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THE MONETARY TRANSMISSION MECHANISM: EVIDENCE FROM THE INDUSTRIES OF FIVE OECD COUNTRIES

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Abstract

This paper presents new evidence on the monetary transmission mechanism based on the effects of unexpected monetary policy shocks on 21 manufacturing industries in 5 OECD countries (France, Germany, Italy, the UK and the US). The goal is twofold. First, to document the cross-industry heterogeneity of monetary policy effects. Second, to explain this heterogeneity in terms of microeconomic characteristics suggested by theory, using an original firm-level database. The results highlight the following empirical regularities: (i) a significant cross-industry heterogeneity of policy effects; (ii) a similar cross-industry distribution of policy effects across countries. These patterns are systematically related to industry output durability and investment-intensity and to measures of firms' borrowing capacity, size and interest payment burden. Quantitatively, the "credit channel" variables are as significant as the traditional variables (durability, investment intensity) in explaining the differential impact of monetary policy.

JEL classification: E52, E32, G32.

Keywords: monetary policy transmission, balance sheet data.

Contents

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1. Introduction[1]

This paper reports new evidence on the monetary transmission mechanism. This evidence is obtained from the study of the impact of unexpected monetary policy shocks on the activity of 21 manufacturing sectors in 5 OECD countries (France, Germany, Italy, the UK and the US). The goal is twofold. First, to document the cross-industry heterogeneity of the output effects of unanticipated monetary policy. Second, to explain these effects in terms of industry characteristics which are suggested by monetary transmission theories.

Our approach, based on a panel of disaggregated data, is motivated by the premise that the industry effects of monetary policy are more helpful in understanding the monetary transmission mechanism than their aggregate counterpart. There are two reasons. First, the factors suggested by economic theory as the determinants of monetary policy effectiveness (e.g. interest-rate demand sensitivity, capital intensity of the production process, firm size, firm access to financial markets) take on a wide range of values in the microeconomic data. In particular, most of the factors vary more across sectors within a country than across developed countries. This means disaggregated data may be more informative than aggregate data.[2] The different impacts of policy on the spending components of output (e.g. durable versus non-durable consumption), documented for instance by Bernanke and Gertler (1995), offer indirect evidence of the heterogeneous industry effects of monetary policy. The information provided by this heterogeneity, which may be useful in understanding the monetary transmission mechanism, is lost with aggregation.

Second, panel data (across industries and countries) allow us to make progress on some difficult identification problems beleaguering the study of the monetary transmission. Usually, one needs to make a set of identifying assumptions to isolate the influence of a specific factor on the response of the economy to a monetary policy shock. Typically this

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[1] We benefited from the comments of Paolo Angelini, Juan Dolado, Eugenio Gaiotti, Bernd Hayo, Rodolfo Helg, Ignacio Hernando, Wilko Letterie and Tony Yates, and from discussions with Jordi Galì, Luigi Guiso, Anil Kashyap, Nobu Kiyotaki, Fabio Panetta and Daniele Terlizzese. We also thank seminar participants at the Bank of Italy and the Monetary Transmission Network of the European Central Bank. Any remaining errors are ours. We thank Miria Rocchelli for her expert assistance in organizing the database. The views herein are personal and do not involve the responsibility of the Bank of Italy.

[2] Sectoral studies have already proved very useful in the understanding of the business cycle determinants (e.g. Stockman, 1988; Basu and Fernald, 1995) and in the evaluation of the optimum currency area criteria (e.g. Helg, Manasse, Monacelli and Rovelli, 1995).

amounts to finding a differential response of two sets of agents to a change in monetary policy and arguing that such difference reflects the presence of the factor under investigation. For instance, the usual identifying assumption adopted in the study of the "credit" channel is that, absent credit market imperfections, small and large firms would react in the same way to a monetary policy disturbance. The fact that they react differently is taken to be evidence of an operative credit channel.[3] However, as pointed out by Eichenbaum (1994), "a different interpretation builds on the notion that small firms [...] could be concentrated in cyclically sensitive industries or in industries were inventories do not build up as quickly at the onset of a recession. Then the differential response of small and large firms to changes in monetary policy [...] simply reflects the underlying reasons for the size distribution of firms." Here we take advantage of cross-industry observations, drawn from a number of countries, to investigate the plausibility of such alternative interpretation. We do this by controlling for a number of factors that might explain the size distribution of firms. For instance we take account of the (possible) concentration of small firms in interest-sensitive industries, identified as those producing durables and investment goods. The data reveal that, even after controlling for these factors, smaller firms in otherwise similar industries display a higher sensitiveness to monetary policy shocks.[4]

We begin by measuring the output effects of unanticipated monetary policy shocks by means of a structural VAR that is applied to 21 manufacturing industries in each of the 5 countries considered. Since it focuses on the effects of (unanticipated) policy shocks, the structural VAR approach is well suited to analyzing the effects of monetary policy because it enables us to control for the systematic interaction between the endogenous variables. Moreover, its widespread use in the literature makes our results comparable to previous studies. After documenting the industry effects of monetary policy we use two industry databases, one of which contains firm-level information, to build a number of proxies for the determinants of the monetary policy impacts as suggested by the "interest rate channel" and the "broad

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[3] See Kashyap and Stein (1994) and Gertler and Gilchrist (1994).

[4] Another desirable feature of disaggregated data, which we do not exploit, is that they make it possible to distinguish aggregate differences related to "behavior" from those related to "composition". This point, which is key to identifying the causes of cross-country "asymmetric" policy effects, is emphasized by Guiso, Kashyap, Panetta and Terlizzese (1999, p. 61): "Relevant differences in the response to a monetary policy shock can be observed among different groups of agents in the same country, similar groups of agents in different countries, or both. However, the relative weights of these groups could differ across countries, in which case aggregation problems will confound attempts to make sense of the evidence."

credit channel" views of the monetary transmission mechanism, which are presented in the next section.[5] These proxies are used to explain the differential industry impacts of monetary policy, as measured by the estimated impulse response functions.

The results highlight the following empirical regularities: (i) a significant cross-industry heterogeneity of policy effects; (ii) a similarity across countries of the cross-industry distribution of policy effects: some industries, e.g. motorvehicles (food), show a systematic above (below) average response to monetary policy shocks. These patterns are systematically related to industry output durability and investment-intensity and to measures of firms' borrowing capacity, size and interest payment burden which, according to the "credit view", should influence the intensity of policy effects. This may be of interest because, as Bernanke (1993) pointed out, it is not the existence of a credit channel effect that is in doubt but rather its *quantitative* importance in the overall context of policy transmission. In this respect, our paper provides some evidence showing that the policy determinants suggested by the credit view are quantitatively as important as traditional ones (e.g. durability, investment intensity) in explaining the heterogeneous effects of monetary policy.

Our study is related to a recent paper by Carlino and DeFina (1998), in which the differential effects of monetary policy shocks across US regions are explained in terms of the concentration of small firms (taken as a measure of a "credit channel" effect) and the share of manufacturing in total production (accounting for the "interest rate channel"). Clearly, the identification of these two channels of monetary transmission rests on the presumption of "credit constrained small firms" and "differing interest rate elasticities of industries" (Carlino and DeFina 1998, p. 572). As argued above, the availability of industry-level data allows us to identify and test for the relevance of the determinants of the policy effects in a more direct way. Our paper is also related to a recent study by Hayo and Uhlenbrock (2000) in which the industry effects of monetary policy in Germany are measured and explained by industry indicators of investment intensity, trade openness and government subsidies. Our analysis extends this work by considering 5 OECD countries and relating the industry effects of monetary policy also to credit channel, firm-level features.

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[5] This novel database, including information from the balance sheets of about 42,000 firms over a 5-year period, is attached as a data appendix.

The paper is organized as follows. In the next section the theoretical underpinnings of the industry effects of monetary policy are briefly discussed. In Section 3 we present the methodology used to identify monetary policy shocks in the five countries at the aggregate level. In Section 4 the method is extended to study the industry responses to policy shocks. The heterogeneity of the industry responses is explained on the basis of structural features in Section 5, which also provides first-round panel evidence on the significance of the different channels of monetary transmission. A summary of the main results and suggestions for future research appears in Section 6.

2. Some sectoral implications of monetary transmission theories

Theoretical studies of the monetary transmission mechanism suggest several reasons why a monetary contraction, inducing an increase in the short-term interest rate, should have different effects on industrial activity. Therefore focusing on industry data is a natural way to utilize the information that such heterogeneity may provide. In this Section, we briefly present some of the theoretical arguments underlying the view that monetary policy effects may vary in intensity across industries.[6] These arguments motivate our empirical investigation.

A first set of hypotheses suggests that changes in real interest rates brought about by monetary policy impinge on sectoral output by affecting both demand and supply decisions. We will call this channel, common to several models, the interest rate channel. It postulates that, by raising the expected real interest rate – in general because of some form of sluggishness in nominal prices (as in the dynamic sticky price models of Yun (1996) and Kim (2000)), or portfolios adjustment (as in the limited participation models studied by Lucas (1990), Fuerst (1992), and Christiano and Eichenbaum (1992)) – a monetary restriction triggers a contraction in expenditure for investment and durable goods, which results in lower output in the industries producing these commodities.[7] In an open economy, higher interest rates may also provoke an exchange rate appreciation which causes expenditure to switch from domestic to foreign goods. In addition, firms in sectors characterized by more capital-

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[6] A comprehensive survey of the monetary transmission mechanism is beyond the scope of this paper. An excellent survey may be found in the symposium of the fall 1995 issue of the Journal of Economic Perspectives. Recent textbook presentations of the broad credit channel argument are given in Freixas and Rochet (1997, Chapter 6) and Walsh (1998, Chapter 7).

[7] The impact on investment and consumption can be magnified by the effect of a money reduction on asset prices other than interest rates, highlighted by monetarist authors, e.g., Meltzer (1995).

intensive production processes may show higher sensitivity to interest rate changes, as shown for example by the calibrated limited participation model of Christiano (1991).

A second monetary transmission mechanism, the so-called credit channel, emphasizes how asymmetric information and costly enforcement of contracts create agency problems in financial markets, resulting in a differential cost between firms' external and internal funds and in a limited access for some (small) firms to credit markets. In general terms, the "broad credit channel" postulates that financial debt becomes relatively scarce under a monetary tightening, which magnifies the real effects of monetary policy. This channel is thus thought as an amplification and propagation mechanism of the former channel, rather than as an independent one − e.g. Bernanke and Gertler (1995). Intuitively, this view relies on the reductive effect of a monetary tightening on borrowers' net worth and therefore on their borrowing capacity. In the theoretical literature, this may occur through effects on borrowers' cash flows, as in Bernanke and Gertler (1989) and Greenwald and Stiglitz (1993), or changes in the valuation of the real and financial assets they hold, as in Kiyotaki and Moore (1997) and Bernanke, Gertler and Gilchrist (1999). Another strand of the literature, e.g. Kashyap and Stein (1994), stresses the so-called "lending channel", focusing on the peculiarity of bank loans as an essential input of production (imperfectly substitutable by borrowers), especially for small firms where the problem of asymmetric information can be rather severe. A monetary tightening that entails a contraction in the supply of bank loans reduces the amount of outstanding bank credit and, finally, output.[8] Thus, firms with more difficult access to financial markets, less collateral, and whose credit-worthiness is more susceptible to changes in interest rates should be more acutely affected by monetary policy.[9]

For our purposes, it is important to note that several of the above mentioned factors − such as capital-labor ratios, trade openness, GDP shares of investment and consumer durables − are more similar across most OECD countries than across industries in any given nation.[10] This considerable cross-industry heterogeneity points at the potential fruitfulness of

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[8] Appraisals of the relevant empirical evidence are in Ramey (1993) and Kashyap and Stein (1994). Dynamic general equilibrium models quantitatively investigating the relevance of these channels are Fisher (1999), Carlstrom and Fuerst (1997), and Cooley and Quadrini (1997).

[9] It is worthwhile to point out that the credit channel can impinge on sectoral output through both prices (as the spread between the interest rate on loans and the risk free rate) and quantities (as a credit rationing effect).

[10] For example, in some countries the cross-industry variation in the percentage of listed firms ranges from 0 to 100 per cent.

the exploration. Moreover, since the broad credit channel suggests several microeconomic factors that amplify monetary policy effects, it is natural to verify its empirical relevance using disaggregated data, that are as close as possible to those identified by theory. Our last motive for using industry data is that they allow to disentangle the role of microeconomic determinants of policy effects from other time-invariant country specific factors that also influence the consequences of policy. These factors can be related to institutional/legal features, such as the workings of financial intermediaries or the judicial system (Cecchetti, 1999), and to the characteristics of the monetary regime (e.g., Lucas (1973) and Ball, Mankiw and Romer (1988) who argue that monetary policy has smaller real effects under a more accommodative rule). When such country-specific effects are present, the role of the microeconomic determinants of monetary policy may be difficult to identify empirically. The use of cross-industry observations, drawn from a number of countries, allows this identification problem to be solved by controlling for country "fixed" effects.

3. Measuring the effects of a monetary policy shock

An important step in the analysis of monetary policy effects involves breaking down the expected and unexpected components. The latter are of particular use in isolating the effects of monetary policy *per se*, separating them from the effects associated with interest rate changes that represent systematic policy reactions to exogenous factors. Isolating the exogenous component of monetary policy from the endogenous response is crucial since the empirical correlation between interest rates, output and prices may be due to reverse causation.

However, the measurement of unexpected policy components is a difficult task. Several approaches have been proposed in the literature, but no wide consensus has yet been reached yet.[11] In this paper, we rely on the structural vector auto regression methodology (SVAR). The multivariate approach of SVARs allows us to estimate exogenous monetary policy shocks while controlling for the systematic feedback between monetary policy and the main macroeconomic variables. While the impulse responses generated by the SVAR are not an estimate of the *total* effects of monetary policy (they neglect the effects due to the systematic policy component), their exogeneity makes them particularly appealing to test hypotheses on the monetary transmission mechanism.

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[11] See the exchange between Rudebusch (1998) and Sims (1998).

The identification method used here relies on the recursiveness assumption presented in Christiano, Eichenbaum and Evans (1998) and briefly explained in Appendix A. The main reason for adopting this scheme is its simplicity, which makes it a natural starting point. Moreover, its widespread use makes the results comparable to several previous studies. Obviously, simplicity also raises the question of the robustness of our findings. This issue is discussed in Section 5.[12]

In essence, the recursiveness assumption amounts to dividing the VAR variables into two sets: on one hand those to which monetary policy reacts contemporaneously (but which respond to policy with a delay); on the other hand, those that the central bank observes with a lag (but which are immediately affected by policy). An appealing feature of the recursive approach is that the ordering of the variables preceding and following the monetary policy instrument does not influence the measurement of their responses to the monetary policy shock (see Appendix A).

Our starting point is the estimation of 5 aggregate VARs (for France, Germany, Italy, the UK and the USA) using monthly data for the 1975-1997 period and a 5-period lag length. For all countries, it is assumed that the operating instrument of monetary policy is a short-term interest rate, as is common in the literature.[13] We follow Christiano et al. (1998) in the specification of a parsimonious 5 variable VAR for the United States which includes industrial production, the consumer price index, a commodity price index, a short-term interest rate and a monetary aggregate. In the recursive ordering, the first three variables enter the monetary authorities' reaction function simultaneously (but respond to it with a lag). The monetary policy shocks thus obtained are asymptotically equivalent to the regression residuals of the short-term interest rate on the contemporaneous values of industrial production, the consumer and commodity price indices and the lagged values of all the VAR variables. For the Unites States, the impulse response functions resulting from this identification scheme, which are

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[12] In short, we find that changing the identification scheme influences the absolute *size* of the policy effect on industrial output but that the *relative* intensity of policy shocks across industries (which is what we want to explain on the basis of industry features) is not significantly changed when a different identification scheme is applied.

[13] On the use of the short-term rate as the operating tool of the G7 central banks see Clarida et al. (1998). We use three-month interest rates for all European countries and the Federal Fund rate for the US; all data were taken from the OECD database "Main Economic Indicators"; sectoral data on output are from the OECD database "Indicators of Industrial Activity". The sample period runs from January 1975 to March 1997; in a few industries data are only available since the early 1980s.

reported in the first column of Figure 1, show that following a monetary tightening there is a temporary reduction of industrial activity and the money stock. These patterns are consistent with theoretical *a priori* about the long-run neutrality of money and the short-run effectiveness of policy. The VAR specification for the European countries also includes the exchange rate, according to the presumption that this variable is more relevant in European countries than in the US, possibly because of the greater degree of openness of the European economies. The exchange rate enters the recursive ordering after the short term rate, thus assuming that monetary policy does not respond contemporaneously to the exchange rate.[14]

The specification adopted for every country and the ordering of variables used in the recursive identification of the monetary policy shock are presented in Table 1, together with some diagnostic statistics for the interest rate equation. The tests show that the estimated interest rate equations display no serial correlation and no parameter instability – when we split the sample in two – except for Germany and the United States. In the latter case it is well-known that this is related to the different operating procedures adopted in the early eighties.[15] As is common in the VAR literature, the normality of the interest rate equation residuals is rejected.

Identification schemes are harmonized across countries to minimize differences in the results originating from different specifications. An alternative identification procedure, based on country-specific schemes, leads to similar estimates of industry effects and almost identical conclusions about the relationships between these effects and their determinants (Section 5).[16]

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[14] The inclusion of the exchange rate among the variables entering contemporaneously in the monetary authority information set (but responding with a lag) helps to deal with the so-called “price puzzle” (i.e. the fact that the price level increases after a restrictive monetary policy shock). This assumption neglects the simultaneous relation between the interest rate and the exchange rate, central to non-recursive identification schemes (e.g. Sims and Zha, 1995). The monthly data used in our analysis, however, may justify the assumption of a non-simultaneous policy reaction to the exchange rate, under the premise that policy reacts to low frequency movements of the exchange rate and does not immediately react to its monthly fluctuations.

[15] Bernanke and Mihov (1998) show that the interest rate equation is only marginally affected by this instability.

[16] The results based on country-specific identification schemes, which appeared in a previous version of the paper, are available from the authors upon request. The main difference between those identification schemes and the standardized ones used here is that in the former a long-term interest rate was included in the VAR for France, Germany and the UK in order to “solve” the price and exchange rate puzzles; moreover, different lag lengths were used for each country.

Figure 1 illustrates the impulse responses of the main variables included in the VARs, along with 5 per cent confidence bands.[17] An unexpected increase of the short-term interest rate causes effects on the other variables that are *qualitatively* similar across countries and broadly in line with previous studies (e.g. Sims, 1992). The policy shock is highly persistent: in all countries the interest rate is significantly above zero in the year following the shock. Industrial production begins to decline after a few months, and bottoms after 18 to 24 months; about three years later it eventually returns to the level prevailing before the shock. Moreover, a higher interest rate leads to a contraction in monetary aggregates and, in European countries, an exchange rate appreciation.[18] The price level does not show clear signs of reduction, which is a common finding in the SVAR literature and is usually interpreted as supporting the presence of nominal rigidities. Quantitatively, the effect of a monetary policy shock on industrial production varies across countries: the maximum impact, measured by the semi-elasticity of output to the interest rate shock,[19] is about 1.6 per cent in Germany, 1.1 per cent in Italy and around 0.7 per cent in all the other countries (see the last row of Table 3). Germany and Italy also show a slower output response to the interest rate shock; industrial production bottoms out after 2 years in Italy and somewhat later in Germany. The effect is faster in France, the UK and the US.

4. Industry effects of monetary policy

In this section we employ the recursive identification scheme presented above to measure the industry effects of monetary policy. We estimate a VAR in which the production index of industry j in country i is added as the *last* variable to the VAR of country i presented before (see Table 1). A lack of data forces us to confine the analysis to differences in the output effects, overlooking possible differences in pricing behavior. The index j spans 21

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[17] Confidence bands are computed with Monte Carlo simulations assuming that innovations are asymptotically normally distributed.

[18] Except in Italy where there is no appreciation. In Germany it is not very significant.

[19] The size of the shock is equal to one standard deviation of the structural innovation of the estimated reaction function and, therefore, varies across countries. Hence, the output effect of policy is normalized by the shock in order to make it comparable across countries. In France, for example, industrial production falls by 0.2 per cent 24 months after a 40 basis point interest rate shock, which amounts to a (semi)elasticity of -0.5.

manufacturing industries. These are listed in Table 2 (according to a 3 or 4 digit ISIC code), which reports their percentage shares of total manufacturing output.[20]

This VAR specification implies that monetary policy does not respond simultaneously to industry-specific shocks but it does not constrain to zero the simultaneous response of industrial output to policy shocks. It is reasonable to consider whether allowing for a simultaneous industry response is consistent with the assumption used in the identification of the aggregate VAR that the contemporaneous aggregate output response is zero. A sufficient condition that there is no inconsistency is the empirical observation that the estimated simultaneous industry responses are generally not significantly different from zero.[21]

The main output of our analysis is a set of 100 VARs and the associated impulse response functions, one for each of the 21 industries in each of the 5 countries (5 industries lack data). For each of the 5 countries considered, Figure 2 shows the effects of a 1 percentage point increase in the interest rate on aggregate industrial production and on the output of 6 large industries – food, textiles, chemicals, iron, machinery and motorvehicles – which represent about half of total manufacturing output (for Italy 5 industries). Most industries display a u-shaped response to the shock. The erratic behavior during the first six months is never statistically significant.[22] Within each country, industry responses differ significantly both qualitatively and quantitatively. In the food and textiles industries the impact on production is less than or equal to that on the aggregate industrial production. On the contrary, the heavy industries (iron, machinery and motorvehicles) shows a response to policy to a markedly greater degree than other industries.

To quantify the output effects of monetary policy across industries (and countries), we construct three summary measures of impact: the industry output elasticity to a 1 percentage point interest rate increase after 24 months; the maximum elasticity recorded between 12 to 36 months after the increase; the average elasticity recorded between 18 and 24 months after

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[20] The data are averages for the 1970-1993 period. The industries for which data are available account for about 90 per cent of total manufacturing output in each of the countries considered. The monthly data used in the VAR are not available for all industries in some countries; these "missing" data are denoted by an asterisk in Table 2.

[21] It is also important to note that the coefficients of the lagged industry output in the policy equation (short-term rate) are never significantly different from zero. Therefore the policy shocks measured by the industry VAR are essentially identical to those obtained from the aggregate VAR.

[22] Standard error bands are not reported here for reasons of legibility.

the increase (so that single "peaks" have less influence on the impact measure). These three measures are highly correlated, suggesting that the policy effects identified by our analysis do not depend crucially on the particular measure of impact that is utilized.[23] These measures are reported in Table 3.

The impact of policy industrial output is usually negative in all of the countries and in several cases it is statistically different from zero (bold numbers). A visual inspection of Table 3 reveals that the largest (negative) impacts tend to be concentrated in the lower part of the table, where the "heavy" industries are located. In the United States, Italy and the United Kingdom the motorvehicle industry has the largest maximum impact (respectively -2.0, -2.5 and -2.4 per cent). The machinery (MH) and iron (IR) industries also record impacts that are clearly larger than those recorded by the aggregate industrial production indices in four out of five countries (see the last row of Table 3). At the other extreme, the maximum impact on the footwear (FT) and wearing apparel (CL) industries is almost never significantly different from zero; in Italy, where it is significantly different from zero, the size of the maximum impact (-0.6 per cent) is approximately half the impact recorded by aggregate industrial production (-1.1 per cent).[24]

To analyze the extent to which the cross-industry effects of monetary policy are similar across countries, we measure the uniformity of the ranking of impacts between pairs of countries using the Spearman index of rank correlation.[25] The results, presented in Table 4, are based on both the 24-month and the maximum elasticity (Panels A and B, respectively). First, it is apparent that no two countries show an "inverse" correlation of rankings (the rank correlation index is never significantly less than zero). Rather, most of the correlations are significantly greater than zero, suggesting a certain degree of cross-country similarity in the cross-industry profile of policy effects.

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[23] In each country, the cross-industry correlation between the maximum and the 24 month elasticity is greater than 0.92; that between the maximum and the 18-24 month elasticity is above 0.95 and that between the 24-month and the 18-24 month elasticity is greater than 0.98.

[24] The shipbuilding industry displays a positive response to the policy shock in three out of four countries (statistically significant in Germany); positive responses also appear in the Tobacco industry. Hayo and Uhlenbrock (2000) argue that government subsidies may help understanding the "unusual" output responses of some industries.

[25] The rank correlation index between country i and country j would be 1 if the rankings of the elasticity of Table 3 were identical or -1 if they were reversed.

We use a simple linear regression to break down the impact of monetary policy in industry j of country i (call it η_{ij}) into country and industry-specific components. To this end, we run the regression (there are 100 η_{ij} estimates obtained from the industry VARs)

$$\eta_{ij} = \mu + \alpha_i + \delta_j + \varepsilon_{ij} \quad (1)$$

where i is a country index ($i = 1, 2, ..., 5$) and j is an industry index ($j = 1, 2, ..., 21$). The constant term μ measures the average policy impact across all sectors and countries; the α_i coefficients measure the average (across industries) deviation from μ of country i; the δ_j coefficients measure the average (cross-country) deviation from μ of industry j. Obviously, the α_i and the δ_j coefficients cannot be estimated independently, as the linear dependency between the explanatory variables implies that both the industry effects and the country effects sum to zero (i.e. $\sum_i \alpha_i = \sum_j \delta_j = 0$). Therefore equation (1) is estimated under the constraints

$$\alpha_5 = -\sum_{i \neq 5} \alpha_i \qquad \text{and } \delta_{21} = -\sum_{j \neq 21} \delta_j. \quad (2)$$

The α_i measure how much heterogeneity of responses can be attributed to country specific factors, after controlling for industry differences (identical across countries). Similarly, the δ_j measure the response heterogeneity related to industry-specific factors, after controlling for country effects (identical across industries).

The estimates of equation (1) are reported in Table 5, where both the 24-month and the maximum elasticity are used as impact measures (estimated with GLS assuming the error terms ε_{ij} have country-specific variances and are correlated across countries). The estimated constant μ from the 24-month elasticity equation (first column) indicates that an unexpected interest rate increase of 1 percentage point reduces industrial activity by 0.6 per cent, in the average industry of the average country. The response of US industries is below average (a positive and significant country effect), while no "structural" differences emerge between France, Italy and Germany, where the average (cross-industry) policy effect does not reveal a statistically significant country component.[26] Significant differences appear

[26] Previous estimates, using impact measures derived from country specific VAR schemes (see footnotes 11 and 15), revealed more heterogeneity in the country fixed effects than that appearing in Table 5 (which is based on the harmonized VAR scheme of Table 1). The industry effects, however, are only marginally affected by the

across industries, confirming that industries producing non-durable goods experience a smaller decline in activity than industries producing durable-consumer or investment goods (those appearing in the lower part of Table 5). Note, moreover, that the cross-industry variability is greater than the cross-country variability. Indeed, differences across industries are as large as 2 percentage points, which is more than twice the maximum difference recorded across countries.

5. The determinants of monetary policy effects

The heterogeneity of industry responses in all the countries raises the natural question of how to explain such differences. The "interest rate channel" and the "broad credit channel" views of monetary transmission suggest several features that might help to answer this question. The purpose of this section is to build proxies for some of these features and use them to explain the different industry impacts documented above.

5.1 *The database*

To construct these proxies, we use information drawn from two databases. The first, STAN (from the OECD), contains industry data on value added, investment (i.e., gross capital formation), exports and employment at a level of disaggregation that is analogous to the one we used previously (ISIC 3/4 digits).[27] The second database, Amadeus, is an original firm-level database which contains balance sheet information for about 150,000 major public and private companies from 26 European countries, from all the branches of manufacturing considered earlier, for the period 1993-97.[28] The firms considered are markedly different in terms of size (value added, number of employees) and access to capital markets (both listed and unlisted companies are included). Unfortunately, when using Amadeus we must exclude the United States from our analysis.

VAR scheme.

[27] Data are available for most OECD countries for the 1970-1993 period.

[28] The data in Amadeus provide information on the entire distribution of the industry features considered, such as mean and median, which are not available in the STAN database. For the 21 industries of the 4 European countries studied here the database has observations on about 42,000 firms. The data are likely to be biased towards medium to large-sized firms, because the companies surveyed in Amadeus must comply with at least one of the following criteria: (a) turnover greater than 12 million USD; (b) more than 150 employees; (c) total assets greater than 12 million USD.

To measure the interest rate sensitivity of each industry we use the following variables: a *durability dummy* for industries producing durable goods;[29] measures of trade *openness* (ratio of exports - and of imports plus exports - to the industry value added); measures of *short-term debt* (industry mean and median ratio of short-term debt to total debt); measures of capital intensity (the ratio of an industry's *investment to value added*); measures of financing requirements (industry mean and median of firms' *working capital* per employee).[30] The first two variables are taken as measures of the industry demand sensitivity to changes in interest rates; the last three may affect firms' responsiveness to policy shocks impinging on their production decisions, as suggested by quantitative limited participation models, e.g. Christiano (1991). Therefore, we expect the output effect of monetary policy to be stronger in industries with larger values for each of the above variables.[31]

According to the suggestions of the broad credit channel, the following indicators are constructed: *firm size* (mean and median number of employees per firm in each sector); measures of financial *leverage* (mean and median ratio of total debt to shareholders' capital); the industry share of *listed companies* (the ratio of the number of employees of listed companies, including their subsidiaries, to the total number of employees in the industry). We interpret these variables as proxies for the indebtness capacity of firms. This is consistent with Fisher (1999) who shows, in a quantitative general equilibrium model in which some firms are credit constrained due to asymmetric information problems, that in the steady state these firms have a lower leverage ratio and are considerably smaller than their non-credit-constrained counterparts. We will thus interpret smaller firm size and leverage variables as indicators of more stringent credit constraints.[32] Similarly, it seems reasonable to expect firms listed

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[29] The industries are grouped on the basis of the economic destination of production used in the national accounts statistics. According to this criterion, the industries producing "durable" output are denoted by the ISIC codes beginning with digits: 33, 36, 37, 38 (see Table 2). An alternative measure, which includes industries 34 and 35 (paper and chemicals) among the durable output producers, does not change the results.

[30] Working capital is defined in Amadeus as the sum of the asset items "stocks" and "debtors" less the liability item "creditors". This variable proxies the short-term financial requirement of a firm business associated with its operating activity.

[31] In the case of an interest rate increase, a larger output reduction. Therefore, the expected sign of the partial correlation coefficient between the estimated elasticities (see Table 3) and each of these indicators is negative.

[32] This is also consistent with Giannetti's (2000) finding that more leveraged firms tend to obtain loans at better terms (both maturity and interest rate). Using information from the Amadeus database she shows that "the cost of debt is lower for more levered firms" and that "more levered firms are the ones with a higher share of long term debt to total debt". Both findings lead her to conclude that high leverage is a signal of the ability to get loans

in stock markets, subject to more stringent information dissemination requirements, to have easier access to credit markets. Therefore, on the basis of the broad credit channel hypothesis, we expect to find an inverse relationship between the effectiveness of monetary policy and the level of these variables (i.e. a positive partial correlation coefficient). Finally, we construct an indicator to measure the incidence of interest rate expenditure on cash-flows, called the *interest burden* (mean and median ratio of interest rate payments to operating profits). This variable may affect firms' responsiveness to policy shocks by a deterioration of their creditworthiness, as suggested in Bernanke and Gertler (1989). It is expected that a higher interest rate burden increases the impact of monetary policy.[33]

The sources and definitions of all the variables used in the analysis are detailed in Appendix B and summarized in Table A1. The "interest rate channel" variables appear in the shaded area of the right column; below them, the "broad credit channel" variables are listed in a white box.

5.2 *Regression analysis*

The industry effects that we attempt to explain are measured by the elasticities to monetary policy shocks reported in Table 3. Since these elasticities are averages of the industry behavior over the estimation period, the explanatory variables are also measured as averages over the available period.[34] The use of averages, moreover, reduces the possibility that the results depend on a particular outcome of the data in any given year.

Table 6 reports the results of a regression analysis where the 24-month elasticity is used as the dependent variable.[35] All estimates include country fixed effects to control for unobserved industry-invariant factors that may affect the policy impact in a given country[36]

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at better terms.

[33] The interest rate burden indicator differs from the leverage indicator discussed before, which is a proxy for debt capacity. Conceptually, the independence of the two is obtained if operating profits are independent of leverage. In our sample, the correlation coefficient between leverage and the interest rate burden is 0.5.

[34] The indicators are averages over the available periods: 1993-97 for Amadeus and 1970-93 for STAN.

[35] Similar results are obtained when the other elasticity measures are used (see equations 5 and 6 in Table 6).

[36] The estimates are based on the White heteroschedasticity consistent estimator (Greene, 2000, p. 463) which allows us to take account of the non-spherical disturbances typical of cross-section data.

and common (across country) coefficients for the industry explanatory variables (durability, investment/value added, openness, leverage, size, interest-burden, etc..).[37] The analysis is based on two different data samples: the first one uses the proxies constructed from the STAN database, which includes the United States (equations 1 and 2). The second is based on Amadeus and is limited to European countries (equations 3 to 7).

Equation 1 is estimated using the durability dummy, investment intensity and trade openness as explanatory variables. Since neither openness measure is statistically significant,[38] equation 2 omits this variable. It appears that industries producing durable output and more capital-intensive industries tend to react more intensely to policy shocks. This finding, also highlighted in single-country studies by Hayo and Uhlenbrock (2000) and Ganley and Salmon (1997), confirms the relevance of the traditional interest rate channel of monetary transmission. However, unlike in Hayo and Uhlenbrock, trade openness appears to play no significant role.

The use of balance sheet indicators from Amadeus allows us to go one step further in our analysis and to test the significance of credit channel variables. Equation 3, which incorporates all the explanatory variables constructed from Amadeus (i.e. working capital, short-term debt, size, leverage, listed companies, interest burden), shows that the impact of monetary policy is not significantly related to measures of short-term debt, financing needs (*working capital*) and listed companies (these variables do not pass a joint test of redundancy). After removing redundant variables from the estimation, the significant role of durability is confirmed and evidence appears in support of the broad credit channel hypothesis (equation 4). Two of the variables measuring firms' borrowing capacity, namely leverage and firm size, are significant and have the expected (positive) sign. This is consistent with the hypothesis that greater borrowing capacity reduces the potency of monetary policy. We also find that the interest-burden variable is significant and has the expected (negative) sign.

Quantitatively, the economic significance of the credit channel variables (size and leverage) appears as relevant as that of the interest channel variables. The estimated marginal effect of increasing the typical firm size by two hundred employees is a reduction of about 0.6 percentage points in the policy impact. Note that such an effect is sufficiently large to offset the negative effect experienced by the "durable" industries. Considering that the range

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37 The hypothesis of equal (across country) coefficients is not rejected at the 5 per cent level.

38 The results of equation 1 are based on the (imports+exports)/(value added) indicator.

of variation of the (median) firm size in our sample ranges from 50 to 500 employees (this interval accounts for approximately 90 per cent of the observations), the size variable appears capable of inducing differential impacts of about 1.5 percentage points, quite large if judged in comparison with the range of variation of the policy impacts (Table 3).[39] These findings have a theoretical counterparts in the results in Bernanke, Gertler and Gilchrist (1999): in their quantitative general equilibrium model of the financial accelerator, the response of output to a given monetary impulse is about 50 per cent greater than in an economy without credit market frictions.

The results are reasonably robust. They are essentially analogous to those obtained in a previous version of the paper, where the industry impacts were measured using country-specific identification schemes. The main difference between the previous estimates and the current ones is the cross-country heterogeneity of the country fixed effects, which was previously more apparent.[40] However the cross-industry variability and, quite importantly, its relation to industry features are not affected by the choice of the identification scheme: even with country-specific schemes the durability, leverage, firm-size and interest-burden variables were significantly related to the industry impact of policy. The use of alternative impact measures (maximum or 18-24 month elasticity) somewhat weakens the significance of the leverage variable (see equations 5 and 6), with no major consequences for the other variables. This also holds when instrumental variable estimation is performed (equation 7) to control for possible biases related to measurement errors in the indicators.[41] Overall, the point estimates of all the variables (except leverage) remain significant and their values do not change much across equations. In particular, the coefficients of durability and firm size are almost identical across equations, suggesting that their quantitative significance is rather robust.

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[39] Similarly, the leverage variable may explain about 1 percentage point of the differences in the policy effects.

[40] Country specific effects are quite similar in Table 6. In equation 2 it is not possible to reject the hypothesis (at the 10 per cent level) that France, Germany, Italy and the USA have identical fixed effects; a stronger than average policy effect is detected for the UK. When the European sample is used (equation 4), it is not possible to reject the hypothesis of equal coefficients (at the 10 per cent level) for Germany, Italy and the UK.

[41] We instrument the size, leverage and interest burden variables of equation 4 with their ranks across countries and industries. For instance, we rank all the industries in all the countries according to the median number of employees per firm (size) and use this ranking as an instrument for that variable.

6. Concluding remarks

This paper investigated the differential output effects of unanticipated monetary policy shocks using industry data from 5 OECD countries. The first step of the analysis documented such differences, highlighting two principal empirical regularities: (i) the significant cross-industry heterogeneity of policy effects; (ii) the similarity across countries of the cross-industry distribution of policy effects: some industries, e.g. motorvehicles (food), show a systematic above (below) average response to monetary policy shocks.

The second step of the analysis attempted to explain these regularities in terms of industry characteristics. In particular, we used two industry databases to construct a number of proxies for the determinants of monetary policy effects as suggested by the "interest rate channel" and the "broad credit channel" views of the monetary transmission mechanism. Among the variables indicated by the former, we built a dummy for durable goods industries and industry measures of capital intensity, financing requirements and exchange rate sensitivity (openness to trade). In line with the suggestions of the "broad credit channel", which emphasize the amplifier effect of firms' creditworthiness in the presence of capital market imperfections, we constructed a number of proxies for firms' borrowing capacity, such as the industry's share of listed companies, the mean and median firm size and financial leverage. To build several of these indicators we used an original firm-level database containing balance sheet information from approximately 42,000 listed and unlisted firms. The resulting summary statistics are attached as a data appendix.

The study of the relation between policy effects and industry features showed that, consistent with theoretical suggestions, the impact of monetary policy is stronger in industries that produce durable goods, are more capital intensive and have smaller borrowing capacities (i.e. smaller size and/or leverage ratio). Moreover, the output effects of policy shocks appeared to be greater in industries characterized by a larger interest rate burden (i.e. the ratio of interest payments to operating profit). No clear relation emerged between policy impacts and the degree of openness to trade, financial requirements or stock market access. Conversely, the economic significance of credit channel variables (size and leverage) appeared of the same order of magnitude as that of the interest channel variables, confirming recent results in quantitative general equilibrium models, e.g. Bernanke, Gertler and Gilchrist (1999).

Overall, this evidence suggests that microeconomic industry features have a significant influence on macroeconomic outcomes, showing that the information contained in disaggregated data is useful in understanding the monetary transmission mechanism. Several extensions and applications are left for future research. Among these, it would be of interest to analyze whether there are also heterogeneous policy effects with respect to pricing behavior and to extend the analysis to the service industries. Deepening and widening the collection of disaggregated data is an important task for future empirical work. Future research might also include policy issues. In Europe, for instance, there are questions about the possible asymmetric effects that the ECB policy might have on different countries. In particular, it would be interesting to know to what extent differences documented from historic data might change due to the common monetary policy of the ECB. Some of these issues have been recently addressed by Carlino and DeFina (1998a), Cecchetti (1999), Favero, Giavazzi and Flabbi (1999) and Guiso, Kashyap, Panetta and Terlizzese (1999). Disaggregated data appear to be a potentially promising way to tackle these questions because they allow aggregate policy effects to be broken down into industry and country-specific components. This, in turn, may allow some progress towards the identification of their microeconomic and macroeconomic determinants.

Appendix A: The VAR recursive identification scheme

VARs focus on cross-correlations among a limited number of variables. The estimated (reduced form) VAR equation can be written as

(3) $$C(L)y_t = u_t$$

where $C(L)$ is a matrix-polynomial in the lag operator ($C_0 = I$), y_t is a ($n \times 1$) vector of endogenous variables and u_t is the vector of reduced form errors with covariance matrix $cov(u_t) = \Sigma$. Equation (3) can be seen as the reduced form of the structural model

(4) $$A_0 y_t = \sum_{i=1}^{n} A_i y_{t-i} + \varepsilon_t$$

where

(5) $$\varepsilon_t \equiv A_0 u_t.$$

These three equations make it possible to derive the moving average representation:

(6) $$y_t = [A_0 C(L)]^{-1} \varepsilon_t$$

from which the "impulse response functions", showing the dynamic response of each endogenous variable to the structural innovations (ε), are derived. To derive the impulse response functions the A_0 matrix must be identified, given the estimates of $C(L)$, u_t and Σ. To this end restrictions must be imposed. A standard set of restrictions involves the assumption that the covariance matrix of the structural innovations is the identity matrix

(7) $$E(\varepsilon_t \varepsilon_t') = A_0 E(u_t u_t') A_0' = A_0 \Sigma A_0' = I$$

which amounts to assuming that the structural innovations of the endogenous variables are uncorrelated. Condition (7) imposes at most $n(n+1)/2$ constraints on the n^2 unknown coefficients of A_0. There are $n(n-1)/2$ additional restrictions needed to identify *all* the elements of A_0 (this is a necessary but not sufficient condition). One particular way to achieve this is to assume that the A_0 matrix is lower triangular (i.e. setting the $n(n-1)/2$ off diagonal elements of A_0 equal to zero, also known as Choleski decomposition).

The identification of *policy* effects based on the *recursiveness* assumption relies on a partition of the endogenous variables (y_t) into three groups: the policy variable y_{pt}; n_1 variables not responding contemporaneously to monetary policy but to which the policy variable responds contemporaneously (y_{1t}); n_2 variables responding contemporaneously to policy but to which the policy variable does not respond contemporaneously (y_{2t}; with $n_1 + n_2 + 1 = n$). The A_0 matrix may then be written as

$$(8) \qquad y_t = \begin{bmatrix} \underset{(n_1 \times 1)}{y_{1t}} \\ \underset{(1 \times 1)}{y_{pt}} \\ \underset{(n_2 \times 1)}{y_{2t}} \end{bmatrix}; \qquad A_0 = \begin{bmatrix} \underset{(n_1 \times n_1)}{a_{11}} & \underset{(n_1 \times 1)}{0} & \underset{(n_1 \times n_2)}{0} \\ \underset{(1 \times n_1)}{a_{21}} & \underset{(1 \times 1)}{a_{22}} & \underset{(1 \times n_2)}{0} \\ \underset{(n_2 \times n_1)}{a_{31}} & \underset{(n_2 \times 1)}{a_{32}} & \underset{(n_2 \times n_2)}{a_{33}} \end{bmatrix}.$$

An important property of the recursiveness assumption shown by Christiano, Eichenbaum and Evans (1998; proposition 4.1) is that the impulse response of *all* variables in y_t to a shock in the policy variable y_p is identified by the partition of y_t (i.e. y_{1t}; y_{pt}; y_{2t}). Note that the recursiveness assumption is *not* sufficient to identify all the elements of A_0 (hence the impulse response functions to shocks in variables other than y_p are not identified). In synthesis, the recursiveness result shows that if the variables in y can be partitioned in accordance with (8), then such partition is sufficient to determine the effects of a shock to the variable y_p; moreover these effects do not depend on the ordering of the variables within the y_{1t} and y_{2t} vectors.[42] Hence all that is required to identify the effects of a shock to y_p is the definition of the variables entering the policy reaction function simultaneously (y_{1t}). From a practical point of view, the recursiveness assumption justifies measuring the impulse responses to a policy shock by assuming a lower triangular A_0 matrix (Choleski decomposition) which is consistent with the partition in (8).

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[42] Note for instance that the recursive scheme is not applicable if the variable y_p simultaneously affects, and is affected by, another variable in the y vector.

Appendix B: Data sources and definitions

The following data are used in the VARs estimates:

- Industrial production: monthly indices from OECD Main Economic Indicators (1975:1 - 1997:4);
- Industrial sectors production (ISIC 3/4 digits): monthly indices from OECD Indicators of Industrial Activity;
- CPI: monthly data from OECD Main Economic Indicators (1975:1-1997:4);
- Interest rates: monthly averages of the Federal Fund Rate (US), and the three month interbank rate for all other countries; from BIS Data Bank (1980:1 - 1997:4). For Italy, three month interbank rate from the domestic screen-based market (MID);
- Exchange rates: monthly averages of the real effective (trade weighted) exchange rate from IFS ("rec" line) (1980:1 - 1997:4);
- Money stock: M1 and M3 monetary aggregates, national definitions, monthly data from BIS Data Bank (1980:1 - 1997:4).

A synopsis of definitions and sources of the variables used in the regressions of Table 6 appears in Table A1. The left column lists the countries and industries upon which the analysis is based. The right column lists the variables that are used in the regressions. The dependent variables appear in the upper panel of this column, they are given by the (semi)elasticity of industrial output to an interest rate structural innovation, 24 months after the shock, at its maximum after 12 to 36 months and as the average impact from 18 to 24 months.

Explanatory variables used in the regressions are listed in this column below the dependent variables. The first variable is a durability dummy, which is 1 if the industry produces durable goods. The economic destination of production is from the national accounts statistics: according to this criterion, the "durable" output industries are denoted by the ISIC codes beginning with 33, 36, 37 or 38. An alternative measure, which includes industries 34 and 35 (paper and chemicals) among the durable output producers, does not affect the results in Table 6.

The next three variables are constructed from the STAN-OECD database, which records annual data aggregated at the industry level; the variables we use are averages for the 1970-1993 period. They are:

– the industry "investment intensity" ratio: (investment) / (value added)
– the industry openness ratio: (exports+imports) / (value added)
– the industry export ratio: (exports) / (value added).

The other explanatory variables are constructed from yearly balance sheet data of individual firms contained in Amadeus. First, average firm level data are calculated over the available period (1993-97); second, the industry mean and median value of each variable is calculated from the firm level-data (the exception is the *listed companies* variable). The variables are defined as follows:

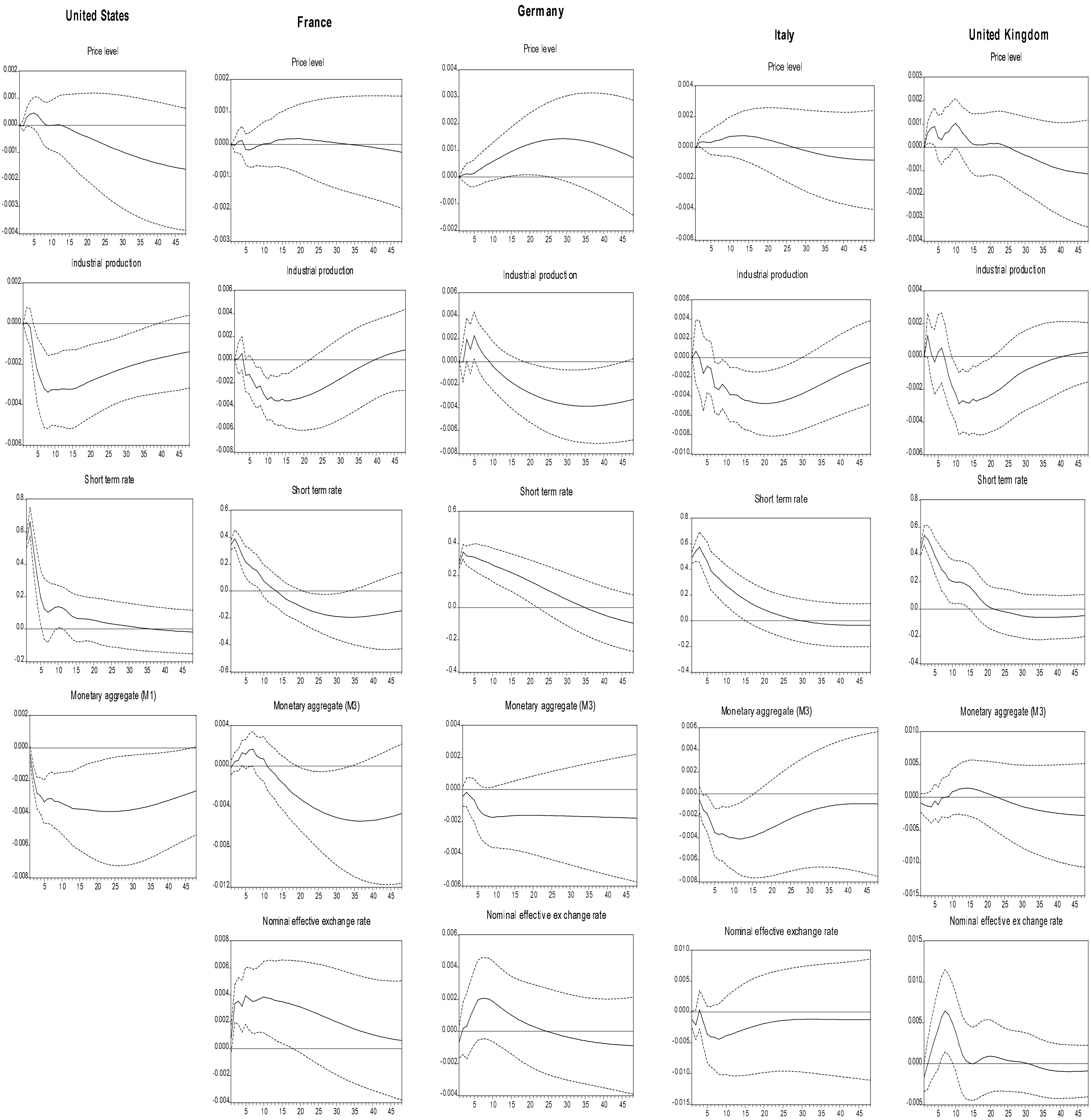
– working capital per employee: the sum of the asset items "stocks" and "debtors" minus the liability item "creditors" divided by the firm's number of employees (data are in thousands of euros per employee).
– short-term debt (ratio): (short-term debt) / (total debt)
– firm size: number of employees per firm (in units)
– leverage (ratio): (total debt) / (shareholders' funds)
– listed companies: ratio of employment in listed firms (including subsidiaries) to total industry employment (the latter variable is from STAN).
– interest burden: ratio of interest rate payments to operating profits.

The variables are reported in Tables A2-A6.

Figure 1

Responses of the main macro variables to a monetary policy shock

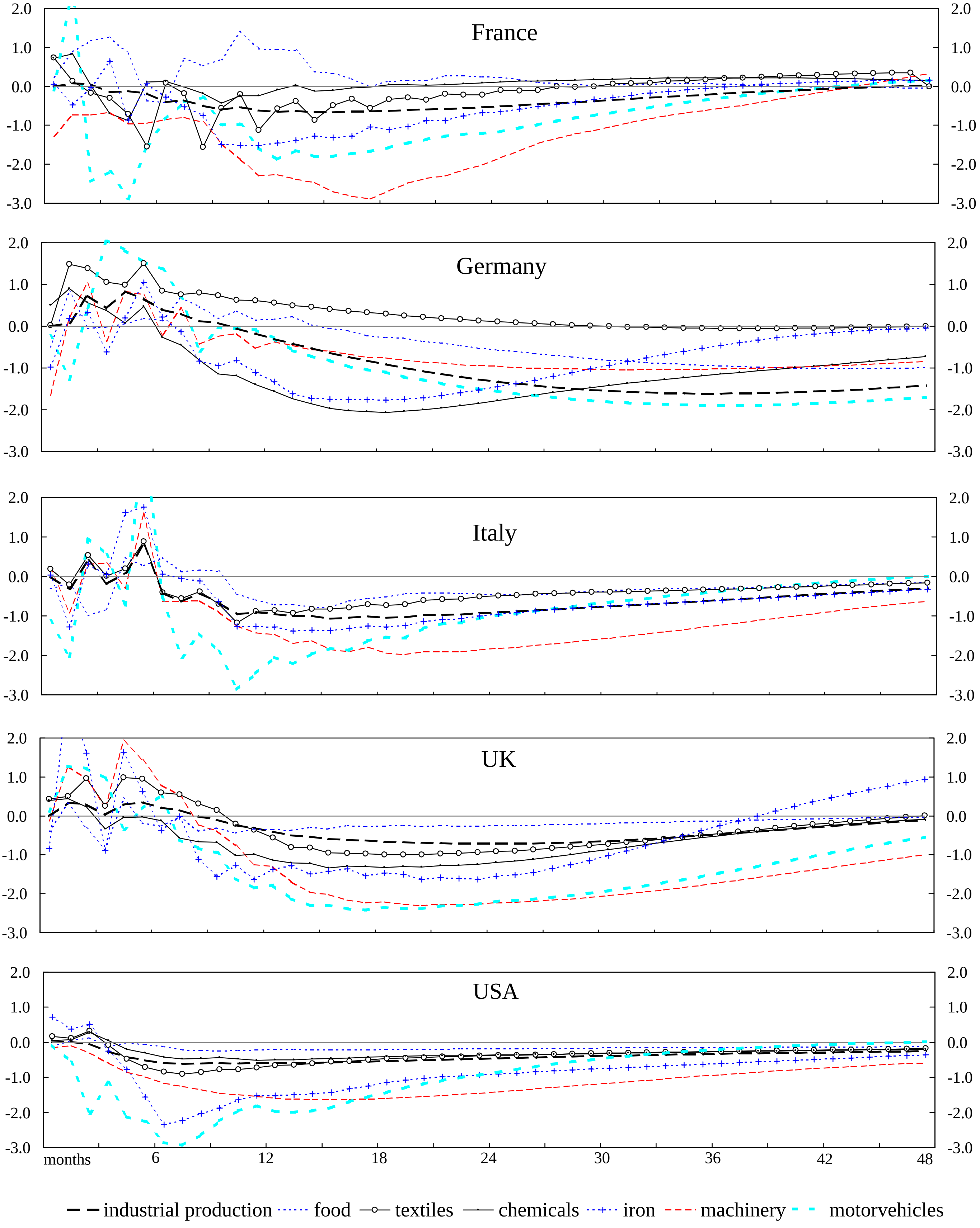
(±2 standard error bands)



Note: The boxes in each column show the response of the VAR variables to a shock in the short-term interest rate (equal to one standard deviation) yielded by the SVAR estimates of Table 1. The error bands were computed with Monte Carlo simulations. The horizontal axis represents the number of months elapsed since the interest rate shock.

Figure 2

Industry impact of a contractionary monetary policy shock



Note: The industry impact is measured by the percent output reduction after an unanticipated interest rate increase (1 percentage point).

Table 1

Aggregate and industry VARs: ordering of variables

FRA	***GER***	***ITA***	***UK***	***USA***
Industrial Production	Industrial Production	Industrial Production	Industrial Production	Industrial Production
Consumer price Index	Consumer price index	Consumer price index	Consumer price Index	Consumer price index
Commodity price index	Commodity price index	Commodity price index	Commodity price index	Commodity price index
Short-term rate (3-month)	Short-term rate (3-month)	Short-term rate (3-month)	Short-term rate (3-month)	Short-term rate (FF rate)
Money (M3)	Money (M3)	Money (M3)	Money (M3)	Money (M1)
Exchange rate	Exchange rate	Exchange rate	Exchange rate	
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Production index of i-th industry	Production index of i-th industry	Production index of i-th industry	Production index of i-th industry	Production index of i-th industry

Note: Estimated on monthly data (from the OECD: "Main Economic Indicators") with a 5-lag specification over the sample period 1975.1-1997.3 and monthly dummies (all data, except the short-term rate, are in log(levels) not seasonally adjusted). Data for France begin in 1980.1. In a few industries in other countries, observations begin around 1980.

Diagnostics of the VAR interest rate equation

		France	Germany	Italy	UK	USA
	# lags					
Serial correlation						
Breusch-Godfrey	*6*	4.4	5.9	5.6	5.1	9.8
(LM test)	*1*	2.8	0.2	1.8	0.2	0.3
Parameter stability						
(loglikelihood ratio)	*mid-sample break*	38.4	47.9*	36.5	34.4	80.0*
Normality						
(Jarque Bera)		rejected	rejected	rejected	rejected	rejected

Note: An asterisk indicates that the null hypothesis of "no-serial correlation" and "no structural break", respectively, is rejected at the 10 per cent level. # *lags* shows the order of lagged residuals that are used in the serial correlation test.

Table 2

Manufacturing Industries (shares of total industrial production)

ISIC CODE	***INDUSTRIES***	***FRANCE***	***GERMANY***	***ITALY***	***UK***	***USA***
311	Food (FD)	10.3	5.6	7.8	9.6	7.8
313	Beverages (BV)	2.1	2.8	2.5	3.0	1.4
314	Tobacco (TB)	0.9	2.8	0.5	1.1	1.5
321	Textiles (TX)	3.5	2.7	8.9	3.7	3.0
322	Wearing apparel (CL)	2.6	1.4	4.4	2.2	2.3
323	Leather (LT)	0.5	0.3	1.0	0.3	0.2
324	Footwear (FT)	0.7	0.3	2.0	0.7	0.3
33	Wood and furniture (WD)	3.2	3.3	5.5	3.0	4.7
3411	Paper (PP)	2.5	2.4	2.3	3.2	4.2
342	Printing and publishing (PR)	4.7	2.0	3.5	7.1	6.4
351+352	Industrial chemicals (CH)	8.5	10.9	7.5*	11.3	10.0
353	Petroleum refineries (PT)	6.5	3.5	0.9	1.5*	1.7
36	Non-metallic mineral (NM)	4.3	4.2	7.2*	3.8	2.8
362	Glass (GL)	1.2	1.0	1.4	0.7	0.8*
371	Iron and steel (IR)	3.6	5.8	3.8	3.6	3.7
372	Non ferrous metals (NF)	1.9	1.8	0.8	1.3	1.7
381	Fabricated metal products (MP)	7.3	9.4	9.7	6.0	7.1
382	Machinery and equipment (MH)	9.7	11.3	9.6	11.8	11.4
383	Electrical machinery (EM)	9.6	11.2	7.3	9.1	8.6
3841	Ship building (SH)	0.5	0.4	0.4*	1.2	0.7
3843	Motor vehicles (MV)	6.9	9.3	4.9	5.5	6.1

Source: OECD-STAN database; averages of annual data for the 1970-1993 period.
An asterisk indicates that monthly industrial production data are not available. That industry is thus excluded from VAR analysis of the corresponding country.

Table 3

Elasticity of industrial output to a monetary policy shock

Industry	France			Germany			Italy			UK			USA		
	24-month elasticity	maximum elasticity	18-24 month elasticity	24-month elasticity	maximum elasticity	18-24 month elasticity	24-month elasticity	maximum elasticity	18-24 month elasticity	24-month elasticity	maximum elasticity	18-24 month elasticity	24-month elasticity	maximum elasticity	18-24 month elasticity
Food (FD)	0.24	-0.01	0.17	-0.53	-0.94	-0.36	**-0.46**	**-0.78**	-0.46	**-0.26**	**-0.38**	-0.26	**-0.19**	**-0.22**	-0.20
Beverages (BV)	-0.53	-1.28	-0.66	-0.33	-0.74	-0.22	**-0.67**	**-1.16**	-0.82	**-0.64**	**-0.68**	-0.55	**-0.26**	**-0.29**	-0.25
Tobacco (TB)	-0.24	-0.27	-0.13	0.75	-0.21	1.00	**1.56**	0.82	1.49	-0.60	-1.21	-0.58	0.15	-0.10	0.25
Textiles (TX)	-0.22	-1.13	-0.31	0.47	0.42	0.46	**-0.51**	**-0.93**	-0.63	**-0.94**	**-1.00**	-0.98	-0.39	**-0.72**	-0.43
Wearing apparel (CL)	-0.50	-1.10	-0.72	-0.22	-0.27	0.05	-0.24	**-0.58**	-0.28	-0.33	-0.36	-0.33	0.03	-0.22	-0.02
Leather (LT)	-1.11	**-2.40**	-1.21	0.72	0.39	0.85	0.42	-0.45	0.29	-1.39	-1.77	-1.45	0.09	-0.34	-0.01
Footwear (FT)	-0.07	-0.13	0.07	2.94	2.23	3.15	0.05	-0.10	0.21	-0.75	-0.96	-0.84	0.48	0.35	0.48
Paper (PP)	-0.16	-0.32	-0.12	**-2.13**	**-2.19**	-2.14	**-1.36**	**-1.97**	-1.50	**-0.76**	**-0.88**	-0.68	**-0.28**	**-0.36**	-0.31
Printing and publishing (PR)	-0.68	**-1.04**	-0.82	-0.03	-0.96	0.25	**-1.76**	**-2.03**	-1.87	-0.58	-0.76	-0.49	-0.27	-0.48	-0.31
Industrial chemicals (CH)	0.08	-0.24	0.04	**-1.84**	**-2.06**	-1.98	n.a.	n.a.	n.a.	**-1.24**	**-1.34**	-1.29	**-0.37**	**-0.51**	-0.39
Petroleum refineries (PT)	-0.02	-0.20	0.08	**-3.08**	-3.15	-2.95	**-1.28**	**-1.29**	-1.23	n.a.	n.a.	n.a.	**-0.54**	**-0.66**	-0.57
Wood and furniture (WD)	**-1.27**	**-1.33**	-1.23	-2.18	-2.95	-1.91	**-1.46**	**-1.46**	-1.43	**-1.17**	**-1.17**	-1.14	**-0.38**	**-0.62**	-0.46
Non-metallic mineral (NM)	**-0.88**	**-1.21**	-1.01	-1.20	-1.80	-0.92	n.a.	n.a.	n.a.	**-0.95**	**-0.97**	-0.86	**-0.52**	**-0.72**	-0.58
Glass (GL)	-0.21	-0.37	-0.30	**-2.51**	**-2.60**	-2.36	**-0.59**	**-0.74**	-0.65	**-0.89**	**-0.93**	-0.77	na	na	na
Iron and steel (IR)	-0.68	**-1.52**	-0.91	-1.53	-1.77	-1.68	**-1.00**	**-1.39**	-1.16	-1.63	-1.63	-1.57	**-0.93**	**-1.53**	-1.05
Non-ferrous metals (NF)	-0.45	-0.63	-0.49	-1.84	-1.85	-1.80	**-1.24**	**-1.83**	-1.41	**-0.81**	**-0.93**	-0.67	**-0.62**	**-0.91**	-0.73
Fabricated metal products (MP)	**-0.99**	**-1.48**	-1.19	**-1.94**	**-2.16**	-1.79	-0.12	-0.14	-0.07	-0.23	-0.68	-0.34	**-0.55**	**-0.70**	-0.60
Machinery and equipment (MH)	-2.00	**-2.90**	-2.41	-0.94	-1.04	-0.85	**-1.86**	**-1.97**	-1.90	**-2.26**	**-2.31**	-2.26	**-1.45**	**-1.63**	-1.54
Electrical machinery (EM)	-0.20	-0.35	-0.23	-0.47	-0.65	-0.32	**-0.59**	**-0.84**	-0.65	-1.83	-1.83	-1.74	-0.43	-0.65	-0.49
Shipbuilding (SH)	-0.15	-0.70	0.12	**3.24**	2.56	3.36	n.a.	n.a.	n.a.	0.93	0.30	0.94	0.11	0.00	0.16
Motorvehicles (MV)	-1.21	**-1.88**	-1.40	-1.50	-1.89	-1.28	-1.06	**-2.46**	-1.35	**-2.27**	**-2.42**	-2.34	-0.93	**-1.99**	-1.21
Industrial Production (IP)	-0.53	**-0.66**	-0.59	**-1.27**	**-1.61**	-1.06	**-0.93**	**-1.07**	-0.99	-0.71	**-0.72**	-0.68	**-0.47**	**-0.59**	-0.51

Note: The *24-month* elasticity is the percentage output change registered 24 months after a 1 percentage point increase in the short-term rate.
The *maximum-elasticity* is the smallest percentage output change recorded between 12 and 36 months after a 1 percentage point increase in the short-term rate.
The 18-24 month elasticity is the average elasticity recorded between 18 and 24 months after a 1 percentage point increase in the short-term rate.
Bold numbers in the first two columns of each country indicate that the point estimate of the output effect is significantly different from zero at the 5 per cent level.

Table 4

Rank Correlation of Industry Effects

A - Rank correlation of *24-month* elasticity to policy

	FRA	GER	ITA	UK
GER	0.30			
ITA	0.39	0.59		
UK	0.39	0.16	0.39	
USA	0.47	0.66	0.64	0.56

B - Rank correlation of *maximum* elasticity to policy

	FRA	GER	ITA	UK
GER	0.27			
ITA	0.35	0.61		
UK	0.46	-0.01	0.26	
USA	0.66	0.52	0.66	0.51

Note: Correlation is measured by the Spearman rank correlation index for the 16 industries where data are available for all countries. The index is distributed with zero mean and standard deviation 1/(n-1) (i.e. 0.07 in our sample).

Table 5

Decomposition of industry responses by country and industry effects

	Dependent variable					
	24-month elasticity			Maximum elasticity		
	Coefficient	Standard error		Coefficient	Standard error	
Constant	-0.63	0.01	***	-0.95	0.01	***
Dummies:						
- Country						
France	0.13	0.13		0.00	0.12	
Germany	-0.12	0.23		-0.15	0.15	
Italy	0.00	0.12		-0.09	0.23	
UK	-0.30	0.11	***	-0.12	0.11	
US	0.29	0.08	***	0.36	0.07	***
- Industry						
Food (FD)	0.40	0.04	***	0.49	0.04	***
Beverages (BV)	0.15	0.04	***	0.12	0.04	***
Tobacco (TB)	0.94	0.04	***	0.74	0.04	***
Textiles (TX)	0.32	0.04	***	0.28	0.04	***
Wearing apparel (CL)	0.38	0.04	***	0.44	0.04	***
Leather (LT)	0.36	0.04	***	0.03	0.04	
Footwear (FT)	1.18	0.04	***	1.24	0.04	***
Paper (PP)	-0.30	0.04	***	-0.18	0.04	***
Printing and publishing (PR)	-0.01	0.04		-0.09	0.04	**
Industrial chemicals (CH)	-0.21	0.06	***	-0.10	0.06	*
Petroleum refineries (PT)	-0.66	0.06	***	-0.40	0.06	***
Wood and furniture (WD)	-0.66	0.04	***	-0.56	0.04	***
Non-metallic mineral (NM)	-0.26	0.06	***	-0.25	0.06	***
Glass (GL)	-0.34	0.06	***	-0.12	0.06	**
Iron and steel (IR)	-0.52	0.06	***	-0.62	0.04	***
Non-ferrous metals (NF)	-0.36	0.04	***	-0.27	0.04	***
Fabricated metal products (MP)	-0.15	0.04	***	-0.11	0.04	**
Machinery and equipment (MH)	-1.07	0.04	***	-1.02	0.04	***
Electrical machinery (EM)	-0.07	0.04		0.09	0.04	**
Shipbuilding (SH)	1.66	0.06	***	1.46	0.06	***
Motorvehicles (MV)	-0.77	0.04	***	-1.17	0.04	***

No. of observations: 100

SUR Estimation; *, ** and *** indicate rejection of the null hp. of zero coefficients at the 10, 5 and 1 per cent level, respectively.

Table 6

Industry determinants of monetary policy effects

Explanatory Variable	Dependent Variable						
	24-month elasticity				maximum elasticity	18-24 month elasticity	24-month elasticity
	Equation 1	Equation 2	Equation 3	Equation 4	Equation 5	Equation 6	Equation 7 (IV estimation)
Durability dummy	-0.60	-0.58	-0.59	-0.67	-0.62	-0.69	-0.61
	0.16	*0.15*	*0.19*	*0.18*	*0.18*	*0.19*	*0.19*
Investment/value added°	-1.80	-2.08					
	1.06	*1.04*					
Openness°	0.58						
	0.43						
Working capital per employee*			0.002				
			0.006				
Short-term debt*			2.36				
			2.26				
Firm size* (hundred employees per firm)			0.32	0.28	0.26	0.29	0.19
			0.12	*0.10*	*0.10*	*0.10*	*0.10*
Leverage*			0.28	0.36	0.24	0.35	0.08
			0.20	*0.18*	*0.18*	*0.18*	*0.27*
Listed companies*			-0.73				
			0.57				
Interest burden*			-0.28	-0.30	-0.21	-0.29	-0.26
			0.11	*0.11*	*0.12*	*0.12*	*0.17*
Country fixed effect:							
France	-0.32	-0.01	-2.62	-1.01	-1.30	-1.08	-0.42
	0.26	*0.17*	*1.92*	*0.40*	*0.45*	*0.41*	*0.56*
Germany	-0.67	-0.37	-3.52	-2.47	-2.52	-2.35	-1.37
	0.37	*0.37*	*1.50*	*0.71*	*0.73*	*0.73*	*0.82*
Italy	-0.38	-0.09	-3.15	-1.52	-1.59	-1.59	-0.44
	0.36	*0.29*	*1.78*	*0.74*	*0.82*	*0.77*	*1.11*
UK	-0.76	-0.45	-3.20	-1.69	-1.68	-1.67	-1.04
	0.27	*0.16*	*2.10*	*0.44*	*0.46*	*0.45*	*0.58*
US	-0.03	0.15					
	0.20	*0.16*					
No. Of observations:	91	91	80	80	80	80	80
$\bar{R}^2$ **- Adj:**	0.19	0.16	0.33	0.33	0.24	0.31	0.27

Note: Pooled (cross-section cross-country) least squares; White Heteroskedasticity-Consistent standard errors (in italics).
* Industry's median firm (mean firm for the interest burden indicator); data constructed from the Amadeus database.
° Industry averages; data constructed from the the OECD STAN database.

Table A1

Country
France
Germany
Italy
United Kingdom
United States

ISIC	Acronym	Industry
311	FD	Food
313	BV	Beverages
314	TB	Tobacco
321	TX	Textiles
322	CL	Wearing apparel
323	LT	Leather
324	FT	Footwear
341.1	PP	Paper
342	PR	Printing and publishing
351	CH	Industrial chemicals
353	PT	Petroleum refineries
330	WD	Wood and furniture
360	NM	Non-metallic mineral
362	GL	Glass
371	IR	Iron and steel
372	NF	Non ferrous metals
381	MP	Fabricated metal product
382	MH	Machinery and equipment
383	EM	Electrical machinery
384.1	SH	Shipbuilding
384.3	MV	Motorvehicles

Variables	Source	
Elasticity maximum 24 month 18-24 month		DEPENDENT
Durability Dummy (1 if ISIC code equals 33, 36, 37, 38)		EXPLANATORY
Investment/(value added) Openness: (a) (exp.+imp)/value added (b) exp./value added	STAN 1970-1993	EXPLANATORY
Working capital per employee (1000 euros) mean median	AMADEUS 1993-1997	EXPLANATORY
Short term debt: (ratio to total debt) mean median	AMADEUS 1993-1997	EXPLANATORY
Employees per firm mean median	AMADEUS 1993-1997	EXPLANATORY
Leverage: (total debt) / (own capital) mean median	AMADEUS 1993-1997	EXPLANATORY
Listed companies (employment share)	AMADEUS 1993-1997	EXPLANATORY
Interest burden: (i-payments)/profit mean median	AMADEUS 1993-1997	EXPLANATORY

Table A2

France

Isic Code	Industry (acronym)	Elasticity: maximum	Elasticity: 24 month	Elasticity: 18-24 month	Durability Dummy	Invest-ment / Value added	Openness	Export	Working capital per employee: mean firm	Working capital per employee: median firm	Short term debt: mean	Short term debt: median	Employees per firm: mean firm	Employees per firm: median firm	Leverage: mean	Leverage: median	Listed companies (employment share)	Interest burden: mean firm	Interest burden: median firm	# of firms surveyed in Amadeus
311	Food (FD)	-0.01	0.24	0.17	0	n.a.	0.27	0.13	41.0	18.5	0.81	0.83	221	93	16.94	2.41	0.09	1.01	0.35	1253
313	Beverages (BV)	-1.28	-0.53	-0.66	0	n.a.	0.62	0.52	265.9	82.0	0.75	0.79	210	80	11.44	1.48	0.33	1.01	0.36	232
314	Tobacco (TB)	-0.27	-0.24	-0.13	0	n.a.	0.36	0.05	112.4	75.8	0.86	0.90	1266	142	0.89	0.64	0.90	0.08	0.09	5
321	Textiles (TX)	-1.13	-0.22	-0.31	0	0.15	0.63	0.28	130.4	33.4	0.79	0.83	224	146	4.38	1.53	0.09	2.22	0.34	405
322	Wearing apparel (CL)	-1.10	-0.50	-0.72	0	n.a.	0.53	0.23	45.3	32.4	0.83	0.86	203	113	3.25	1.73	0.08	0.85	0.42	292
323	Leather (LT)	-2.40	-1.11	-1.21	0	0.18	0.84	0.39	101.6	26.3	0.80	0.85	267	167	2.12	1.31	0.12	0.54	0.44	43
324	Footwear (FT)	-0.13	-0.07	0.07	0	n.a.	0.75	0.24	38.2	18.0	0.76	0.78	283	230	6.75	1.48	0.07	0.57	0.17	86
3411	Paper (PP)	-0.32	-0.16	-0.12	0	0.13	0.27	0.11	43.7	28.2	0.77	0.81	288	174	10.72	1.57	0.21	1.62	0.27	306
342	Printing and publishing (PR)	-1.04	-0.68	-0.82	0	0.11	0.12	0.06	42.5	17.9	0.83	0.88	191	104	6.53	2.23	0.07	1.17	0.21	483
351	Industrial chemicals (CH)	-0.24	0.08	0.04	0	0.16	0.53	0.27	79.0	41.1	0.78	0.83	358	128	3.21	1.58	0.50	0.59	0.19	922
353	Petroleum refineries (PT)	-0.20	-0.02	0.08	0	0.15	0.21	0.08	126.6	62.4	0.78	0.85	941	226	6.28	1.94	0.84	0.45	0.23	42
330	Wood and furniture (WD)	-1.33	-1.27	-1.23	1	0.18	0.29	0.11	49.1	25.7	0.79	0.82	207	137	4.48	1.91	0.08	0.85	0.33	394
360	Non-metallic mineral (NM)	-1.21	-0.88	-1.01	1	0.18	0.32	0.17	60.6	26.0	0.75	0.78	322	145	13.29	1.67	0.29	0.76	0.24	365
362	Glass (GL)	-0.37	-0.21	-0.30	1	0.13	0.60	0.36	40.6	24.1	0.76	0.80	395	161	30.79	1.72	0.28	0.98	0.36	117
371	Iron and steel (IR)	-1.52	-0.68	-0.91	1	0.11	0.54	0.31	52.4	24.1	0.77	0.80	406	214	6.93	1.88	0.18	1.14	0.41	211
372	Non-ferrous metals (NF)	-0.63	-0.45	-0.49	1	0.41	0.58	0.23	54.6	39.7	0.74	0.79	451	153	4.61	1.73	0.49	0.71	0.36	94
381	Fabricated metal products (MP)	-1.48	-0.99	-1.19	1	n.a.	n.a.	n.a.	50.1	26.2	0.81	0.83	272	156	4.17	2.14	0.16	0.65	0.28	660
382	Machinery and equipment (MH)	-2.64	-1.31	-1.20	1	0.04	0.65	0.33	67.3	32.8	0.76	0.84	384	154	5.29	2.35	0.25	0.98	0.24	1059
383	Electrical machinery (EM)	-0.35	-0.20	-0.23	1	0.15	0.54	0.28	79.8	31.8	0.82	0.85	576	193	6.28	2.07	0.31	1.33	0.22	629
3841	Shipbuilding (SH)	-0.70	-0.15	0.12	1	0.02	0.46	0.32	102.7	26.6	0.83	0.88	330	137	14.90	2.65	0.52	1.16	0.15	47
3843	Motorvehicles (MV)	-1.88	-1.21	-1.40	1	0.17	0.71	0.42	66.7	21.2	0.80	0.83	1106	226	8.31	2.22	0.35	2.33	0.30	255
						Source: database STAN			*Source: database AMADEUS*										*Total*	7900

Table A3

Germany

Isic Code	Industry (acronym)	Elasticity maximum	Elasticity 24 month	Elasticity 18-24 month	Durability Dummy	Invest-ment / Value added	Openness	Export	Working capital per employee mean firm	Working capital per employee median firm	Short term debt mean	Short term debt median	Employees per firm mean firm	Employees per firm median firm	Leverage mean	Leverage median	Listed companies (employment share)	Interest burden mean firm	Interest burden median firm	# of firms surveyed in Amadeus
311	Food (FD)	-0.94	-0.53	-0.36	0	0.13	0.29	0.12	109.9	55.2	0.59	0.59	1450	338	52.89	2.30	0.12	2.09	0.51	1567
313	Beverages (BV)	-0.74	-0.33	-0.22	0	0.16	0.14	0.05	236.1	37.9	0.46	0.44	359	219	2.66	2.00	0.12	0.50	0.19	488
314	Tobacco (TB)	-0.21	0.75	1.00	0	0.02	0.09	0.05	220.8	127.8	0.55	0.66	1064	469	3.09	2.99	n.a.	0.02	0.01	31
321	Textiles (TX)	0.42	0.47	0.46	0	0.11	0.85	0.36	165.6	47.0	0.59	0.59	764	348	2.38	1.71	0.12	0.83	0.42	623
322	Wearing apparel (CL)	-0.27	-0.22	0.05	0	0.04	1.02	0.29	570.1	74.3	0.65	0.71	476	189	6.00	1.72	0.05	0.59	0.38	442
323	Leather (LT)	0.39	0.72	0.85	0	0.06	1.12	0.45	64.7	65.6	0.37	0.32	2300	1275	1.77	1.70	0.08	1.69	1.69	71
324	Footwear (FT)	2.23	2.94	3.15	0	0.06	0.97	0.21	86.0	75.0	0.49	0.48	1787	1173	1.89	1.52	0.27	0.96	0.63	57
341.1	Paper (PP)	-2.19	-2.13	-2.14	0	0.15	0.39	0.19	353.6	51.5	0.50	0.43	1457	458	4.57	2.67	0.29	0.98	0.74	534
342	Printing and publishing (PR)	-0.96	-0.03	0.25	0	0.13	0.20	0.14	92.1	25.7	0.49	0.44	909	363	14.13	2.29	0.05	0.40	0.17	955
351	Industrial chemicals (CH)	-2.06	-1.84	-1.98	0	0.12	0.47	0.26	194.0	64.7	0.50	0.48	1756	383	19.63	2.01	0.67	0.57	0.23	1245
353	Petroleum refineries (PT)	-3.15	-3.08	-2.95	0	0.07	0.26	0.05	340.8	91.1	0.56	0.58	696	238	20.69	2.59	0.57	0.68	0.20	101
330	Wood and furniture (WD)	-2.95	-2.18	-1.91	1	0.11	0.32	0.10	56.6	32.5	0.62	0.57	637	443	8.17	2.46	0.04	0.98	0.42	1029
360	Non-metallic mineral (NM)	-1.80	-1.20	-0.92	1	0.14	0.25	0.14	195.6	43.7	0.51	0.47	695	374	6.71	1.72	0.14	0.80	0.36	1020
362	Glass (GL)	-2.60	-2.51	-2.36	1	0.15	0.36	0.21	240.1	41.2	0.47	0.42	918	569	2.47	1.59	0.21	1.75	0.93	193
371	Iron and steel (IR)	-1.77	-1.53	-1.68	1	0.13	0.42	0.26	173.5	50.5	0.54	0.52	1750	475	4.73	2.60	0.18	0.66	0.52	582
372	Non-ferrous metals (NF)	-1.85	-1.84	-1.80	1	0.13	0.55	0.24	70.6	65.9	0.50	0.49	1597	565	2.11	1.62	0.13	0.56	0.39	131
381	Fabricated metal products (MP)	-2.16	-1.94	-1.79	1	0.09	0.32	0.21	162.7	42.8	0.54	0.53	889	466	4.94	2.30	0.06	1.25	0.38	1460
382	Machinery and equipment (MH)	-1.04	-0.94	-0.85	1	0.08	0.54	0.42	245.5	56.2	0.53	0.53	1638	472	9.57	2.62	0.26	1.07	0.39	3098
383	Electrical machinery (EM)	-0.65	-0.47	-0.32	1	0.10	0.43	0.26	206.5	56.6	0.55	0.56	2205	478	12.08	2.68	0.25	0.86	0.46	1158
384.1	Shipbuilding (SH)	2.56	3.24	3.36	1	n.a.	n.a.	n.a.	100.2	60.7	0.53	0.54	3538	1257	6.31	3.90	0.84	1.32	0.55	65
384.3	Motorvehicles (MV)	-1.89	-1.50	-1.28	1	n.a.	n.a.	n.a.	71.5	38.2	0.51	0.49	6786	1181	5.76	2.34	0.37	1.12	0.45	461
																				Total
						Source: database STAN			*Source: database AMADEUS*											15311

Table A4

Italy

Isic Code	Industry (acronym)	Elasticity			Durability Dummy	Invest-ment / Value added	Openness	Export	Working capital per employee		Short term debt		Employees per firm		Leverage		Listed companies	Interest burden		# of firms
		maximum	24 month	18-24 month					mean firm	median firm	mean	median	mean firm	median firm	mean	median	(employment share)	mean firm	median firm	surveyed in Amadeus
311	Food (FD)	-0.78	-0.46	-0.46	0	0.14	0.27	0.08	106.5	62.8	0.20	0.20	147	53	16.76	3.82	0.08	3.72	0.88	1141
313	Beverages (BV)	-1.16	-0.67	-0.82	0	0.12	0.25	0.18	144.4	93.1	0.14	0.14	105	41	9.99	3.38	0.05	1.63	0.78	229
314	Tobacco (TB)	0.82	1.56	1.49	0	0.12	0.23	0.02	65.9	60.7	n.a.	n.a.	132	100	6.90	6.90	n.a.	1.19	0.99	12
321	Textiles (TX)	-0.93	-0.51	-0.63	0	0.16	0.35	0.23	77.5	46.6	0.14	0.14	176	88	7.33	3.19	0.03	1.63	0.76	696
322	Wearing apparel (CL)	-0.58	-0.24	-0.28	0	n.a.	n.a.	n.a.	72.6	50.9	0.14	0.14	172	79	6.99	4.13	0.02	1.58	0.66	454
323	Leather (LT)	-0.45	0.42	0.29	0	0.12	0.51	0.33	124.6	71.6	n.a.	n.a.	87	48	8.17	4.24	n.a.	0.88	0.73	197
324	Footwear (FT)	-0.10	0.05	0.21	0	0.08	0.54	0.50	78.4	29.0	n.a.	n.a.	130	81	10.13	4.82	n.a.	0.80	0.62	226
3411	Paper (PP)	-1.97	-1.36	-1.50	0	0.17	0.20	0.08	53.7	42.8	0.19	0.19	162	82	8.65	3.27	0.06	0.76	0.50	292
342	Printing and publishing (PR)	-2.03	-1.76	-1.87	0	0.12	0.09	0.06	63.1	29.0	0.37	0.37	321	97	11.77	3.83	0.17	2.12	0.65	321
351	Industrial chemicals (CH)	n.a.	n.a.	n.a.	0	0.07	0.31	0.25	97.9	58.8	0.19	0.19	197	85	6.07	2.99	0.18	1.14	0.54	1062
353	Petroleum refineries (PT)	-1.29	-1.28	-1.23	0	0.35	0.62	0.30	152.5	78.6	0.02	0.02	487	64	24.85	3.45	0.02	1.76	0.88	73
330	Wood and furniture (WD)	-1.46	-1.46	-1.43	1	0.14	0.25	0.06	55.6	36.2	0.02	0.02	119	85	6.26	3.85	n.a.	4.34	0.73	443
360	Non-metallic mineral (NM)	n.a.	n.a.	n.a.	1	n.a.	n.a.	n.a.	83.7	46.2	0.18	0.18	191	105	6.56	2.73	0.04	1.29	0.62	529
362	Glass (GL)	-0.74	-0.59	-0.65	1	0.18	0.32	0.19	60.6	38.1	0.16	0.16	263	114	3.32	2.15	0.04	0.72	0.40	94
371	Iron and steel (IR)	-1.39	-1.00	-1.16	1	0.24	0.33	0.18	110.8	48.6	0.12	0.12	201	82	6.94	3.66	0.08	1.23	0.72	523
372	Non-ferrous metals (NF)	-1.83	-1.24	-1.41	1	n.a.	n.a.	n.a.	101.6	55.6	0.15	0.15	138	81	9.49	4.52	0.05	0.94	0.72	104
381	Fabricated metal products (MP)	-0.14	-0.12	-0.07	1	0.18	0.60	0.29	60.8	38.9	0.07	0.07	128	86	6.16	3.41	0.01	0.90	0.58	621
382	Machinery and equipment (MH)	-1.97	-1.86	-1.90	1	0.11	0.64	0.45	86.1	47.6	0.11	0.11	234	97	11.10	4.04	0.08	3.14	0.61	1697
383	Electrical machinery (EM)	-0.84	-0.59	-0.65	1	0.05	0.70	0.27	95.0	46.6	0.12	0.12	1241	109	10.48	3.79	0.12	0.94	0.58	757
3841	Shipbuilding (SH)	n.a.	n.a.	n.a.	1	n.a.	n.a.	n.a.	166.8	71.3	n.a.	n.a.	429	93	21.16	6.53	n.a.	5.03	1.32	52
3843	Motorvehicles (MV)	-2.46	-1.06	-1.35	1	0.19	0.97	0.25	50.3	33.7	0.67	0.67	621	107	6.78	3.73	0.45	1.03	0.63	287

Total 9810

Source: database STAN (Investment / Value added, Openness, Export)

Source: database AMADEUS (Working capital per employee through Interest burden)

Table A5

United Kingdom

Isic Code	Industry (acronym)	Elasticity			Durability Dummy	Invest-ment / Value added	Openness	Export	Working capital per employee		Short term debt		Employees per firm		Leverage		Listed companies (employment share)	Interest burden		# of firms surveyed in Amadeus
		maximum	24 month	18-24 month					mean firm	median firm	mean	median	mean firm	median firm	mean	median		mean firm	median firm	
311	Food (FD)	-0.38	-0.26	-0.26	0	0.12	0.29	0.08	38.0	12.4	0.78	0.82	1836	232	5.36	1.76	0.76	0.83	0.21	904
313	Beverages (BV)	-0.68	-0.64	-0.55	0	0.14	0.27	0.16	109.4	21.4	0.74	0.80	3159	279	6.48	1.06	0.92	0.70	0.26	226
314	Tobacco (TB)	-1.21	-0.60	-0.58	0	0.05	0.13	0.07	142.8	51.4	0.81	0.97	13515	301	4.84	2.74	0.99	0.18	0.09	21
321	Textiles (TX)	-1.00	-0.94	-0.98	0	0.08	0.68	0.26	35.0	18.0	0.80	0.85	946	275	8.06	1.30	0.75	0.96	0.21	432
322	Wearing apparel (CL)	-0.36	-0.33	-0.33	0	0.04	0.65	0.22	25.2	12.9	0.85	0.92	985	260	7.04	1.63	0.74	0.52	0.18	311
323	Leather (LT)	-1.77	-1.39	-1.45	0	0.05	0.84	0.37	44.2	24.6	0.87	0.93	366	178	3.97	1.34	0.48	0.39	0.34	52
324	Footwear (FT)	-0.96	-0.75	-0.84	0	0.03	0.68	0.15	55.1	15.0	0.85	0.90	1459	308	10.81	1.31	0.71	0.52	0.19	77
3411	Paper (PP)	-0.88	-0.76	-0.68	0	0.10	0.28	0.09	34.0	20.6	0.75	0.79	1131	231	3.78	1.82	0.76	0.49	0.17	381
342	Printing and publishing (PR)	-0.76	-0.58	-0.49	0	0.08	0.12	0.07	23.5	10.8	0.78	0.85	803	188	77.35	2.11	0.73	0.80	0.18	878
351	Industrial chemicals (CH)	-1.34	-1.24	-1.29	0	0.20	0.71	0.38	48.3	30.9	0.78	0.84	1799	211	3.71	1.57	0.81	0.60	0.17	867
353	Petroleum refineries (PT)	n.a.	n.a.	n.a.	0	n.a.	n.a.	n.a.	111.8	43.6	0.71	0.75	4465	249	4.31	1.89	0.88	0.53	0.16	70
330	Wood and furniture (WD)	-1.17	-1.17	-1.14	1	0.09	0.47	0.03	22.9	12.6	0.85	0.91	720	207	16.47	1.90	0.74	0.36	0.15	462
360	Non-metallic mineral (NM)	-0.97	-0.95	-0.86	1	n.a.	n.a.	n.a.	24.4	18.4	0.72	0.79	1469	269	7.42	1.47	0.85	0.52	0.18	428
362	Glass (GL)	-0.93	-0.89	-0.77	1	0.18	0.46	0.19	21.2	15.9	0.74	0.78	1187	272	2.47	1.59	0.75	0.80	0.27	120
371	Iron and steel (IR)	-1.63	-1.63	-1.57	1	0.15	0.39	0.20	44.7	18.6	0.78	0.83	819	219	10.04	1.87	0.75	0.48	0.22	325
372	Non-ferrous metals (NF)	-0.93	-0.81	-0.67	1	0.10	0.88	0.35	67.7	30.9	0.77	0.82	539	160	7.19	1.73	0.63	0.90	0.18	139
381	Fabricated metal products (MP)	-0.68	-0.23	-0.34	1	0.08	0.32	0.17	43.5	14.6	0.81	0.86	706	204	4.54	1.81	0.70	0.61	0.17	803
382	Machinery and equipment (MH)	-2.31	-2.26	-2.26	1	n.a.	n.a.	n.a.	34.9	21.2	0.82	0.88	850	222	11.72	1.88	0.64	1.41	0.16	1424
383	Electrical machinery (EM)	-1.83	-1.83	-1.74	1	0.10	0.63	0.29	39.7	19.8	0.81	0.87	986	225	8.22	1.80	0.83	0.87	0.16	1001
3841	Shipbuilding (SH)	0.30	0.93	0.94	1	n.a.	n.a.	n.a.	29.7	11.4	0.78	0.87	579	270	11.68	1.68	0.32	0.50	0.16	101
3843	Motorvehicles (MV)	-2.42	-2.27	-2.34	1	n.a.	n.a.	n.a.	19.6	13.2	0.82	0.88	1498	289	4.44	1.91	0.69	0.60	0.16	326
																				Total 9348

Source: database STAN (Investment/Value added, Openness, Export)

Source: database AMADEUS (Working capital through Interest burden)

Table A6

United States

Isic Code	Industry (acronym)	Elasticity maximum	Elasticity 24 month	Durability Dummy	Invest-ment / Value added	Openness	Export
311	Food (FD)	-0.24	-0.18	0	0.11	0.09	0.05
313	Beverages (BV)	-0.59	-0.12	0	0.15	0.10	0.02
314	Tobacco (TB)	-1.21	0.13	0	0.05	0.12	0.11
321	Textiles (TX)	-1.17	-0.45	0	0.10	0.19	0.07
322	Wearing apparel (CL)	-0.25	0.22	0	0.03	0.31	0.03
323	Leather (LT)	-0.73	0.19	0	0.05	0.62	0.14
324	Footwear (FT)	-1.90	-0.84	0	0.03	1.16	0.06
3411	Paper (PP)	-0.68	-0.24	0	0.20	0.14	0.06
342	Printing and publishing (PR)	-0.66	0.01	0	0.08	0.03	0.02
351	Industrial chemicals (CH)	-0.60	-0.33	0	0.18	0.17	0.08
353	Petroleum refineries (PT)	-0.74	-0.48	0	0.35	0.13	0.03
330	Wood and furniture (WD)	-0.44	-0.20	1	0.08	0.12	0.03
360	Non-metallic mineral (NM)	-1.06	-0.33	1	0.13	0.11	0.04
362	Glass (GL)	n.a.	n.a.	1	n.a.	n.a.	n.a.
371	Iron and steel (IR)	-3.50	-0.73	1	0.14	0.16	0.03
372	Non-ferrous metals (NF)	-0.89	-0.59	1	0.14	0.23	0.07
381	Fabricated metal products (MP)	-1.01	-0.91	1	0.08	0.10	0.04
382	Machinery and equipment (MH)	-1.50	-1.39	1	0.10	0.38	0.22
383	Electrical machinery (EM)	-0.56	-0.04	1	0.12	0.41	0.17
3841	Shipbuilding (SH)	-0.43	0.05	1	0.08	0.14	0.09
3843	Motorvehicles (MV)	-2.06	-1.46	1	0.15	0.42	0.13

Source: database STAN

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