

ORIGINAL ARTICLE

Monetary policy shocks and sectoral investment: evidence and identification challenges in the Euro area

Choques de política monetaria y inversión sectorial: evidencia empírica y desafíos de identificación en la zona del euro

Oscar Manuel Ramalhete da Mata^{*}

Universidad Rey Juan Carlos, Madrid, España; ORCID: 0009-0004-7490-6072

^{*}Correspondence to email: oscarrrmata@gmail.com

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Abstract

This article examines whether monetary policy shocks affect sectoral investment differently in the euro area, depending on each sector's degree of external financial dependence. To this end, it estimates a sector-country-year panel data model that combines monetary shocks identified through high-frequency surprises around European Central Bank announcements with a structural measure of sector-level financial dependence. The estimated coefficients display signs consistent with the credit channel hypothesis: sectors with greater external financial dependence may show a stronger investment response to monetary shocks. However, the estimates do not reach robust statistical significance, so the evidence does not allow the mechanism under analysis to be conclusively validated. The results suggest that this limitation is related to the structure of the data, particularly the high level of sectoral aggregation, the low temporal frequency of investment data, and the limited cross-sectional dispersion of financial dependence. Its main contribution is to clarify the empirical conditions required to identify heterogeneous effects of monetary policy using aggregated sectoral data.

Keywords: monetary policy; sectoral investment; external financial dependence; credit channel; panel data; sectoral heterogeneity; euro area.

JEL Classification: E22; E52; G31; C23.

Resumen

Este artículo examina si los choques de política monetaria afectan de manera diferenciada a la inversión sectorial en la zona del euro, según el grado de dependencia financiera externa de cada sector. Para ello, se estima un modelo de datos de panel sector-país-año que combina choques monetarios identificados mediante sorpresas de alta frecuencia asociadas a anuncios del Banco Central Europeo con una medida estructural de dependencia financiera sectorial. Los coeficientes estimados presentan signos compatibles con la hipótesis del canal de crédito: los sectores con mayor dependencia de financiación externa podrían mostrar una mayor sensibilidad de la inversión ante choques monetarios. Sin embargo, las estimaciones no alcanzan significación estadística robusta, por lo que la evidencia no permite validar de forma concluyente el mecanismo analizado. Los resultados apuntan a que esta limitación está asociada a la estructura de los datos, en particular al elevado nivel de agregación sectorial, la baja frecuencia temporal de la inversión y la limitada dispersión transversal de la dependencia financiera. La contribución principal consiste en delimitar las condiciones empíricas necesarias para identificar efectos heterogéneos de la política monetaria con datos sectoriales agregados.

Palabras clave: política monetaria; inversión sectorial; dependencia financiera externa; canal de crédito; datos de panel; heterogeneidad sectorial; zona del euro.

Clasificación JEL: E22; E52; G31; C23.

1. Introduction

The transmission of monetary policy to the real economy is not homogeneous across sectors. Differences in financial structure, external financial dependence, and exposure to credit help explain differentiated investment responses to monetary shocks. This issue has been examined mainly through the credit channel, which emphasizes the role of financial frictions in the propagation of monetary disturbances. In particular, unexpected changes in monetary conditions may affect the cost and availability of finance, thereby conditioning the investment capacity of sectors that are more dependent on external resources (Bernanke & Gertler, 1995; Kashyap & Stein, 2000; Miranda-Agrippino & Ricco, 2021).

In this context, the working hypothesis is that sectors with greater external financial dependence should exhibit greater investment sensitivity to monetary policy shocks. The reason is that these sectors rely more heavily on external financial resources to sustain their investment decisions, so changes in the cost or availability of credit may affect them more strongly. This hypothesis is also related to broader debates on financial cycles, the temporal structure of investment, resource misallocation, and the vulnerability of projects to changes in monetary conditions (Alonso et al., 2023; Alonso & Sánchez-Bayón, 2024). In empirical terms, the approach is consistent with the literature that uses structural characteristics of firms or sectors as a source of heterogeneity in monetary transmission (Rajan & Zingales, 1998; Ottonello & Winberry, 2020; Cloyne et al., 2023).

Despite this theoretical basis, sector-level empirical evidence for the euro area remains limited. A significant part of the literature relies on aggregate series or firm-level microdata, while sectoral studies face relevant restrictions of comparability, frequency, and disaggregation. Therefore, it cannot be assumed that effects identified at the aggregate or firm level are observable with the same precision when working with sectoral data. The identification of heterogeneous effects depends critically on the structure, frequency, and granularity of the available data (Jeenas, 2019; Albertazzi et al., 2021).

This article empirically examines this hypothesis for the euro area. To this end, it uses a sector-country-year panel data model that combines monetary shocks identified through high-frequency surprises around European Central Bank announcements with a structural measure of sector-level financial dependence. This strategy makes it possible to exploit the common temporal variation of monetary shocks while also using cross-sectoral heterogeneity as a source of identification for the differential effect (Gertler & Karadi, 2015; Altavilla et al., 2019).

The article's contribution is not to provide conclusive validation of the transmission channel under analysis, but rather to empirically assess its identification conditions using aggregated sectoral data. In particular, the article argues that the ability to detect differential effects of monetary policy depends decisively on sectoral granularity, the temporal frequency of real variables, and the correspondence between the nature of monetary shocks and the structure of the available data. This perspective makes it possible to analyse monetary transmission not only as an aggregate effect on investment, but also as a potentially uneven process across sectors with different degrees of financial exposure.

2. Data and Empirical Strategy

The empirical analysis uses a sector-country-year panel for the euro area. The unit of observation combines information on sectoral investment, monetary policy shocks, and a structural measure of external financial dependence. The objective is not to estimate the average aggregate effect of monetary policy on investment, but rather to identify whether the investment response differs across sectors with different degrees of external financial dependence.

The analysis relies on the credit channel as its conceptual framework. Under this approach, changes in monetary conditions may affect the cost and availability of finance, thereby conditioning access

to credit and the investment capacity of sectors more exposed to financial constraints (Bernanke & Gertler, 1995; Kashyap & Stein, 2000).

In this context, sectors with greater external financial dependence should exhibit greater investment sensitivity to monetary shocks, because a larger share of their investment decisions depends on external financial resources and, therefore, on prevailing credit conditions. This interpretation is consistent with the literature on financial heterogeneity and investment (Ottonello & Winberry, 2020) and, at a broader level, with approaches that relate monetary conditions to financial cycles and the temporal structure of investment (Alonso et al., 2023; Sánchez-Bayón & Castro-Oliva, 2023).

The dependent variable is sectoral investment, obtained from Eurostat. The shock variable corresponds to monetary policy disturbances associated with European Central Bank decisions, identified through high-frequency surprises. The heterogeneity variable is sector-level external financial dependence, used as a structural characteristic of sectors. This variable approximates the need to rely on external resources to finance investment and is treated as time-invariant within the empirical specification.

The identification strategy follows the logic of interactions between common shocks and structural heterogeneity (Rajan & Zingales, 1998). In this case, monetary shocks vary over time and are common across sectors, while financial dependence varies across sectors. The coefficient of interest is obtained from the interaction between these two variables. Thus, the estimation compares the relative investment response of sectors with higher and lower external financial dependence to the same monetary shock.

Monetary policy shocks are approximated through high-frequency surprises associated with European Central Bank announcements. This approach rests on the standard assumption that, within narrow time windows around announcements, movements observed in financial prices mainly capture unanticipated information about monetary policy (Gertler & Karadi, 2015; Altavilla et al., 2019). Since sectoral investment is observed at annual frequency, monetary shocks were subsequently aggregated to the same frequency. This aggregation makes the series compatible, although it also reduces the temporal granularity available to identify the investment response.

The baseline specification incorporates sector, country, and time fixed effects. These controls make it possible to absorb persistent differences across sectors, country-specific characteristics, and aggregate shocks in each year. The estimation also includes lags of the monetary shocks in order to capture possible dynamic investment responses. This choice reflects the need to account for the temporal dimension of the transmission of shocks to real variables, a common concern in the empirical literature on dynamic responses to macroeconomic disturbances (Jordà, 2005; Cloyne & Hürtgen, 2016). Statistical inference is conducted using robust standard errors clustered at the country level.

The baseline specification can be represented, in general terms, as:

$$I_{s,c,t} = \alpha + \beta_0(Shock_t \times FinDep_s) + \beta_1(Shock_{t-1} \times FinDep_s) + \beta_2(Shock_{t-2} \times FinDep_s) + \mu_s + \eta_c + \tau_t + \varepsilon_{s,c,t}$$

where $I_{s,c,t}$ represents investment in sector s , country c , and year t ; $Shock_t$ represents the monetary policy shock aggregated to annual frequency; $FinDep_s$ represents the sector's external financial dependence; μ_s denotes sector fixed effects; η_c denotes country fixed effects; τ_t denotes time fixed effects; and $\varepsilon_{s,c,t}$ is the error term. The coefficients β_0 , β_1 , β_2 capture, respectively, relative differences in the investment response across sectors with different degrees of external financial dependence to contemporaneous monetary policy shocks, one-period lagged shocks, and two-period lagged shocks.

Table 1 presents the descriptive statistics for the main variables. Sectoral investment displays high dispersion across observations, while the financial dependence variable shows more limited cross-sectional variation. This feature is relevant for the interpretation of the results, because identification of the differential effect depends precisely on the sectoral variation in $FinDep_s$. Lower dispersion in this variable may reduce the model's ability to detect statistically robust effects, even if the sign of the estimated coefficients is consistent with the theoretical hypothesis.

Table 1. Descriptive statistics of the main variables.

	Mean	SD	Min	Max
value	1612.36	1844.42	18	8803.00
shock	0.03	0.10	-0.11	0.34
findep	0.08	0.11	-0.08	0.21

Source: author's elaboration based on Eurostat (nama_10_a64_p5) and the monetary policy shock database of Jarociński and Karadi (2020).

3. Results

Table 2 presents the estimation of the baseline model. The specification includes the interaction between monetary policy shocks and external financial dependence, as well as two lags of this interaction. The three reported coefficients are positive: 765.79 in the contemporaneous period, 179.10 in the first lag, and 291.59 in the second lag. This sign is compatible with the hypothesis that sectors with greater external financial dependence may display a stronger investment response to monetary policy shocks.

Table 2. Baseline model estimation results.

	1
Shock × FinDep	765.679 (3571.390)
Shock × FinDep (t-1)	179.110 (3261.515)
Shock × FinDep (t-2)	291.599 (3460.439)
Num. Obs.	476
R ²	0.831
RMSE	756.36

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Note: robust standard errors clustered at the country level are reported in parentheses.

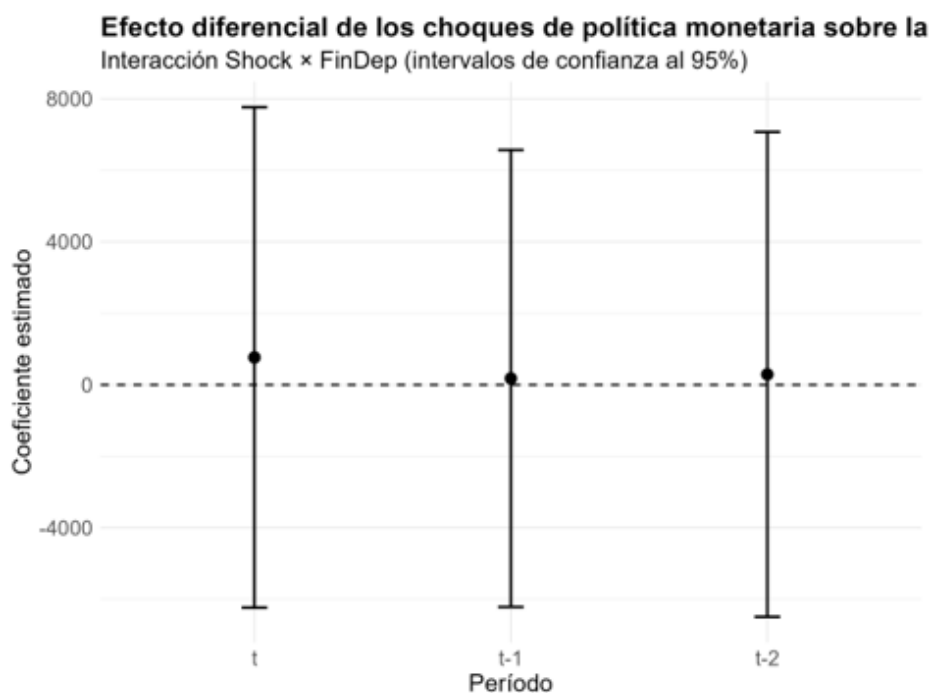
Source: author's elaboration.

However, the estimated coefficients do not reach statistical significance at conventional levels. In addition, the standard errors are large relative to the magnitude of the coefficients. Therefore, the results do not allow us to affirm the existence of a statistically robust differential effect of monetary policy on sectoral investment. The evidence should be interpreted as suggestive with respect to the sign of the relationship, but not as a conclusive empirical validation of the mechanism under analysis.

Figure 1 reinforces this interpretation. The 95% confidence intervals are wide and include zero in all periods considered. This width reflects a high degree of uncertainty in the estimates and limits the model's ability to distinguish precisely between the presence and absence of a differential effect across sectors.

The lack of statistical significance remains when using robust standard errors clustered at the country level. The model is estimated on 476 observations and reports an R² of 0.831; however, this fit should be interpreted with caution, given that the specification includes fixed effects and that the main objective is not to maximize aggregate fit, but to identify relative differences in the investment response according to sectoral financial dependence.

Overall, the results point in the direction predicted by the theoretical hypothesis, but they do not provide sufficient statistical evidence to robustly confirm the differential effect. This combination—signs compatible with the hypothesis, large standard errors, and wide confidence intervals—anticipates the interpretation developed in the discussion: the model's identification capacity is conditioned by the sectoral and temporal structure of the data used.

Figure 1. Estimated coefficients of the Shock $\times$ FinDep interaction and 95% confidence intervals.

Source: author's elaboration based on the estimates.

4. Discussion

The results do not robustly confirm the existence of a differential response of sectoral investment according to external financial dependence. The estimated coefficients display signs compatible with the theoretical hypothesis, but the absence of statistical significance and the width of the confidence intervals prevent these results from being interpreted as conclusive evidence of the mechanism under analysis.

This combination of results is relevant from a methodological perspective. In models that identify heterogeneous effects through the interaction between common shocks and structural characteristics, estimation depends on two sources of variation: the temporal variation of the shock and the cross-sectional variation of the characteristic used to differentiate sectors. When either of these dimensions is limited, the model's ability to detect differential effects is reduced, even when the estimated signs are consistent with the initial hypothesis (Rajan & Zingales, 1998; Cloyne et al., 2023; Holm et al., 2021).

In this sense, the results should be interpreted in light of the restrictions imposed by the database used. Sectoral aggregation reduces the available cross-sectional variation, while the annual frequency of investment limits the ability to capture dynamic responses to monetary shocks originally identified at high frequency. The issue lies not only in the magnitude of the estimated coefficients, but also in the ability of the empirical design to identify differences across sectors with precision. From this perspective, sectoral heterogeneity is not a secondary detail, but a relevant dimension of monetary transmission, insofar as the same shock may operate with different intensity depending on each sector's financial position and investment structure.

The main implication of these results is that identifying sectoral heterogeneity in the transmission of monetary policy requires sufficiently granular databases, both in the sectoral and temporal dimensions. This issue is especially relevant in studies that attempt to translate mechanisms identified at the aggregate or microeconomic level into intermediate levels of sectoral aggregation (Jeenas, 2019; Albertazzi et al.,

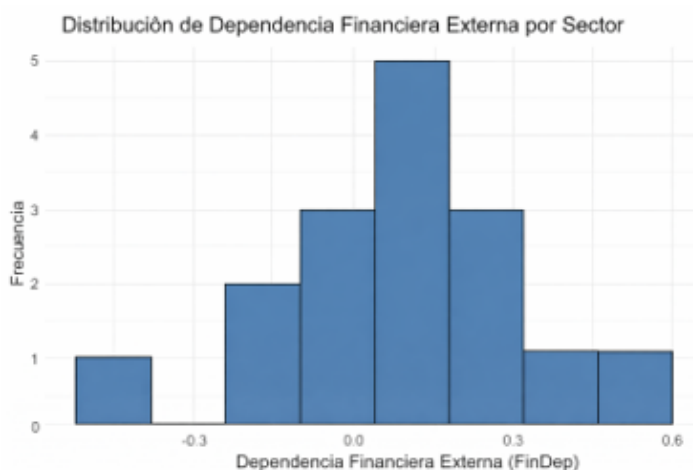
2021). Therefore, the article should not be read as conclusive causal evidence of the credit channel at the sectoral level, but rather as an empirical exercise that shows the conditions under which this mechanism can, or cannot, be robustly identified using aggregated data.

4.1 Identification Limitations

The absence of statistical significance is associated with structural restrictions in the database used. In particular, the process of sectoral harmonisation implies a high level of aggregation, which reduces granularity in the sectoral dimension. This limitation directly affects the identification strategy, because cross-sectional variation in external financial dependence is the main element that makes it possible to distinguish the relative response of some sectors compared with others.

Figure 2 illustrates the distribution of external financial dependence at the sectoral level. The available information shows that the variable does not generate a sufficiently marked separation across all sectors, which may limit the model's ability to exploit clear differences in investment sensitivity to monetary shocks. In this context, even coefficients with signs compatible with the theoretical hypothesis may be accompanied by large standard errors and wide confidence intervals.

Figure 2. Distribution of external financial dependence at the sectoral level.



Source: author's elaboration.

A second limitation is related to the temporal frequency of the data. Monetary policy shocks are constructed using high-frequency information associated with European Central Bank announcements, whereas sectoral investment is observed at annual frequency. This discrepancy requires monetary shocks to be aggregated in order to make them compatible with the dependent variable. This aggregation is necessary to estimate the model, but it entails a loss of information about the precise timing of the shock and about the trajectory of the investment response (Gertler & Karadi, 2015; Altavilla et al., 2019; Miranda-Agrippino & Ricco, 2021).

The combination of sectoral aggregation and low temporal frequency reduces the statistical power of the estimation. For this reason, the lack of statistical significance should not be interpreted simply as the absence of the theoretical mechanism, but rather as evidence that the empirical design used has limited capacity to identify it with precision. This is one of the article's main contributions: to show that heterogeneous monetary transmission may depend not only on the underlying economic mechanism, but also on the structure of the data used to measure it.

4.2 Methodological Implications

Beyond the specific estimation results, the empirical exercise offers a relevant methodological implication. The identification of heterogeneous effects of monetary policy does not depend only on the theoretical validity of the channel under analysis or on the econometric specification used. It also depends, decisively, on the structure of the data available to observe that mechanism.

This interpretation also engages, from a complementary perspective, with studies that emphasise the need to reassess macroeconomic research on capital and cycles when analysing the effects of monetary conditions on the structure of investment (Sánchez-Bayón et al., 2023).

In models based on the interaction between common shocks and structural characteristics, the source of identification requires sufficient variation in both dimensions. On the one hand, monetary shocks must be measured at a frequency that makes it possible to capture their transmission to real variables. On the other hand, the sectoral characteristic used to differentiate responses must display sufficient cross-sectional dispersion. If sectoral disaggregation is limited, or if the real variable is observed at low frequency, the estimation may lose the ability to identify differential effects, even when the underlying economic relationship is plausible.

This consideration is especially important for the study of monetary transmission at the sectoral level. Monetary policy shocks are usually identified using high-frequency information, while many real variables, including sectoral investment, are available only at annual frequency and at relatively high levels of aggregation. The lack of correspondence between the precision with which the shock is identified and the frequency with which the response is observed may weaken the empirical identification of the mechanism.

For this reason, future research could benefit from more disaggregated sectoral databases, higher temporal frequency, and more precise measures of financial dependence. It would also be useful to explore specifications that make it possible to compare different levels of aggregation, in order to assess the point at which sectoral heterogeneity becomes empirically identifiable. In this sense, the article's contribution is not limited to the estimated coefficients, but lies in showing the data conditions required to study heterogeneous monetary transmission robustly.

5. Conclusions

This article examined whether monetary policy shocks affect sectoral investment differently depending on external financial dependence. To this end, it used a sector-country-year panel data model for the euro area, combining monetary shocks identified through high-frequency surprises around European Central Bank announcements with a structural measure of sector-level financial dependence.

The estimated coefficients display signs compatible with the hypothesis that sectors with greater external financial dependence may show greater investment sensitivity to monetary shocks. However, the estimated effects do not reach robust statistical significance. Therefore, the results do not allow the mechanism under analysis to be conclusively validated in the empirical configuration considered.

The lack of statistical significance should be interpreted in light of the identification restrictions of the exercise. In particular, the high level of sectoral aggregation, the limited dispersion of financial dependence, and the annual frequency of investment reduce the model's ability to detect differential effects with statistical precision. In this sense, the results do not constitute evidence of the absence of the mechanism, but rather an indication of the difficulties involved in identifying it with the available data.

The article's main contribution therefore lies in clarifying the empirical conditions required to study heterogeneous monetary transmission at the sectoral level. The analysis shows that sectoral granularity, the temporal frequency of real variables, and the correspondence between monetary shocks and the structure of the data are central elements for identifying differential effects. Future research could advance in this direction by using more disaggregated databases, more precise measures of financial dependence, and better temporal alignment between monetary shocks and sectoral investment.

Authors' contributions

Oscar Manuel Ramalhete Mata: [Conceptualization](#), [methodology](#), [formal analysis](#), [research](#), [original draft](#)

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The authors declare that they have no conflict of interest

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