new owners who can deploy and manage the assets better than current owners.[10]

Liquidation is clearly an appropriate response to financial distress (insolvency with debt) if the distress is caused primarily by intrinsic factors and current owners are considered unable to redeploy and manage assets more productively.

2. Bankruptcy under rehabilitation procedures. Chapter 11 in the US allows the incumbent management and current owners to retain control of an insolvent firm. While in Chapter 11 management negotiates with creditors for debt relief and rescheduling of loans. A deal can involve a combination of restructuring of debt and restructuring of assets including the sale of parts of the firm's assets. Such a deal can be economically efficient if the current management team is considered qualified. In particular, if current asset values can be expected to recover a focus on restructuring of liabilities in the short run can be economically efficient. In other words, the greater the weight of macroeconomic conditions in the distess situation, the stronger is the case for a focus on liability restructuring. Clearly, current owners and management should have incentives to manage assets in the most efficent manner. Such incentives could be restored by, for example, debt relief that lifts the value of equity above zero.

Many countries do not have easily accessible rehabilitation procedures of the Chapter 11 type that allows current owners and management to retain control and re-

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[10] K. S. Thorburn, "Transparency in Bankruptcy Law: A Perspective on Bankruptcy Costs across Europe", in L. Oxelheim (ed.) *Corporate and Institutional Transparency for Economic Growth in Europe* (Oxford, UK: Elsevier, 2006), pp. 155-172. Evidence is presented that in a system without Ch 11 type law 75% of all liquidations end up as sales of "going concerns". Thus the firms continue under different ownership.

emerge from bankruptcy. Instead owners must give up their stakes and the management team must be changed in bankruptcy. The presumption is that if the owners and the management team has not been able to avoid insolvency by, for example, selling off assets in time or work out a debt relief program with creditors, the incumbents are not qualified to retain control.

The incentives for owners and management to negotiate informal work-outs with creditors are strong in these countries. Creditors also have an incentive to contribute to informal work-outs if the firm's intrinsic value is likely to remain positive. Thus, if macroeconomic factors have a strong weight in an increasing default probability, creditors as well as shareholders have incentives to negotiate temporary debt relief by means of bridge loans or rescheduling. If the distress situation is caused primarily by intrinsic factors, creditors could support debt relief up to a point where the intrinsic value of the firm's assets exceeds the debt provided creditors have faith in the management team.

Under Chapter 11 the incentives to seek bankruptcy protection can be strong even if intrinsic factors are the major cause of distress since commitments to labor or other stakeholders with claims can be renegotiated. In this case it lies in the interest of the court to determine whether distress is caused primarily by macroeconomic factors or whether the firm is trying to avoid consequences of prior commitments or liability for damages it has caused.

As long as the firm's equity value is not close to zero shareholders and management have incentives to take actions in response to an increased likelihood of distress to avoid direct and indirect bankruptcy costs. Even in this case the appropriate actions depend on the weight of intrinsic and macroeconomic factors.

3. Change of management. An increased probability of default caused by macroeconomic factors can be blamed on management only under specific circumstances. Specifically, a highly leveraged firm is likely to be relatively sensitive to macroeconomic conditions. The benefits of changing management in response to an increased probability of default are not likely to be large as long as intrinsic factors do not contribute to the increased probability. On the other hand, an increased probability caused by intrinsic factors can be interpreted as a signal that assets are deployed poorly or that strategies are not executed

well. In this case shareholders as well as creditors would want to change management. Management can be entrenched, however, with the result that only a takeover makes a change in management possible. In the extreme case when a takeover is not feasible, bankruptcy is the last opportunity to change management.

4. Substantial asset restructuring. A takeover usually implies that the incumbent management team is ousted. Thus, the team has an incentive to do what's necessary to avoid that the firm becomes a takeover target. In accordance with the discussion above, observation of an increasing default probability caused by intrinsic factors can be seen as a signal to management that substantial asset restructuring is necessary. This restructuring can be more or less far-reaching depending on level and rate of change of the default probability.

5. Liability restructuring. Any increase in the default probability should always be taken seriously and management can never be complacent with respect to the deployment of assets. However, if the increase is caused by macroeconomic factors and it reaches an uncomfortable level it should be taken as a signal that the capital structure of the firm is inappropriate in the macroeconomic environment. Either leverage should be reduced or macroeconomic risk management needs to be strengthened.

3. Predicting corporate default

In this section, different type of credit scoring models will be discussed from the perspective of their intent and capacity to recognize the influence of macroeconomic factors in the estimation of credit risk.

3.1 Altman's Z-score model

From a wide range of book and market value ratios, Altman[11] used Multiple Discriminant Analysis to identify the following model for predicting bankruptcy in the USA:

(6)   Z-score $= .012X_1 + .014X_2 + .033X_3 + .006X_4 + .999X_5$

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[11] E. I. Altman, "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy", *Journal of Finance*, 23 (1968), pp 589-609.

Where X_1 = Working capital / Total assets

X_2 = Retained Earnings / Total assets

X_3 = Earnings before interest and taxes / Total assets

X_4 = Market value of equity / Book value of total debt

X_5 = Sales / Total assets

Z = Overall index

In this model the first four firm-specific values on the right-hand side are given as percentages (or multiplied by 100 if given as absolute values) whereas the final value is given as an absolute (number of times). For example if the X_1-value is 10% the number 10 is used in the model.[12]

From his original sample of 66 firms (of which 33 did go bankrupt) Altman observed that, in general, firms with a Z-score greater than 2.99 did not go bankrupt and firms with a Z-score below 1.81 went bankrupt within a year. Firms with Z-scores in between were in the "grey area".

There is no independent role of macroeconomic variables in the Z-score model. The variables constituting the score are affected by firm-and industry specific, as well as macroeconomic conditions. Thus, the contribution of intrinsic versus macroeconomic factors to a low z-score cannot be observed directly.

Over the years Altman has presented modified versions of the Z-score. The Z'- score for non-traded firms substitutes book values for market values in the X_4-factor. Another version, the Z''-score model, does not include the X_5-variable. This model is often used in emerging markets. The original model has also been updated resulting in a ZETA-score model available on a proprietary basis.

In this paper we employ the original Z-score model and take the Z-scores as bankruptcy indicators. Altman has shown that it performs well for American firms on a one-year horizon as recently as between 1997 and 1999.[13]

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[12] See E. I. Altman, "Predicting, Financial Distress of Companies: Revisiting the Z-score and ZETA-models", (2000), personal homepage, July, for more about the Z-score model.

[13] See E. I. Altman, "Corporate Distress Prediction Models in a Turbulent Economy and Basel II Environment", Personal homepage, (2002), September. The author flags for the possibility that z-score levels indicating high probability of bankruptcy may have to be adjusted for large firms.

3.2 Bankruptcy prediction based on option pricing theory

Bankruptcy prediction based on option pricing theory was introduced by Robert Merton[14] in 1974. Using insights gained from the development of the option pricing model[15] he described the payoff from a default-risky bond in terms of the pay-offs on a risk-free bond and a put option on the value of the firm's assets. The borrower holds a put option and its value depends on the value of the firm's assets, the face amount of debt, the volatility of the asset value, the time to maturity of the bond, and the yield on a default-free bond with the same time to maturity. The difference in yield between the default-risky and the default-free bond is the *credit spread*. This spread is a put option premium that increases with leverage and asset value volatility.

The KMV model puts the Merton model to practical use.[16] KMV Corporation (now owned by Moody's) is a company specialising in credit risk analysis. The model uses an *Expected Default Frequency* (EDF), which is firm specific and a function of the capital structure of the firm, the volatility in the returns of assets and the current asset value. The first step in estimating the EDF is estimating the asset value and the volatility of the asset returns. If all liabilities of the firm were publicly traded, it would be a rather simple task to estimate the asset value. As this is not ordinarily the case, however, the value of the liabilities is estimated using the Merton approach. The second step is estimating the *distance-to-default*, which is defined as the number of standard deviations between the mean of the probability distribution of the future asset value and the so called *default point*, defined as the sum of the short-term debt and half the long-term debt. The third and last step is relating the distance-to-default statistic to historical data on default frequencies of firms with different distances-to-default. Thereby, a probability of default for a firm is estimated.

Like the Z-statistic, the EDF statistic depends on firm-, industry- and macroeconomic factors. Thus, the contribution of macroeconomic factors could in

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[14] R. Merton, "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates", *Journal of Finance* 29 (1974), pp. 449-470.
[15] See F. Black and M. Scholes, "The Pricing of Options and Corporate Liabilities", *Journal of Political Economy* 8 (1973), pp. 637-654 and R. Merton , "The Theory of Rational Option Pricing", *Bell Journal of Economics and Management Science* 4 (1973), pp. 141-183.
[16] O. Vasicek*, Credit valuation. Net Exposure 1(1)* (1997) and S. Kealhofer, "Managing Default Risk in Portfolios of Derivatives", *Derivative Credit Risk*, Ch. 4 Risk Publications (1995), pp. 49-66 and *Portfolio management of Default Risk. Net Exposure 1 (2),* (1998).

principle be analyzed by estimating the contribution of macroeconomic factors to volatility and asset values.

Pesaran et al.[17] link a global macroeconomic model to a credit risk model of the type described. They use equity indices, interest rates, inflation, real money balances, output and oil-prices to explain changes in credit risk across industries and firms. Pesaran together with Schuermann and Treutler extend the model to consider diversification of credit risk.[18] Opportunities for diversification depend on the importance of macroeconomic factors.

D'Amato and Luisi estimate the contribution of macro factors to EDF's by assuming that that they are determined by the same set of indicators of real and financial activity as credit spreads.[19] They analyse how spreads depend on the factors and apply the results on EDFs. Under these assumptions macroeconomic indicators have significant predictive power for future default risk.

The Credit Metrics model developed at JP Morgan builds on the models described but introduces the credit migration approach[20] as well. It includes the risk of default of a company with a specific credit rating. Essential to the model is also the transition matrix stating probabilities of changes in ratings conditional on current ratings. These probabilities are derived from historical data. Macroeconomic factors can be introduced in the analysis in the KMV model above.

3.3 An Actuarial approach

CreditRisk+[21] is a model used by Credit Suisse. It focuses solely on the default risk, not the risk of credit downgrading. Probabilities are obtained using historical data. Within a portfolio of bonds the number of defaults per period is assumed to follow a Poisson distribution.

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[17] See M.H. Pesaran, H. T. Schuermann, B.-J. Treutler and S. Weisner, "Macroeconomic Dynamics and Credit Risk: A Global Perspective", *Journal of Money, Credit and Banking* 38, No. 5 (2005), pp. 1211-1261.

[18] See M.H. Pesaran, H. T. Schuermann and B.-J. Treutler , " Global Business Cycles and Credit Risk" in M. Carey and R.M. Stultz (eds.), *The Risks of Financial Institutions* (Chicago: University of Chicago Press, 2005).

[19] See J. D. D'Amato and M. Luisi, "Macro Factors in the Term Structure of Credit Spreads", *Working paper*, Bank for International Settlements, No 203 (2006), March.

[20] J.P. Morgan, *CreditMetrics: Technical Documentation*, (1997).

[21] See Credit Suisse, *Credit Risk+: A Credit Risk Management Framework,* (1997) Credit Suisse Financial Products.

The main advantage of the model is that it is simple to use. There is no explicit consideration of macroeconomic fluctuations influencing probabilities of default over time, however.

3.4 Models introducing explicit macroeconomic factors

CreditPortfolioView is a risk assessment model developed by Wilson[22] and adopted by McKinsey. It relates the default probability for a firm in an industry to changes in country-and industry-specific variables. The model assumes that the default probability follows a logit distribution:

(7) $P_{j,t} = 1 / (1 + e^{-Y_{j,t}})$,

Where $P_{j,t}$ is the probability of default for country/industry j in period t, and $Y_{j,t}$ is an index value from a multi-factor model wherein country- and industry-specific factors are introduced. Using logit estimation, coefficients expressing the contribution of each factor to the probability of default within an industry can be estimated. Since the analysis is performed on the industry level it is assumed that firms within an industry are homogeneous with respect to impact of macroeconomic variables.

Carling et al. introduce macroeconomic factors along with accounting data, payment behaviour, and loan related conditions in a model of default risk for Swedish firms.[23] This very data-intensive model explains the survival time to default for business borrowers in the loan portfolio of a Swedish bank that provided the data. By introducing macroeconomic factors the authors improve on predictions of the absolute level of the probability of default, while models without macroeconomic factors are reasonably accurate only with respect to rankings of default risk. The significant macroeconomic factors are the output gap, the yield curve and Swedish households' expectations about the economy.

Linde et al use a very large panel data set including all Swedish corporations (limited liability businesses) during a 12 year period to analyse factors that

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[22] See T. C. Wilson, "Portfolio Credit Risk I", *Risk* 10, No. 9 (1997) pp. 111-116 and "Portfolio Credit Risk II", *Risk* 10, No. 10 (1997), pp. 56-61.
[23] K. Carling, T. Jacobson, J. Linde and K. Roszbach, "Corporate Credit Risk and the Macro Economy", *Journal of Banking and Finance* 31, No. 3 (2007), March, pp. 845-868.

explain defaults and to derive probabilities of default conditional on firm specific, industry and macro factors.[24] The authors compare out of sample predictions with and without macro factors. These factors are the same as those used in Carling et al.[25] The results clearly show that default risk estimates are improved by the inclusion of macroeconomic factors. Another result is that predictions are improved by estimating the model on the industry level rather than the aggregate level.

The macroeconomic factors employed in these models are useful for the analysis of historical default data although the output gap and similar variables are observed only with a lag. This observation lag is a disadvantage for the internal or external analyst whose objective it is to determine whether changes in the probability of default depend on intrinsic or macroeconomic conditions.

4. Decomposing Z-values into Intrinsic and Macroeconomic components.

The default prediction models discussed so far use a set of macroeconomic factors that contribute to default prediction across all firms or all firms within an industry, and to the construction of diversified portfolios with low aggregate risk. We here emphasize that macroeconomic exposure is firm-specific. Our objective is thus to identify specific macroeconomic factors that affect a firm's default probability in order to gain information about the appropriate restructuring strategy in an approaching distress situation. For this purpose the macroeconomic factors should be observable without much time lag and with sufficient frequency for management and lenders to be able to update the information. Generally, price variables including interest and exchange rates are observed more or less continuously without a lag.

We develop a relatively simple method for decomposing credit scores or estimated default probabilities into macroeconomic and "intrinsic" components based on frequently observable variables. As discussed in Section 2, lenders and management need to determine whether to focus on liability restructuring or more fundamental asset restructuring that could include seeking court supervised liquidation.

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[24] J. Linde, T. Jacobson, R. Nilsson and K. Roszbach, "Aggregate Fluctuations and Business Default", *Working paper*, Sveriges Riksbank, (2006), Stockholm.
[25] K. Carling, T. Jacobson, J. Linde and K. Roszbach, "Corporate Credit Risk and the Macro Economy", *Journal of Banking and Finance* 31, No. 3 (2007), March, pp. 845-868.

Among the papers referred to above, Pesaran et al. is most similar in its intent to explain how macroeconomic factors contribute to default risk estimates based on the Merton Model.[26] We decompose Z-scores instead. Recent evidence indicates that the Z-score model has out-performed the KMV model during recent years.[27]

Another difference between our approach and other approaches to introducing macroeconomic factors is that we focus entirely on price variables as opposed to quantity variables like output, employment, and demand conditions, and we allow the relevant price variables to differ across firms. As noted, the reason for focusing on price variables is that they can be observed more or less continuously while many other macroeconomic indicators are published on a quarterly basis with substantial lags. Frequent and up to date information about changes in default probabilities can be essential for decisions about how to approach underlying problems.

Price variables, like interest rates, exchange rates, and goods prices are expected to serve as signals of underlying shocks. Presumably, they respond in a systematic way to underlying monetary and real shocks on the macro-and lower levels. Therefore, they can be used to disentangle the nature of shocks.

Altman's original Z-score model can be transformed to incorporate the sensitivity of the firm to different macroeconomic factors influencing the firm. To be able to observe the sensitivity of the firm to macroeconomic variables we decompose the Z-score into two parts[28]:

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[26] See M.H. Pesaran, H. T. Schuermann, B.-J. Treutler and S. Weisner, "Macroeconomic Dynamics and Credit Risk: A Global Perspective", *Journal of Money, Credit and Banking* 38, No. 5 (2005), pp. 1211-1261 and M.H. Pesaran, H. T. Schuermann and B.-J. Treutler , " Global Business Cycles and Credit Risk" in M. Carey and R.M. Stultz (eds.), *The Risks of Financial Institutions* (Chicago: University of Chicago Press, 2005).

[27] See E.I. Altman, "Are Historically Based Default and Recovery Models in the High-Yield and Distressed Debt Markets Still Relevant in Today's Credit Environment?", *Special report*, (2006), New York University, Salomon Centre, Stern School of Business, October.

[28] For a similar treatment of Value Based Management frameworks, see L. Oxelheim and C. Wihlborg, "Recognizing Macroeconomic Fluctuations in Value Based Management", *Journal of Applied Corporate Finance* 15, No. 4 (2003), pp. 104-110.

(8) $Z_{i,t} = Z_{I,i,t} + Z_{M,i,t}$

In the above expression $Z_{i,t}$ is the total Z-score of company i at time t according to Altman's Z-score model, $Z_{I,i,t}$ is the intrinsic part of the Z-score of company i at time t and $Z_{M,i,t}$ is the part of the Z-score that depends on macroeconomic fluctuations. The Z-score model can be expressed in the following way:

(9) $Z_{I,i,t} + Z_{M,i,t} = .012\ X_{1,i,t} + .014\ X_{2,i,t} + .033\ X_{3,i,t} + .006\ X_{4,i,t} + .999\ X_{5,i,t}$

We expect that each of the Z-score factors, $X_{1,i,t}$ through $X_{5,i,t}$, are sensitive to macroeconomic fluctuations. Each of them can be decomposed into an intrinsic and a macroeconomic component.

(10) $X_{i,t} = X_{I,i,t} + X_{M,i,t}$

where $X_{i,t}$ is the value of the i:th firm specific variable in time period t, $X_{I,i,t}$ is the intrinsic level of the i:th firm specific variable in period t and $X_{M,i,t}$ is the part of the variable value that depends on macroeconomic fluctuations. The new Z-score model with factors that depend on changes in macroeconomic variables is:

(11) $Z_t = Z_{I,t} + Z_{M,t} = .012\ (X_{I,1,t} + X_{M,1,t}) + .014\ (X_{I,2,t} + X_{M,2,t}) + .033\ (X_{I,3,t} + X_{M,3,t}) + .006\ (X_{I,4,t} + X_{M,4,t}) + .999\ (X_{I,5,t} + X_{M,5,t})$

Where X_1 = Working capital / Total assets

X_2 = Retained Earnings / Total assets

X_3 = Earnings before interest and taxes / Total assets

X_4 = Market value equity / Book value of total debt

X_5 = Sales / Total assets

Thereafter, the Z_M can be calculated for each period as the sum of the five macroeconomic effects ($X_{M,i}$).

An alternative approach, that will be used below, is to decompose Z_t directly without decomposing the factors X_1-X_5. The two approaches should be equivalent if the macroeconomic contributions to the different components of the Z-score remain constant over time in relative terms. Even if the relationship between each component and macroeconomic factors are unstable over time, this alternative approach should be more robust since the relationship between the total Z-score and macroeconomic factors is likely to be more stable than the component relationships. The reason is that the impact of the macro economy can shift among the component variables over time.

In the following we will only be using the component factors to calculate the Z-value in each period. Thereafter we will estimate effects of macroeconomic variables on changes in Z before decomposing these Z-changes in intrinsic and macroeconomic components.

We choose to use the MUST-approach to identify macroeconomic factors influencing firms' Z-values.[29] The focus in this approach is on macroeconomic price variables; exchange rates, interest rates and inflation rates, i.e. changes in price levels. As noted, price variables are observable by analysts without long lags, and they aggregate information about unobservable, underlying shifts in demand and supply.[30] The approach involves seeking the relevant factors and their weights for each individual firm, starting from a set of variables that are chosen a priori based on each firm's identification of relevant macroeconomic variables and on information about production structure, relevant markets, and the origin of major competitors.

The extent to which changes in Z in a period depends on changes in macroeconomic factors can be expressed in the following way:

(12) $dZ_{M,i,t} = ((\delta Z_{M,i})/(\delta e)) \bullet de_t + ((\delta Z_{M,i})/(\delta i)) \bullet di_t + ((\delta Z_{M,i})/(\delta p)) \bullet dp_t$

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[29] See L. Oxelheim and C. Wihlborg, *Managing in the Turbulent World Economy: Corporate Performance and Risk Exposure* (Chichester, UK: Wiley, 1997).

[30] Two assumptions must be valid for the price variables to be stable indicators of effects of macroeconomic conditions on a firm. First, there should be a systematic relation between a shock of a particular type and the effects on a firm and a group of price variables. Second, since each type of shock has its particular impact on a firm and the set of price variables, the relative frequency of underlying shocks should be stable over the estimation period and the subsequent period to be analyzed.

In this expression de_t, di_t, and dp_t represent changes in exchange rates, interest rates and price levels during a period. The partial derivatives show the sensitivity of the Z-score to changes in the macroeconomic factors. A particular firm may very well be affected by domestic as well as foreign macroeconomic factors, at different sensitivities.

Econometrically, the macroeconomic influences on the Z-scores are identified in regressions with changes in Z-scores as the dependent variables and macroeconomic as well as industry and firm-specific variables as independent variables in order to account for possible correlation between macro economic factors and factors that affect firms' intrinsic credit risk.

In the next section we use Z-scores for GM and Ford to illustrate how the relevant macroeconomic price variables can be identified, and how changes in Z-scores can be decomposed period by period.

5. Decomposition of Z-score changes for GM and Ford. Can they survive?

In this section we begin by calculating the quarterly Z-scores for GM and Ford for the period 1995 (4th quarter)-2005 (3rd quarter). Thereafter, we regress changes in Z-scores on macroeconomic and industry price variables. The estimated coefficients for the macroeconomic variables are used to decompose the changes in Z-scores into changes caused by macroeconomic factors and intrinsic factors. The decomposition should allow us to determine whether the two companies have moved closer or further away from Economic and Financial Distress, respectively, during the observation period.

The variables that together build up the Z-score were obtained from GM's and Ford's quarterly statements. The variables, defined in Section 2, are individually likely to depend on macroeconomic factors but, as mentioned, we choose to decompose the Z-score itself rather than its components.

The levels of the quarterly Z-scores are presented in column 1 of Table 1 for GM and in Table 2 for Ford. GM's score has fluctuated between -.07 and +1. The corresponding figures for Ford are .06 and .79. According to Altman's rule of thumb for his original sample of firms, these low Z-scores for the whole period indicate that bankruptcy would be expected within a year. The bankruptcies have not occurred, however. Altman has later concluded that the rule of thumb stating that bankruptcy is

very likely within a year if the score falls below 1.8, does not apply to very large corporations like GM and Ford.[31] There is no doubt the scores are very low, however, and that they indicate a high probability of bankruptcy for both corporations throughout the period.

For the purposes here, we focus on changes in the Z-scores in the columns "Z-changes" rather than the levels in order to determine what kind of distress the two firms have been moving towards. The average quarterly change for GM in Table 1 is -.013 with a standard deviation of .20. The corresponding figures for Ford in Table 2 are -.005 and .15. Thus the accumulated change for the period for GM is approximately -.51 and for Ford the accumulated change is -.2. There is a downward trend in the Z-score for both firms as shown in Figures 1 and 2. The standard deviations of quarterly changes are large for both firms but it is lower for Ford. This observation implies that it is more meaningful to talk about a trend in the case of Ford than in the case of GM. Figure 1 shows that most of the drop in GM's Z-score occurred before 1998 while most of the decline in Ford's Z-score occurred during the period 1998-2001.

Two regressions for changes in Z-scores for each firm are presented in Tables 3 and 4. In Table 3, a number of potentially important exchange rates, interest rates, price levels, and commodity price changes are included. As noted, annual reports for the two firms were used to identify which country variables to include in each regression. For both companies we have included macroeconomic variables for the Euro-area, Japan and the USA. In addition, UK, Australian and Brazilian price variables are included for Ford, because these countries are identified in Ford's annual report. These countries are important for the firm either as a production, market or competitor location. The relative prices included are the producer price index relative to the consumer price index (PPI and CPI are introduced separately), the world market oil price and, for Ford, the price of aluminium. Instead of PPI/CPI we could have included the relative price for motor vehicles as an industry specific price variable but the two relative prices are highly correlated and the components of PPI/CPI is easily accessible. Lags of independent variables were introduced as well but they did not improve results.

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[31] See E.I. Altman, "Are Historically Based Default and Recovery Models in the High-Yield and Distressed Debt Markets Still Relevant in Today's Credit Environment?", *Special report*, (2006), New York University, Salomon Centre, Stern School of Business, October.

It can be debated whether the oil price should be considered an industry specific variable or a macro variable. It is certainly a variable beyond the firms' influence but the car manufacturers are able to adjust in many ways to changes in it. If this adjustment takes longer than the time-horizon we are concerned with, the oil price should be considered a macroeconomic factor rather than an intrinsic one for the purposes here. It turns out in Table 3 that the oil price does not contribute to explain changes in the two firms Z-scores.

The dependent variable is the unit change in the Z-score relative to the previous quarter. Percent changes cannot be used since there are values close to zero and a few negative observations. All independent variables are measured as percent rate of change relative to the previous quarter (divided by 100) except interest rates changes that are measured as percentage point changes. Price variables are quarterly averages corresponding to definitions of the components of the Z-scores.

The results of the regressions are presented in Table 3. As a result of high correlation among several macroeconomic variables a subset of the price variables are sufficient to identify the macroeconomic impact on the Z-scores. In the results of the stepwise regressions presented in Table 4 we have used a significance level of 5% as our selection criteria. In the following we discuss and use the results for the second set of regressions in Table 4 where most of the coefficients are significant. The adjusted R-squares are higher in this table while the Durbin-Watson statistic remains acceptable.

In Table 4, it is clear that Ford is subject to much more varied macroeconomic influences than GM. While Ford's Z-score is sensitive to one exchange rate (Euro), two interest rates (USA and Japan), four CPIs (Japan, UK, USA, and EMU) and three PPIs (indicating the relative price between traded and non-traded goods in Japan, USA and EMU), GM's Z-score is sensitive to two exchange rates (Euro and Yen relative to the dollar), two interest rates (EMU and Japan) and the CPI and the relative price between CPI and PPI in Japan. The oil price does not seem to influence any of the firms during the period when oil prices fluctuated relatively little relative to subsequent periods. The adjusted R-squares are almost the same for the two firms.

The signs of coefficients are in line with what can be expected for the impact of particular variables. Specifically, a US Dollar depreciation relative to the Euro and the Yen (at a 10% level) increases the Z-score for GM, and a US Dollar depreciation relative

to the Euro increases the Z-score for Ford. Since the macroeconomic conditions should be viewed as indicators of macroeconomic conditions, these signs indicate that a US Dollar depreciation is associated with economic conditions that benefit the two car producers.

The EMU interest rate is negatively associated with Z-scores for GM. A higher interest rate means a challenge to the company from the financial as well as from the real side (lower demand). The Japanese long term government bond rate is negatively associated with Z-scores of Ford whereas the US money market rate is positively related.

The effect of pure inflation in a country is actually obtained by the sum of the coefficients for CPI and PPI. The signs for PPI are the opposite of the signs for CPIs but the CPI coefficients are larger. Thus, the sign for the CPI indicates the effect of pure inflation. Changes in the EMU (at a 10% level) and the Japanese CPIs affect Z-scores of Ford positively while those in US and British CPI affect Ford's Z-scores negatively. Since inflation is linked to changes in the cost level of a country, the results indicate that cost increases in competitor countries (Europe, Japan) are beneficial while inflationary cost increases in the US and the UK have a negative effect on Ford in particular. Changes in the Japanese CPI are positively associated with GM's Z-scores.

The effect of a change in producer prices relative to consumer prices in a country is captured by the coefficient sign for PPI. These PPI signs are the opposite of the CPI signs. For example, Ford's Z-score, that is negatively affected by the US CPI, is positively affected by the US PPI. This makes sense, if the sum of the signs indicates the effect of pure inflation and the sign for PPI indicates the profit effect of output prices rising faster than costs.

We turn now to the decomposition of the Z-scores and the changes of these scores in Table 1 for GM and Table 2 for Ford. The columns "Z-change macro" are obtained by multiplying the regression coefficients in Table 4 with actual changes in the macroeconomic variables for each period. The far right column in Tables 1 and 2, "Z-change res" show the residual change after deducting the changes caused by macro factors from the total Z-changes. In other words, the far right column represents changes in Z-scores caused by changes in the firms' intrinsic competitiveness.

Looking at the average quarterly changes for the period it can be seen that the accumulated macro effect on GM's score is small while the accumulated macro effect

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explains most of the Z-score change for Ford. The standard deviations of quarterly changes are quite large for both macro effects and residual, intrinsic effects.

To observe the developments during the period more clearly we have constructed Figures 1 and 2, where the macro effects on the Z-scores have been deducted from the Z-scores in levels.[32] Thus, the dotted lines show our estimates of intrinsic Z-scores.

There is a clear difference in the developments of the intrinsic Z-scores. For GM the total Z-score and the intrinsic Z-score move together over the period as a whole. For Ford, on the other hand, the intrinsic Z-score does not have much of a trend while the total Z-score does. In other words, most of the changes in Ford's Z-score is explained by macroeconomic factors.

Finally, we interpret the results in light of the discussion of approaches to increasing default probabilities. The generally low levels of the Z-scores imply that both firms are in need of restructuring of some kind. Focusing on the events during our data period, the changes in the Z-scores for GM caused by intrinsic factors would indicate that GM is in urgent need of asset restructuring involving sale of assets, re-evaluation of strategies or increases operational efficiency. Ford's Z-scores for the period indicates that macroeconomic factors explain most of the increased default probability. Thus, it seems that Ford's leverage is excessive relative to its sensitivity to macroeconomic factors or it needs to enhance its approach to risk management. The generally low Z-scores for Ford indicate that asset restructuring should be considered as well although the urgency for Ford is less than for GM.

6. Conclusions

We have suggested that indicators of the probability of corporate default, or changes therein, can be decomposed into a macroeconomic and an intrinsic component. If a declining value of the indicator of default is explained by macroeconomic factors a reduction in leverage or improved macroeconomic risk management can reduce the probability of default. In case of insolvency, rehabilitation under Chapter 11 with a focus on debt relief combined with asset restructuring to the extent creditors consider it necessary, could be an appropriate procedure. If the declining value of the indicator is

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[32] The dotted lines show these residual Z-scores under the assumption that the macro effect on the z-scores in 1995, Q4, was zero.

explained by intrinsic factors fundamental asset restructuring is required. If the board considers the current management deficient the first step must be to change the team. In case the management team is entrenched the solution could be a takeover. Bankruptcy procedures remain as the last resort. If the bankruptcy is caused primarily by intrinsic factors Chapter 11 would usually not be appropriate unless management can be forced out.

The method of decomposition we propose relies on market price variables on the macro-, industry- and firm levels to obtain coefficients for the sensitivity of the default indicator to changes in the different price variables. We focus on price variables because they are most easily, frequently, and quickly observed, and they should be systematically related to the underlying fundamental factors.

Once the coefficients are estimated, observations of changes in the macro variables can be used to calculate the total macroeconomic impact on the default indicator for a period. The remaining change in the indicator during a period is considered caused by intrinsic factors.

Altman's Z-score was used as the indicator of default probability for firms in an illustration of the practical use of the method of decomposition. The Z-scores for GM and Ford were calculated and the quarterly changes during the period 1997-2005 were decomposed into macroeconomic and intrinsic components. Both GM's and Ford's Z-scores fell during the period with substantial variation from quarter to quarter. The decomposition indicated that the decline in GM-score was explained by intrinsic factors while the decline in Ford's Z-score was explained mainly by macroeconomic factors although the accumulated decline for Ford was larger.

The implications for restructuring are that the need for fundamental asset restructuring at GM was urgent in 2005 while Ford's need for asset restructuring did not worsen. Ford should consider whether its leverage is excessive or whether its approach to macroeconomic risk management can be improved.

Table 1 Z-score, Changes in Z-scores and decomposed Z-scores, GM.

	Level Z	Z-effect macro	Z-effect residual	Z-change	Z-change macro	Z-change res
Coefficient						
1995/Q4	0.717	0.081	0.636			
1996/Q1	0.977	0.424	0.553	0.260	0.343	-0.083
1996/Q2	0.991	0.493	0.498	0.014	0.068	-0.054
1996/Q3	0.915	0.066	0.849	-0.076	-0.427	0.351
1996/Q4	0.760	0.252	0.508	-0.155	0.186	-0.342
1997/Q1	0.996	0.287	0.708	0.236	0.035	0.201
1997/Q2	0.907	0.486	0.420	-0.089	0.199	-0.288
1997/Q3	0.876	0.122	0.754	-0.031	-0.364	0.333
1997/Q4	0.310	0.138	0.172	-0.566	0.016	-0.582
1998/Q1	0.617	0.266	0.351	0.307	0.128	0.179
1998/Q2	0.580	0.191	0.389	-0.037	-0.075	0.038
1998/Q3	0.471	-0.003	0.474	-0.109	-0.194	0.085
1998/Q4	0.322	0.009	0.313	-0.149	0.012	-0.161
1999/Q1	0.305	0.008	0.297	-0.018	-0.001	-0.017
1999/Q2	0.466	0.305	0.161	0.162	0.297	-0.135
1999/Q3	0.318	-0.180	0.497	-0.149	-0.485	0.336
1999/Q4	0.147	-0.298	0.445	-0.171	-0.118	-0.052
2000/Q1	0.364	-0.205	0.569	0.217	0.093	0.123
2000/Q2	0.194	0.006	0.188	-0.170	0.211	-0.381
2000/Q3	0.398	-0.016	0.414	0.204	-0.022	0.227
2000/Q4	0.334	0.141	0.193	-0.065	0.157	-0.221
2001/Q1	0.370	-0.002	0.372	0.037	-0.143	0.179
2001/Q2	0.410	0.170	0.240	0.039	0.172	-0.133
2001/Q3	0.350	0.094	0.256	-0.059	-0.076	0.017
2001/Q4	0.157	0.295	-0.138	-0.193	0.201	-0.394
2002/Q1	0.441	0.104	0.338	0.284	-0.191	0.475
2002/Q2	0.383	-0.108	0.491	-0.059	-0.212	0.153
2002/Q3	-0.069	-0.207	0.138	-0.452	-0.099	-0.353
2002/Q4	0.214	0.080	0.135	0.284	0.287	-0.003
2003/Q1	0.414	-0.180	0.593	0.199	-0.259	0.459
2003/Q2	0.539	0.129	0.410	0.125	0.308	-0.183
2003/Q3	0.554	0.066	0.488	0.015	-0.063	0.078
2003/Q4	0.207	-0.276	0.483	-0.347	-0.342	-0.005
2004/Q1	0.063	-0.218	0.281	-0.143	0.058	-0.202
2004/Q2	0.066	0.088	-0.022	0.003	0.306	-0.303
2004/Q3	0.102	-0.088	0.190	0.036	-0.175	0.212
2004/Q4	0.199	-0.165	0.365	0.097	-0.078	0.175
2005/Q1	-0.021	-0.200	0.179	-0.220	-0.034	-0.186
2005/Q2	0.239	0.052	0.187	0.260	0.252	0.008
2005/Q3	0.221	0.034	0.187	-0.018	-0.018	0.000
Average	0.420	0.056	0.364	-0.013	-0.001	-0.012
Stand dev.	0.287	0.201	0.206	0.201	0.214	0.249

Table 2 Z-scores, changes in Z-scores and decomposed Z-scores, Ford

|	Level Z	Z-effect macro	Z-effect residual	Z-change	Z-change macro	Z-change res
Coefficient						
1995/Q4	0.281	-0.070	0.351			
1996/Q1	0.405	-0.371	0.775	0.124	-0.300	0.424
1996/Q2	0.409	-0.077	0.486	0.004	0.294	-0.290
1996/Q3	0.372	-0.047	0.419	-0.037	0.030	-0.067
1996/Q4	0.404	-0.114	0.518	0.033	-0.067	0.099
1997/Q1	0.408	0.055	0.353	0.004	0.169	-0.165
1997/Q2	0.462	-0.099	0.561	0.053	-0.154	0.208
1997/Q3	0.443	-0.092	0.535	-0.018	0.008	-0.026
1997/Q4	0.382	-0.171	0.554	-0.061	-0.080	0.018
1998/Q1	0.786	0.027	0.759	0.404	0.199	0.205
1998/Q2	0.555	-0.158	0.713	-0.231	-0.186	-0.045
1998/Q3	0.474	-0.113	0.587	-0.081	0.046	-0.127
1998/Q4	0.518	-0.042	0.560	0.044	0.071	-0.027
1999/Q1	0.508	-0.205	0.712	-0.010	-0.163	0.153
1999/Q2	0.515	0.058	0.457	0.007	0.263	-0.255
1999/Q3	0.482	-0.068	0.550	-0.033	-0.126	0.093
1999/Q4	0.492	-0.208	0.701	0.010	-0.141	0.151
2000/Q1	0.481	-0.244	0.724	-0.012	-0.035	0.024
2000/Q2	0.428	-0.048	0.476	-0.052	0.196	-0.248
2000/Q3	0.352	-0.127	0.479	-0.076	-0.079	0.003
2000/Q4	0.333	-0.176	0.509	-0.019	-0.049	0.029
2001/Q1	0.132	-0.378	0.510	-0.201	-0.203	0.001
2001/Q2	0.058	-0.389	0.447	-0.073	-0.010	-0.063
2001/Q3	0.060	-0.241	0.302	0.002	0.147	-0.145
2001/Q4	0.235	-0.210	0.446	0.175	0.031	0.144
2002/Q1	0.135	-0.163	0.298	-0.100	0.048	-0.148
2002/Q2	0.149	-0.439	0.588	0.014	-0.276	0.290
2002/Q3	0.125	-0.359	0.484	-0.024	0.080	-0.104
2002/Q4	0.401	-0.199	0.600	0.276	0.160	0.116
2003/Q1	0.108	-0.414	0.522	-0.293	-0.215	-0.078
2003/Q2	0.114	-0.262	0.376	0.006	0.152	-0.147
2003/Q3	0.116	-0.244	0.360	0.002	0.018	-0.016
2003/Q4	0.365	-0.175	0.541	0.250	0.068	0.181
2004/Q1	0.071	-0.505	0.576	-0.294	-0.330	0.035
2004/Q2	0.034	-0.333	0.367	-0.038	0.172	-0.209
2004/Q3	0.006	-0.315	0.321	-0.028	0.018	-0.046
2004/Q4	0.342	-0.228	0.570	0.337	0.087	0.250
2005/Q1	0.081	-0.294	0.375	-0.261	-0.066	-0.195
2005/Q2	0.071	-0.408	0.479	-0.010	-0.114	0.103
2005/Q3	0.081	-0.273	0.354	0.010	0.135	-0.125
Average	0.304	-0.203	0.507	-0.005	-0.005	0.000
Stand dev.	0.190	0.140	0.128	0.149	0.156	0.163

Table 3 Full specifications of regressions. Z-score changes on price variables. GM and Ford

	(1) Z-value GM	(2) Z-value Ford
EMU ECU-EUR/USD exchange rate monthly average	4.210	4.910
	(0.082)	(0.027)*
CAN CAD/USD exchange rate monthly average	-2.867	0.556
	(0.232)	(0.780)
JPN JPY/USD exchange rate monthly average	2.326	-1.045
	(0.078)	(0.294)
USA Yield 10-year federal government securities	-0.082	0.060
	(0.816)	(0.818)
JPN Yield 10-year interest-bearing government bonds	-0.134	-0.286
	(0.563)	(0.301)
DEU Yield 10-year government bonds (proxy - 9-10+ year federal securities)	0.158	0.275
	(0.689)	(0.435)
USA Rate 3-month CDs	0.024	0.247
	(0.892)	(0.057)
EMU 3-month EURIBOR	-0.324	-0.078
	(0.215)	(0.644)
JPN Rate new 90-<120 day CDs	0.714	-0.109
	(0.140)	(0.757)
USA PPI Manufacturing Industries	11.863	24.786
	(0.527)	(0.109)
JPN PPI MANUFACTURING	-18.114	-19.701
	(0.226)	(0.090)
EMU PPI Total Manufacturing - Domestic Market	-18.362	-27.944
	(0.432)	(0.172)
AUS CPI All items	-2.716	
	(0.778)	
JPN CPI All items	24.637	30.511
	(0.037)*	(0.031)*
EMU CPI HICP All items	-12.847	61.126
	(0.517)	(0.038)*
Aluminum Price Change	0.957	-0.698
	(0.322)	(0.367)
Oil Price Change	-0.068	0.157
	(0.888)	(0.588)
AUS AUD/USD exchange rate monthly average		0.769
		(0.642)
GBR GBP/USD exchange rate monthly average		-1.935
		(0.431)
BRA BRL/USD exchange rate monthly average		0.109
		(0.889)
GBR Yield 10-year central government securities		-0.386
		(0.137)
BRA Producer prices: manufacturing - proxy		0.479
		(0.779)
USA CPI All items		-45.179
		(0.058)
GBR CPI All items		-55.528
		(0.013)*
Constant	0.438	0.402
	(0.001)**	(0.002)**
Observations	40	40
Adjusted R-squared	0.23	0.26
D.W.	1.6	1.5

Table 4 Reduced specifications of regressions. Z-score changes on price variables. Stepwise backward elimination. GM and Ford.

	Z-value GM	Z-value Ford
EMU ECU-EUR/USD exchange rate monthly average	2.360 (0.024)*	4.492 (0.000)**
JPN JPY/USD exchange rate monthly average	1.720 (0.061)	
EMU 3-month EURIBOR	-0.336 (0.009)**	
JPN Rate new 90-<120 day CDs	0.420 (0.136)	
JPN PPI MANUFACTURING	-11.280 (0.131)	-22.271 (0.007)**
JPN CPI All items	25.403 (0.002)**	28.794 (0.006)**
GBR CPI All items		-41.583 (0.006)**
EMU PPI Total Manufacturing - Domestic Market		-22.705 (0.021)*
USA CPI All items		-43.192 (0.010)*
EMU CPI HICP All items		29.930 (0.078)
USA PPI Manufacturing Industries		24.900 (0.014)*
JPN Yield 10-year interest-bearing government bonds		-0.251 (0.029)*
USA Rate 3-month CDs		0.180 (0.030)*
Constant	0.364 (0.000)**	0.507 (0.000)**
Observations	40	40
Adjusted R-squared	0.39	0.39
D.W.	1.4	1.6

p values in parentheses
* significant at 5%; ** significant at 1%

Figure 1 Z-scores GM. Total and intrinsic after removing macroeconomic influences
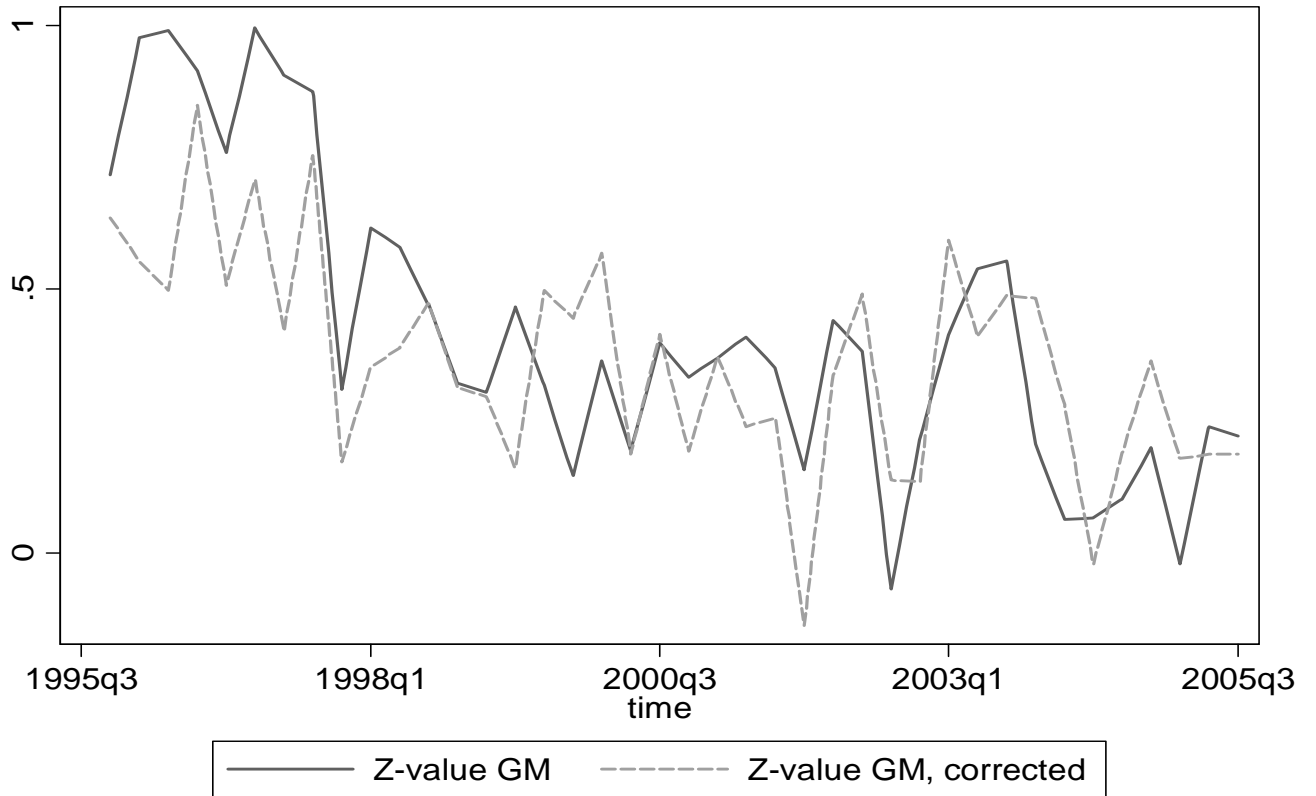
Figure 2 Z-scores Ford. Total and intrinsic after removing macroeconomic influences