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The impact of financial stress on sectoral productivity☆

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ABSTRACT

This paper examines the impact of financial stress on labour productivity in two broad sectors: production and market services. The results indicate that, while both sectors are affected by financial stress, the channels through which this happens differ.

1. Introduction

Recent events have focused the attention of the academic and policy community on the operation of financial markets. However, financial crises are not uncommon events: between 1980 and 2000, seven systemic crises and other more moderate crises took place in advanced OECD countries (Davis and Karim, 2008). A comparison of the magnitude and duration of these crises has clear implications for debates about the impact of financial cycles on key economic indicators, such as labour productivity. Existing empirical research has addressed this issue at the aggregate economy level. Barrell et al. (2010), for instance, provide evidence that one in four crises leave a permanent scar on aggregate labour productivity. However, little is known about whether such impacts vary across different sectors. The goal of this paper is to fill this gap. An enquiry in this direction is not only empirically relevant, but theoretically important as well, since it sheds light on why some countries are more affected than others by financial crises.

Episodes of financial turmoil may cause fluctuations in labour productivity through changes in physical and intangible capital investment, changes in resource allocation within and across sectors, as well as changes in the market environment. In particular, an increase in financial stress may raise the user cost of capital (following weakening of banks' willingness to take risk and finance new investment), slow down the process of industrial restructuring, make R&D and innovation more costly, and reduce international trade and investment (see O'Mahony, 2010). Since production industries are typically more capital intensive and more exposed to international activities than service industries, we might expect a proportionally greater impact on the labour productivity of the former. There is also some suggestion in the literature that innovation in service industries requires less external financing than in production industries, as the latter are more dependent on large-scale and costly R&D labs (Dahlstrand and Cetindamar, 2000). In order to investigate whether the labour productivity growth rate of production industries is more responsive to financial cycles than that of service industries, this paper considers panel cointegration techniques in a data set consisting of 12 OECD countries[1] over a 27-year period (1981–2007), and employs the financial stress index[2] developed by Balakrishnan et al. (2011) and Cardarelli et al. (2011).

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[1] These countries are: Australia, Denmark, Spain, Finland, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom and the United States.

[2] The financial stress index (FSI) is a time-varying measure of financial instability in 17 advanced economies (1980–2009) and 27 emerging economies (1996–2009), and contains three main components: the bank-related stress, the securities-related

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2. Data and empirical model specification

We may write the sectoral production function for production industries ($m = PD$) and service industries ($m = MS$) in the following form:

$$\ln(VA_{it}^m) = b\ln(LAB_{it}^m) + (1-b)\ln(CAP_{it}^m) + A_{it}^m \quad m \in \{PD, MS\} \tag{1}$$

where VA_{it}^m is the value added in sector m, country i and year t, LAB_{it}^m is the labour input in efficiency terms, CAP_{it}^m is the capital input, b and $(1-b)$ are the labour and capital shares respectively, and A_{it}^m is an indicator of technology. The variable LAB_{it}^m may be multiplicatively decomposed into hours worked by persons engaged, denoted by EH_{it}^m, and average skills of the members of the workforce, denoted by S_{it}^m. Subtracting the logarithm of EH_{it}^m from both sides of Eq. (1), we get

$$\ln(Y_{it}^m) = b\ln(S_{it}^m) + (1-b)\ln(K_{it}^m) + A_{it}^m \tag{2}$$

where $Y_{it}^m = \frac{VA_{it}^m}{EH_{it}^m}$ is labour productivity and $K_{it}^m = \frac{CAP_{it}^m}{EH_{it}^m}$ is capital deepening. The level of technology may depend on a number of factors, including openness to trade, foreign direct investment, removal of barriers to competition through the European Single Market programme, and investment in research and development (see Barrell et al., 2010). We can summarise these determinants using the following equation:

$$A_{it}^m = c_1\ln(OPEN_{it}^m) + c_2\ln(FDI_{it}) + c_3 ESM_{it} + c_4\ln(R\&D_{it}) \tag{3}$$

where $OPEN_{it}^{PD}$ is the sum of imports and exports of goods as a percentage of GDP, $OPEN_{it}^{MS}$ is the sum of imports and exports of services as a percentage of GDP, FDI_{it} is the inward foreign direct investment stock as a percentage of GDP, ESM_{it} is a variable that mirrors the official timing of the European Single Market program,[3] and $R\&D_{it}$ is the R&D stock as a percentage of real output. A problem that arises with the above specification is that the variables $\ln(OPEN_{it}^m)$, $\ln(FDI_{it})$ and ESM_{it} appear to be highly collinear. To address this problem, we construct a composite index using the first principal component of the variables in question, denoted by C_{it}^m; that is, the component with the maximal overall variance of all linear combinations of $\ln(OPEN_{it}^m)$, $\ln(FDI_{it})$ and ESM_{it}.[4] Substituting the technology Eq. (3) into the labour productivity Eq. (2), and replacing the three correlated variables in (3) by C_{it}^m (to be referred to as competitiveness index), we get

$$\ln(Y_{it}^m) = b\ln(S_{it}^m) + (1-b)\ln(K_{it}^m) + d_1 C_{it}^m + d_2\ln(R\&D_{it}). \tag{4}$$

As already mentioned, the occurrence of financial shocks may affect labour productivity through changes in capital investments and the market environment. Such shocks may arise from both domestic and international developments. To this extent, we can write the capital deepening variable, the competitiveness index and the R&D variable in Eq. (4) as linear functions of the "domestic" financial stress,[5] denoted by FS_{it}, and the "imported" financial stress, computed as the weighted average of all other countries' financial stress (using bilateral trade shares as weights) and denoted by WFS_{it}, as follows:

$$\ln(K_{it}^m) = \widetilde{K}_{it}^m + \beta_1 FS_{it} + \beta_2 WFS_{it} \tag{5}$$

$$C_{it}^m = \widetilde{C}_{it}^m + \beta_3 FS_{it} + \beta_4 WFS_{it} \tag{6}$$

$$\ln(R\&D_{it}) = \widetilde{R\&D}_{it} + \beta_5 FS_{it} + \beta_6 WFS_{it} \tag{7}$$

where $\beta_1, \ldots, \beta_6 < 0$ and $\widetilde{K}_{it}^m$, $\widetilde{C}_{it}^m$ and $\widetilde{R\&D}_{it}$ capture all factors that affect the left-hand-side variables other than financial stress; obtained using estimated residuals from country-by-country regressions on FS_{it} and WFS_{it}. Building upon Eqs. (4)–(7), we can estimate long-run relationships between output, inputs and financial stress using the following specification:

$$\ln(Y_{it}^m) = \alpha_1\ln(S_{it}^m) + \alpha_2\widetilde{K}_{it}^m + \alpha_3\widetilde{C}_{it}^m + \alpha_4\widetilde{R\&D}_{it} + \alpha_5 FS_{it} + \alpha_6 WFS_{it} + \text{error}_{it}. \tag{8}$$

If both sides in (8) are $I(1)$ and the variables are cointegrated, then the error term is an $I(0)$ process for all i. A principal feature of cointegrated variables is their responsiveness to any deviation from long-run equilibrium. Thus, we can re-parameterise (8) into an error correction equation as follows:

$$\Delta\ln(Y_{it}^m) = \varphi\Big(\ln(Y_{it-1}^m) + \vartheta_1\ln(S_{it-1}^m) + \vartheta_2\widetilde{K}_{it-1}^m + \vartheta_3\widetilde{C}_{it-1}^m + \vartheta_4\widetilde{R\&D}_{it-1} + \vartheta_5 FS_{it-1} + \vartheta_6 WFS_{it-1}\Big) + \delta_1\Delta\ln(Y_{it-1}^m) + \delta_2 Avg\,\Delta\ln(Y_{it}^m) + \text{error}_{it} \tag{9}$$

where $\Delta\ln(Y_{it}^m)$ is the first difference of the dependent variable and φ is the error-correcting speed of adjustment term. Notice that, in order to address the possibility of cross-country heterogeneity and probable existence of common unobserved factors omitted from the panel, we follow Pesaran (2006)'s Common Correlated Effects (CCE) approach and augment the error correction equation with cross-sectional year averages of the dependent variable, denoted by $Avg\,\Delta\ln(Y_{it}^m)$.

Industry-level[6] data on output and inputs are retrieved from the EU KLEMS Database (O'Mahony and Timmer, 2009). Statistics on foreign direct investment, overall trade and bilateral trade flows are extracted from the UNCTAD FDI Database, the World Bank's World Development Indicators and the IMF Direction of Trade Statistics respectively. Data on R&D stock are taken from the OECD Main Science and Technology Indicators and complemented, where needed, by the OECD Research and Development Expenditure in Industry Database.

3. Empirical results

The first step is to examine the unit root properties of the time series under consideration. To do so, we implement the panel unit root tests proposed by Maddala and Wu (1999) (ADF–Fisher tests) and those proposed by Im et al. (2003) (IPS tests). The advantage of these tests is that they permit heterogeneity of the autoregressive roots under the alternative hypothesis; that is, they combine individual unit root tests to derive a panel-specific result. Table 1 reports the corresponding results and provides

stress and the exchange rate stress. Cardarelli et al. (2011) show that the most important effects of FSI on output occur in periods of financial stress associated with the banking sector. Hence, the index used for this paper is constructed by taking the standardised average of the three bank-related subcomponents (the beta of the banking sector, the TED spread and the inverted term structure) and the corporate debt spread (to capture shifts in risk and uncertainty), averaged across months.

3 For Finland and Sweden, ESM_{it} starts at 0 in 1992 and gradually rises to 1 in 1995; that is, the year they became full EU members. For the remaining EU countries, it starts at 0 in 1986 and gradually rises to 1 in 1992 (see Barrell et al., 2010).

4 The principal component analysis illustrates that C_{it}^m has positive loadings of roughly equal size on all three variables and can explain about 71% of the variance or information contained in them.

5 To create variables that are relatively more sensitive to long-term than to short-term fluctuations, the financial stress time series are smoothed using the Hodrick–Prescott (HP) filter with $\lambda = 10$. Baxter and King (1999) show that $\lambda = 10$ is the appropriate value for the smoothing parameter when applying the HP filter to annual data, and that using this value produces a much better correspondence with band-pass filters.

6 Production comprises the sum of manufacturing, utilities and construction, whereas market services include distribution, transport and communications, financial and business services (excluding real estate) and personal services.