An empirical analysis of the dynamic relationship between investment-grade bonds and credit default swaps

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Risky corporate and sovereign bonds are among the most recent securities to benefit from the trading of associated derivative contracts. Credit derivatives are financial instruments that can be used to transfer credit risk from the investor exposed to the risk (the protection buyer) to an investor willing to assume that risk (the protection seller). Single-name credit default swaps (CDS) are the most liquid of the several credit derivatives currently traded and form the basic building blocks for more complex structured credit products. A single-name CDS is a contract that provides protection against the risk of a credit event by a particular company or country. The buyer of protection makes periodic payments to the protection seller until the occurrence of a credit event or the maturity date of the contract, whichever is first. If a credit event occurs the buyer is compensated for the loss (possibly hypothetically) incurred as a result of the credit event, which is equal to the difference between the par value of the bond or loan and its market value after default.

This paper addresses the validity and implications of a theoretical relationship equating credit default swap prices and credit spreads using data for a small cross-section of US and European firms for which high-quality data are available. For this sample of investment-grade firms, the theoretical arbitrage relationship linking credit spreads over the risk-free rate to CDS prices holds reasonably well on average for most of the companies (but especially for US firms), when the risk-free rate is proxied by the swap rate. Where the relationship does not hold, imperfections in the CDS market or measurement errors in the credit spread may be responsible. Due to contract specifications in credit default swaps, particularly in Europe, a cheapest-to-deliver option may also be included in the CDS price making it an upper bound on the true price of credit risk. We are unable to incorporate the repo cost of corporate bonds in our analysis due to a lack of reliable data. As a result, the measured credit spread may underestimate the true credit spread, and so forms a lower bound on the true price of credit risk. Subject to these caveats, for most reference entities, both the cash bond and credit default swap markets appear to price credit risk equally on average. We demonstrate, however, that price discovery takes place primarily in the CDS market. We speculate that price discovery occurs in the CDS market because of (micro)structural factors that make it the most convenient location for the trading of credit risk, and because there are different participants in the cash and derivative market who trade for different reasons.

The second part of the paper examines the determinants of changes in the two measures of the price of credit risk. Variables suggested by the structural literature on credit risk are capable of explaining around one quarter of the weekly changes in credit default swap prices. The same variables are less successful in capturing changes in credit spreads. Firm-specific equity returns and implied volatilities are statistically more significant and of greater economic importance for CDS prices than for credit spreads. The pricing discrepancy between CDS prices and credit spreads is closed primarily through changes in the credit spread, reflecting the CDS market's lead in price discovery. It is through this error correction mechanism that both CDS and credit spreads price credit risk equally in the long run. We argue that these findings are supportive of the structural models of credit risk.

Crisis spillovers in emerging market economies: interlinkages, vulnerabilities and investor behaviour

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Many emerging market economy (EME) financial crises in the 1990s quickly spread to other countries. By contrast, immediate spillovers from the Argentina crisis in 2001–02 were much more limited. Why do some crises spread quickly and widely, while others are constrained to only a few countries? How is financial distress transmitted across countries? Do crises spread purely to countries with existing vulnerabilities? And can individual EMEs or the international community do anything to limit the potential for shocks to have harmful effects elsewhere? To address these questions, we need to enhance our understanding of how crises can be propagated.

Drawing on elements of both the contagion and early-warning system literature we propose a simple methodology for assessing potential spillovers to EMEs from crises elsewhere which stresses the joint importance of intra-EME linkages, related country-specific vulnerabilities and investor behaviour. The first element is an assessment of the potential for shocks to pass from a crisis economy to other EMEs through real and financial interlinkages, both directly and indirectly through third economies. Obviously, an examination of these *ex-ante* linkages can only offer a first pass at assessing potential for shock transmission: in some crises new (or strengthened) linkages will open up, for example, when investors reassess the fundamental vulnerabilities of EMEs following a crisis elsewhere; in other cases pre-existing linkages may turn out to be less important in crisis dynamics than expected. The second component is an examination of specific vulnerabilities of EMEs to shocks potentially transmitted from a crisis EME. Other important factors, which are more difficult to quantify *ex ante*, include the potential responses of policymakers and investors to the initial shock and crisis transmission.

This framework provides insights into the reasons for different spillovers in two case studies—Asia 1997–98 and Argentina 2001–02. These studies suggest that the framework might be a useful starting point for assessing the likelihood of a crisis spreading from one EME to another. However, our case studies also highlight what we do not know about the spread of crises. Actual crisis dynamics are affected by a much wider range of factors. Some crises spread through mechanisms we have not been able to measure. For example, we have limited information on non-bank financial channels. And even for bank channels, theory offers us little guidance on how creditors will adjust their lending in the event of losses on part of their portfolio due to an EME crisis. Further work in these areas might shed light on the evolution of recent crises, help to provide forward-looking tools for spotting incipient future crises, and potentially help policymakers to identify measures that might prevent them.

Investment-specific technological change and growth accounting

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In a set of related and influential papers, Greenwood, Hercowitz and Krusell, hereafter GHK, have claimed that the growth-accounting framework that they ascribe to Jorgenson is flawed. They also claim that the methodology of the national accounts is flawed, at least for the purposes of productivity analysis. They develop an alternative framework centred round the concepts of 'neutral technological change' and 'investment-specific technological change'. They use their framework as the basis for determining what proportion of growth is due to investment-specific technological change, ie what is the quantitative importance of 'embodiment'. Embodiment means (roughly) the extent to which in the long run productivity growth is due to improvements in the quality of machinery and equipment, rather than (say) greater efficiency in the way in which production of consumption goods is carried out. GHK claim that Jorgensonian growth accounting severely understates the role of embodiment.

Contrary to their claim, this paper shows that their model can be analysed as a special case of the more general Jorgensonian approach. Consequently, as is also shown, their criticisms of the Jorgenson framework are incorrect. The equations of the GHK model can be derived from a two-sector model in which the production functions are the same up to a scalar multiple (total factor productivity (TFP)). Investment-specific technological change (ISTC) is then found to be closely related to the more familiar concept of TFP growth. In fact, in this special case of the two-sector model, ISTC equals the difference between TFP growth in the investment good sector and TFP growth in the consumption good sector. Neutral technological change is found to equal the growth rate of TFP in the consumption sector.

The two-sector model from which the GHK approach can be derived is consistent with Jorgensonian growth accounting. Jorgenson's approach does not employ the particular aggregate production function that they attribute to him. In his approach, the growth of aggregate output is measured by weighted averages of the growth rates of output in the various sectors, where the weights are the time-varying shares of each sector in the value of output: there is no need to assume that the relative price of investment goods is constant.

GHK criticise the methodology behind the US (and other countries') national accounts, arguing that expenditure on investment goods should be deflated by the price of consumption goods, not the price of investment goods. This argument must also be rejected. The two-sector model that lies behind GHK's results is itself consistent with standard national accounting principles. However, if our interest is in measuring welfare rather than output, there is a case for deflating all types of expenditure by the price of consumption. But then it is net, not gross, domestic product that we should be looking at.

In the empirical section of the paper, we compare two studies of the importance of technical progress in the equipment-producing sectors in explaining US growth, the first by GHK, the second a growth-accounting study by Jorgenson and Stiroh. GHK find embodiment to be twice as important as do Jorgenson and Stiroh. The main reason for this difference is found to be data, not methodology. GHK use a deflator for equipment that falls much more rapidly than the official one. Methodology does provide a subsidiary reason. GHK quantify the role of technical progress in the equipment-producing sector by asking by how much the steady-state growth rate of consumption would be reduced if ISTC were the only source of technical progress. By contrast, the growth-accounting tradition estimates the contribution of TFP growth in a particular sector to aggregate TFP growth. This is measured by TFP growth in the sector in question, weighted by the ratio of the sector's gross output to GDP.

An empirical model of household arrears

Working Paper no. 214

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There has been a rapid build-up of debt by UK households since the second half of the 1990s, as occurred also in the late 1980s. The ratio of total household debt to disposable income rose to 120% in 2002 Q2, some 10 percentage points above the previous peak in the early 1990s. Unsecured debt has increased from around 16% of total debt in 1990 to around 20% in 2002. A large part of the increase in unsecured debt has been due to growth in credit card borrowing. Despite the growth in both secured and unsecured debt there has been a contrasting difference in the build-up of arrears on different types of borrowing. Credit card arrears of three months have been rising since 1996 but, in contrast, mortgage arrears of six months or more have fallen continuously since 1992.

This paper attempts to explain these differences in the pattern of arrears in terms of the factors accounting for the probability of default on secured and unsecured household loans, and the factors influencing supply of the two types of loans.

Much of the literature uses one of two alternative theories of default to determine the likelihood of going into arrears on a mortgage. The 'equity' theory of default holds that, when households default, they choose to do so voluntarily after a rational analysis of all future costs and benefits associated with continuing or not continuing to meet the obligations of the mortgage. The 'ability-to-pay' theory of default suggests individuals default involuntarily when they are unable to meet current payments. The latter suggests a greater role for flow measures of mortgage repayments. However, the ability-to-pay model can equally be seen as a special case of the equity model where liquidity constraints operate. In general, the literature emphasises the complexity of decisions of borrowers and lenders. There is also a distinction between default and going into arrears. Being in arrears does not necessarily imply an inability to repay debt. All these considerations make it difficult to generate aggregate testable models. Although the empirical analysis in this paper gives some insights into the main influences on arrears, the empirical estimates are essentially reduced-form.

Our empirical model of mortgage arrears provides broad support to the 'ability-to-pay' theory, with mortgage income gearing the most significant explanatory variable. Other significant variables include the unemployment rate, the amount of undrawn equity and the loan to value ratio (LTV) for first-time buyers. Interestingly, the empirical model suggests that mortgage arrears are negatively linked to the loan to value ratio. One possible explanation for this put forward is the effect of second mortgages, which are typically at lower loan to value ratios but tend to be higher risk. Alternatively, it could reflect supply-side behaviour by banks, given that they are more prepared to extend higher loan to value ratios to better credit risks.

There has been relatively little previous work on explaining credit card arrears in aggregate, although there has been extensive work on credit-scoring techniques applied to individual borrowers. Most of the work originates in the United States, using the Survey of Consumer Finances. This is used to identify characteristics associated with more risky borrowers. Other relevant factors include card usage statistics, which provide an insight into the way in which more risky customers use their cards. Time-series models are also available but these have tended to look at defaults rather than arrears. There is evidence, however, that defaults and arrears have moved together.

As for mortgage arrears, the model of credit card arrears is reduced-form rather than derived from an underlying theoretical structure. Availability of data also limits the scope of the empirical analysis. However, the results indicate a strong positive relationship between credit card arrears and household income gearing. In addition, the growth of credit cards is found to be a significant factor, underlining the importance of increased credit card penetration in the United Kingdom in recent years. Unlike the mortgage arrears model, the research does not find a significant effect for unemployment in explaining credit card arrears. Joint tests of the two equations support these findings, although a role for the loan to value ratio is found in explaining credit card arrears but with the opposite sign to that for mortgage arrears. A possible explanation for the opposing signs is that higher LTVs are associated with a better credit risk on mortgage loans, but they might also suggest that households are more likely to be overextended and therefore will build up arrears on credit card debt.

The paper also considers the speed of adjustment within each of the two models. Credit card arrears are found to respond more rapidly than mortgage arrears to shocks from the two equations estimated independently, consistent with anecdotal evidence that individuals tend to default on unsecured debt before secured debt. But when they are considered jointly we find that credit card arrears are a leading indicator of future mortgage arrears. Once this link is taken into account, the underlying speed of adjustment across the two models is found to be very similar.

These equations can be integrated into an overall macroeconomic framework to aid projections of arrears conditional on the macroeconomic environment, and hence permit an analysis of the financial position of UK households.

At the aggregate level, further work might seek to link household sector mortgage arrears to mortgage repossessions and credit card write-offs, and thereby analyse the implications of changes in arrears for the financial position of UK banks. More complete models of the stock/flow relationship of arrears at different durations might improve our understanding of the dynamics between macroeconomic factors and household financial distress. At the disaggregated level, research might usefully consider survey and panel-based sources of data, such as the British Household Panel Survey, to identify those households with a higher risk of default and their characteristics. At the household level, it is likely that changes in individual family financial circumstances (family formation, separation) may be at least as important as aggregate macroeconomic factors.