Understanding Monetary Policy Transmission: Evidence from Brazilian Manufacturing Sectors

José Marcelo Cardoso de Lima Filho*

March 16, 2024

Abstract

This study examines the transmission of monetary policy in Brazil's manufacturing sectors from 1996 to 2019. Utilizing detailed sectoral data, we employ a dynamic panel estimation approach to identify the most relevant transmission channels. Our findings highlight the significant influence of labor intensity on the transmission of monetary policy to output levels. By focusing on sector-specific data, this study offers insights into the heterogeneous effects of monetary policy on different industries, contributing to our understanding of the broader economic impacts of Central Bank decisions.

Keywords: Monetary Policy, Industrial Sectors, Transmission, Brazil

1 Introduction

The transmission of monetary policy is a complex and pivotal topic in understanding the broader impacts of Central Bank decisions on the economy. The pioneering work of Friedman and Schwartz (1963) laid the groundwork for addressing monetary policy issues. While my understanding of this topic has evolved over time, there remains a lack of consensus in the macroeconomic literature regarding the empirical relevance of competing channels.

*Universidade Federal de Santa Catarina

As highlighted by Mishkin (1995), monetary policy propagation occurs through four main channels: the interest rate channel, credit channel, exchange rate channel, and asset price channel. These channels serve as conduits for transmitting policy effects to real variables such as output and employment, ultimately influencing price levels.

It's worth noting that the transmission of monetary policy varies across industries, with sectors displaying differential responses to changes in interest rates.

The seminal work by Bernanke and Gertler (1995) delves into the credit channel of monetary transmission, illustrating how it impacts firms through their balance sheets. The authors also underscore the heterogeneous nature of monetary policy transmission, observing that the propagation of monetary shocks unevenly affects investments in the real estate sector.

Despite these insights, empirical studies predominantly assess monetary policy transmission using aggregate data. To contribute to our understanding of how monetary policy impacts real economic variables, this study aims to evaluate this question at the industrial level in Brazil, identifying the channels through which industries are most affected by monetary tightening measures implemented by the Central Bank.

Analyzing detailed industrial sector data can yield deeper insights into monetary policy transmission compared to aggregate data, for two main reasons. Firstly, the effectiveness of monetary policy is influenced by various factors such as interest rate sensitivity and sector-specific financial requirements, which vary significantly among sectors within a country. This suggests that monetary policy may have significant distributive effects, elucidated by examining sector-specific data variations. For instance, prior studies have demonstrated differential impacts of monetary policy on different production spending components, such as investment and durable versus non-durable consumption (Dedola and Lippi, 2005).

Secondly, sectoral analysis offers an opportunity to address common identification challenges in monetary transmission studies by providing a broader set of control variables. For instance, it's common to examine how small and large firms respond to monetary shocks, often assuming that smaller firms are more affected by credit market frictions (Gertler and Gilchrist, 1994).

However, the observed varied responses may be influenced not only by credit constraints but also by the fact that smaller firms tend to be concentrated in sectors more sensitive to the economic cycle. By analyzing data across different sectors and countries, I can relate sectoral production responses to specific sector characteristics, such as firm size, while controlling for other relevant variables such as production durability, financing requirements, and industry-specific characteristics.

Building upon this literature, my study employs the estimation of a dynamic panel with individual effects, aiming to investigate the most relevant channels for monetary policy transmission in Brazil across 21 manufacturing sectors from 1996 to 2019. A significant finding from my analysis is that the labor intensity of companies, which is associated with the credit channel, is a characteristic that exerts a noteworthy influence on the transmission of monetary policy to the output levels of the Brazilian industrial manufacturing sectors.

1.1 Monetary policy transmission channels

As mentioned, there are three different ways in which monetary policy is transmitted in the economy: the interest rate channel, the credit channel, and the exchange rate channel Mishkin (1995). In this section, I will briefly describe each of these channels that are the subject of my research.

Interest Rate Channel (Keynesian Channel): An increase in interest rates leads to growth in long-term rates. Due to price rigidity, the real interest rate increases. Industries respond to this channel by reducing investment, which negatively impacts prices and output (Mishkin, 1995).

Credit Channel: The increase in interest rates diminishes companies' net worth, restricting their ability to secure new loans due to their reduced capacity to provide collateral. Consequently, firms decrease investment and output (Bernanke and Gertler, 1995).

Exchange Rate Channel: Rises in the interest rate result in the appreciation of the local currency, leading to a reduction in the trade balance, which negatively affects the output of industries producing for export (Taylor, 1995).

2 Econometric specification

To investigate the transmission of monetary policy at the industry level, I employed an adapted version of the model proposed by Rajan and Zingales (1998). For my study, I have specified a balanced panel comprising 21 Brazilian manufacturing industries for the period spanning from 1996 to 2019, as outlined in equation 1:

$$\ln Y_{i,t} = \alpha_i + \rho(L)\ln Y_{i,t-p} + \beta(X_i \times MPS_{t-1}) + \gamma Share_{i,t-1} + \varepsilon_{i,t} \tag{1}$$

where the subscripts i and t respectively denote the industries and time, measured in years. $\ln Y_{i,t}$ represents the measurement of industry growth in t; X_i is the characteristic of industry i over a certain dimension (eight were defined in total, which will be detailed in the next section); $MPS_{i,t-1}$ is the proxy for monetary policy in year $t-1$; and, finally, $Share_{i,t-1}$ is the share of the industry in relation to the total value added of the manufacturing sector in year $t-1$ [1].

The main objective of the model is to estimate the β parameter representing the interaction between the monetary policy proxy and the characteristics of industry i. This coefficient provides information on how each industry responds to a monetary tightening ($MPS > 0$) in their respective products and through which transmission channels the monetary contraction is transmitted to a given industry. By differentiating equation 1, such that $\beta = \frac{\partial^2 Y_{i,t+1}}{\partial X_i \partial MPS_t}$, indicates that when $\beta < 0$, it implies that the monetary contraction ends up having a significantly negative effect on the industrial sector through one of the characteristics in X_i.

It is important to highlight that the relationship between output and monetary policy tends to be highly endogenous, as it is not possible to identify whether an observed impact is a cause or effect of monetary policy. To address this problem, the estimation of 1 will utilize fixed effects α_i and given lags of the dependent variable $\ln Y$.

The panel fixed effect $\alpha_{i,t}$ aims to control for all factors that impact the growth of industry i in time t, such as an oil shock that may be expansionary for the oil

[1] Included to account for "convergence effects", i.e., the possibility that larger industries tend to grow more slowly

sector but contractionary for the transport sector. The increase in the lags of the dependent variable, in turn, necessitates the utilization of the Arellano and Bond (1991) estimation method, which will be elaborated upon below.

2.1 Methodology

In a dynamic panel it is possible to model the achievements of past actions of the defending variable affecting its current level, so that:

$$y_{it} = \sum_{j=1}^{p} \alpha_j y_{i,t-j} + \mathbf{x}_{it}\beta + \nu_i + \varepsilon_{i,t} \tag{2}$$

where ν_i can be a fixed or random effect for the unit i, $\mathbf{x}_{it}$ is a predetermined vector of covariates, which can be the lags of x_{it}, $\sum_{j=1}^{p} \alpha_j y_{i,t-j}$ are the dependent variables lagged up to the lag p.

The introduction of the term $\mathbf{x}_{it}$ has no impact on the estimation of the model, provided that they are predetermined. In this case, the estimated parameters will still be consistent. However, the inclusion of the term $\sum_{j=1}^{p} \alpha_j y_{i,t-j}$ may render the panel inconsistent when estimated by OLS [2].

To verify this, one can take the first difference of 2, in order to eliminate the fixed effect ν_i, so that:

$$\Delta y_{it} = \sum_{j=1}^{p} \alpha_j \Delta y_{i,t-j} + \Delta \mathbf{x_{it}}\beta + \Delta\varepsilon_{it}$$

Note that $E[\Delta y_{i,t-j}\Delta\varepsilon_{it}] = E[\alpha_j \Delta\varepsilon_{i,t-p}\Delta\varepsilon_{it}] \neq 0$, indicating autocorrelation between the residuals, making the estimated OLS inconsistent.

To resolve this issue, Arellano and Bond (1991), expanding the idea of Anderson and Hsiao (1981), suggested the estimation of 2 through the Generalized Method of Moments (GMM) using instrumental variables. The authors proposed the use of lagged dependent variables as instruments. In this context, as t increases, the number of instruments also increases.

In this context, the matrix of instrumental variables can be given by: $Z =$

[2]See: Arellano and Bond (1991) and Wooldridge (2010)

$(W, \Delta X)$, where:

$$W = \begin{bmatrix} W_1 \\ \vdots \\ W_N \end{bmatrix}, \Delta X = \begin{bmatrix} \Delta X_1 \\ \vdots \\ \Delta X_N \end{bmatrix}, W_i = \begin{bmatrix} y_{i1} & 0 & \cdots & 0 \\ 0 & y_{i,1}, y_{i,2} & \cdots & 0 \\ \vdots & \vdots & \ddots & \cdots \\ 0 & 0 & \cdots & y_{i,1}, y_{i,2}, ..., y_{i,t-p} \end{bmatrix}$$

Therefore, it is possible to identify that $E[Z'\Delta\varepsilon] = 0$. Finally, the GMM estimator is given by:

$$\hat{\gamma}_{GMM} = (G'ZS_NZ'G)^{-1}G'ZS_NZ'\Delta y$$

Where $\hat{\gamma}_{GMM} = (\hat{\alpha}_{GMM}, \hat{\beta}_{GMM})$, $G = (\Delta y_{-1}, \Delta X)$ and $S_N = (\sum_{i=1}^{N} Z'_{i\cdot}\hat{\varepsilon_{i\cdot}}\hat{\varepsilon_{i\cdot}}'Z_{i\cdot})^{-1}$.

3 Data

This section presents the data used to estimate the model 1. With respect to the dependent variable, production by industrial sector, the gross value of industrial production was used as a proxy, aggregated for 21 two-digit manufacturing sectors of the CNAE 2.0[3] , according to the table 3, extracted from the Annual Industrial Survey (PIA) of the Brazilian Institute of Geography and Statistics (IBGE). The data are annual and belong to the period between 1996-2019. The values were deflated on the basis of the Broad National Consumer Price Index (IPCA), taking as a base the last year of the sample, 2019. The natural logarithm was then applied in order to facilitate the interpretation of the parameters as percentage changes.

The $Share_{i,t}$ was also calculated on the basis of PIA data, where it was calculated as the annual share of the total industrial value added of each of the 21 two-digit CNAE 2.0 manufacturing industries in the total industrial value added of the manufacturing industry. The data for this variable also cover the period

[3] Between 1996 and 2008, the classification of industrial sectors by IBGE was conducted using CNAE 1.0. For this study, I conducted a consolidation between CNAEs 1.0 and 2.0, which are summarized in Table 3.

1996-2019.

Two approaches were utilized for the monetary policy proxy (MPS_t). The first approach is calculated based on the annual average of the short-term real interest rate, computed according to the Fisher equation:

$$MPS_t = \frac{1 + i_t}{1 + \pi_t} \tag{3}$$

Here, the nominal basic interest rate of the Brazilian economy (Selic), extracted from the Central Bank's time series system, was used for i_t, while the IPCA was employed for inflation π_t. The available data for this approach spans the period between 1996 and 2019.

The second approach is calculated based on the deviations between the short-term basic interest rate announced by the Central Bank's Economic Policy Committee (Copom) and the rate expected by the market according to the Focus Bulletin, also published by the Central Bank. Subsequently, the annual averages of the observed differences were computed. Data for this proxy covers the period between 2000 and 2019.

As predicted in equation 1, the monetary policy proxy was multiplied for each of the eight characteristic indicators calculated for the 21 manufacturing industries, which are described below:

1. **Dependence on external financing (EFD):** Represented by the portion of capital expenditures not financed by cash flow from operations (Rajan and Zingales, 1998), this metric's indices are derived from the work of Rajan and Zingales (1998), who tested the credit channel of monetary policy. The expected signal when integrated with a monetary policy proxy is negative.

2. **Tangibility of assets (TAN):** Measuring the proportion of tangible capital in total assets, this metric represents the fraction of assets that can be offered as collateral for financing. Companies with tangible assets find it easier to obtain external financing after a monetary constraint. It also addresses the credit channel. The data for this characteristic are extracted from the work of Souza, Ribeiro, and Matos (2021).

3. **Investment intensity (INV):** Calculated as the proportion of gross investment over value added (Dedola and Lippi, 2005) based on PIA data, capital-intensive industries (with high investment intensity) are more vulnerable to monetary tightening due to the increase in the cost of capital from the perspective of the interest rate channel. On the other hand, considering the credit channel, industries with high investment rates tend to have more collateral, which guarantees them greater access to credit in times of restricted money supply. In this context, the expected sign of its interaction with the monetary policy proxy is uncertain.

4. **Labor intensity (LAB):** Testing the credit channel (Ilyina and Samaniego, 2011), this metric is the ratio of total wages to wages over total value added and was also calculated based on PIA data. Labor-intensive industries are more likely to be affected by monetary contractions as labor cannot be used as collateral (inability to obtain external financing). However, industries with less capital intensity may be less dependent on external financing. For this characteristic, the expected signal is also uncertain.

5. **Liquidity requirements (LIQ):** Measured by the ratio between inventories and sales to reflect the dependence on short-term working capital to maintain inventories (Raddatz, 2006), data on these characteristics were extracted from the work of de Souza, Ribeiro, and Matos (2021). It addresses the cost channel, and its expected sign is negative.

6. **Capital depreciation (DEP):** Calculated using PIA depreciation rates, industries with less durable capital stocks have a more limited ability to serve as collateral to obtain external financing. This metric is derived using sector-specific depreciation rates from the BEA capital flow tables and addresses the credit channel, with an expected negative sign.

7. **Durability (DUR):** This dummy variable takes the value one if the industry produces durable goods (Peersman and Smets, 2005). Predicting a more pronounced effect of monetary policy on industries that produce durable goods,

as such purchases are often financed by credit and are therefore more sensitive to interest rates, it is used to test the interest rate channel and has a negative expected sign.

8. **Degree of trade openness (EXP):** Derived from the study by Souza et al. (2021), this indicator is calculated as the ratio between the total value of imports and exports and the value of industrial transformation. It is used to test the exchange rate channel of monetary policy, with industries with greater exposure to foreign trade expected to suffer more from domestic monetary tightening due to currency appreciation.

The indicators computed for each of the industries examined in this study are summarized in Table 4.

4 Results

In this section, the results obtained from estimating Equation 1 will be presented. Table 1 describes the results using the short-term real interest rate as a proxy for monetary policy. The sample for this analysis covers the period between 1996 and 2019.

The model's consistency is evident from the autocorrelation test, which fails to reject the null hypothesis of no autocorrelation in the second lag (p-value $= 0.9204$). Additionally, the Sargan test confirms the validity of the instruments used for model estimation.

Regarding the impact on Brazilian industrial sectors, the most influential characteristics were INV and LAB. Specifically, LAB explains a decrease of -11.7% in output when $\Delta MPS = 1$. This suggests that the most labor-intensive industrial sectors are particularly susceptible to credit supply constraints. Thus, this indicator underscores the significance of the credit channel within these industrial sectors.

As for INV, it is observed that a variation in the real short-term interest rate of 1 percentage point implies a drop of -10.9% in output. This finding indicates that Brazilian industrial sectors with high investment rates are vulnerable to the interest

	Dependent variable:
	$\ln Y_{i,t}$
$\ln Y_{i,t-1}$	0.648^{***}
	(0.060)
$\ln Y_{i,t-2}$	-0.128^{***}
	(0.033)
$\ln Y_{i,t-2}$	0.092^{***}
	(0.035)
$Share_{t-1}$	-2.815^{*}
	(1.557)
DEP_{t-1}	0.389^{***}
	(0.142)
DUR_{t-1}	0.104
	(0.422)
EXP_{t-1}	-0.919
	(0.570)
LIQ_{t-1}	0.872
	(0.544)
LAB_{t-1}	-11.756^{***}
	(4.505)
EFD_{t-1}	-1.305
	(0.848)
TAN_{t-1}	-0.011
	(0.040)
INV_{t-1}	-10.914^{*}
	(6.066)
Fixed effect:	Individual
Balanced Panel:	n = 21, T = 24, T × n = 504
Number of Observations Used:	420
Sargan test	chisq(247) = 21 (p-value = 1)
Autocorrelation test (1)	normal = -3.4009 (p-value = 0.0007)
Autocorrelation test (2)	normal = -0.0999 (p-value = 0.9204)
Wald test for coefficients	chisq(12) = 1453.774 (p-value = $< 2.22e^{-16}$)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 1: Results of estimating Equation 1 using the short-term real interest rate as a proxy for monetary policy.

rate channel, as an increase in the short-term rate leads to a significant decline in the output of the manufacturing sectors.

The interaction between the real short-term interest rate and the DEP characteristic also presented statistical significance. However, this impact proved to be lower than those estimated for INV and LAB, at 0.389%. Furthermore, the estimated sign for this characteristic differs from the expected, as explained previously.

Table 2 presents the results of estimating model 1 using the average annual deviations between the interest rate announced by the Copom and that expected on the previous day as a proxy for monetary policy.

The Autocorrelation test (p-value = 0.3932) and Sargan test (p-value = 1) ensure the consistency of the model and the validity of the instruments used, respectively.

In general, it is evident that the characteristics tend to have a lesser impact on the output of Brazilian manufacturing sectors compared to the real short-term interest rate.

Among the characteristics that exhibited greater statistical significance are: DUR, LIQ, and LAB.

Similar to the findings when the real interest rate was used as a proxy for monetary policy, the characteristic that had the most pronounced impact on output when interacted with the monetary policy proxy was LAB. In this scenario, a deviation of 1 percentage point between the expected and announced interest rates negatively affected the output of Brazilian manufacturing sectors by -0.287%. This reaffirms the significance of the credit channel and underscores that labor-intensive industrial sectors are more susceptible to financing constraints due to their inability to provide collateral for new loans.

On the other hand, LIQ and DEP presented statistically significant estimates, but their parameters are close to zero: 0.044 and 0.036, respectively. Furthermore, their signs are not as expected, as previously discussed.

	Dependent variable:
	$\ln Y_{it}$
$\ln Y_{i,t-1}$	0.712^{***}
	(0.068)
$\ln Y_{i,t-2}$	-0.125^{***}
	(0.045)
$\ln Y_{i,t-3}$	0.071^{*}
	(0.042)
$Share_{i,t-1}$	-1.890
	(1.307)
$DEP_{i,t-1}$	-0.004
	(0.006)
$DUR_{i,t-1}$	0.036^{**}
	(0.018)
$EXP_{i,t-1}$	0.007
	(0.020)
$LIQ_{i,t-1}$	0.044^{**}
	(0.019)
$LAB_{i,t-1}$	-0.287^{*}
	(0.169)
$EFD_{i,t-1}$	-0.037
	(0.048)
$TAN_{i,t-1}$	0.0002
	(0.002)
$INV_{i,t-1}$	0.116
	(0.197)
Fixed effect:	Individual
Balanced Panel	n = 21, T = 20, T × n = 420
Number of Observations Used	336
Sargan test	chisq(165) = 21 (p-value = 1)
Autocorrelation test (1)	normal = -3.0464 (p-value = 0.0023)
Autocorrelation test (2)	normal = -0.8539 (p-value = 0.3932)
Wald test for coefficients	chisq(12) = 1079.543 (p-value = $< 2.22e^{-16}$)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 2: Model estimation results using, as a proxy for monetary policy, the annual average of the deviations observed between the interest rate announced by the monetary authority and that expected by economic agents on the previous day.

5 Conclusion

Given the presented findings, it is possible to assert that labor intensity (LAB) plays a significant role in the transmission of monetary policy. This observation may be attributed to the comparatively low capital intensity of Brazilian manufacturing industries compared to those in other countries.

Moreover, this suggests that monetary policies can directly influence the employment levels of manufacturing firms, as the workforce is also affected by firms' ability to secure financing.

According to Benmelech et al. (2021), the reasons why funding constraints affect firms' hiring decisions include:

1. Remuneration for labor typically occurs prior to revenue receipt, necessitating external financing for firms lacking sufficient internal resources.

2. Capital market frictions impact labor, as it is not a variable cost but rather a fixed or nearly fixed cost associated with investments in hiring and training.

3. Employment levels within firms are indirectly affected through their impact on investment levels. As firms face greater limitations in securing new investments, labor levels decrease due to the capital-to-labor ratio.

In this context, the results may indicate that the response in production to variations in the monetary supply occurs via variations in companies' workforce, implying an increase in unemployment rates and consequent social implications. This situation may demand public policies to address the social problems that may arise as a result of monetary tightening.

As limitations, it is important to mention the low number of temporal observations for the annual average of the deviations observed between the interest rate announced by the monetary authority and that expected by economic agents. Furthermore, the contradictory results regarding the observed signs need to be investigated further.

A Supplementary tables

Article Code and Classification	CNAE 2.0 Code and Determination	CNAE 1.0 Code and Determination
1 - Manufacture of Beverages and Food Products	10 - Manufacture of Food Products 11 - Manufacture of Beverages	15 - Manufacture of Food Products and Beverages
2 - Manufacture of Tobacco Products	12 - Manufacture of Tobacco Products	16 - Manufacture of Tobacco Products
3 - Manufacture of Textile Products	13 - Manufacture of Textile Products	17 - Manufacture of Textile Products
4 - Manufacture of Apparel and Accessories	14 - Manufacture of Apparel and Accessories	18 - Manufacture of Apparel and Accessories
5 - Preparation of Leather and Manufacture of Leather Goods, Travel Goods and Footwear	15 - Preparation of Leather and Manufacture of Leather Goods, Travel Goods and Footwear	19 - Preparation of Leather and Manufacture of Leather Goods, Travel Goods and Footwear
6 - Manufacture of Wood Products	16 - Manufacture of Wood Products	20 - Manufacture of Wood Products
7 - Manufacture of Cellulose, Paper and Paper Products	17 - Manufacture of Cellulose, Paper and Paper Products	21 - Manufacture of Cellulose, Paper and Paper Products
8 - Printing and Reproduction of Recordings	18 - Printing and Reproduction of Recordings	22 - Publishing, Printing and Reproduction of Recordings
9 - Manufacture of Coke, Petroleum Derivatives and Biofuels	19 - Manufacture of Coke, Petroleum Derivatives and Biofuels	23 - Manufacture of Coke, Petroleum Refining, Production of Nuclear Fuels and Alcohol Production
10 - Manufacture of Chemical Products, Pharmochemicals and Pharmaceuticals	20 - Manufacture of Chemical Products 21 - Manufacture of Pharmochemicals and Pharmaceuticals	24 - Manufacture of Chemical Products
11 - Manufacture of Rubber and Plastic Products	22 - Manufacture of Rubber and Plastic Products	25 - Manufacture of Rubber and Plastic Products
12 - Manufacture of Non-Metallic Mineral Products	23 - Manufacture of Non-Metallic Mineral Products	26 - Manufacture of Non-Metallic Mineral Products
13 - Metallurgy	24 – Metallurgy	27 - Basic Metallurgy
14 - Manufacture of Metal Products, Except Machinery and Equipment	25 - Manufacture of Metal Products, Except Machinery and Equipment	28 - Manufacture of Metal Products -Exclusive Machinery and Equipment
15 - Manufacture of Computer Equipment, Electronic Products and Optical Products	26 - Manufacture of Computer Equipment, Electronic Products and Optical Products	33 - Manufacture of Medical-Hospital Equipment, Precision Instruments and Optical Equipment, Equipment for Industrial Automation, Chronometers and Clocks
16 - Manufacture of Electrical Machinery, Appliances and Electrical Materials	27 - Manufacture of Electrical Machinery, Appliances and Electrical Materials	31 - Manufacture of Electrical Machinery, Apparatus and Materials
17 - Manufacture of Machinery and Equipment	28 - Manufacture of Machinery and Equipment	29 - Manufacture of Machinery and Equipment
18 - Manufacture of Motor Vehicles, Trailers and Bodies	29 - Manufacture of Motor Vehicles, Trailers and Bodies	34 - Manufacture and Assembly of Motor Vehicles, Trailers and Bodies
19 - Manufacture of Other Transport Equipment, Except Motor Vehicles	30 - Manufacture of Other Transport Equipment, Except Motor Vehicles	35 - Manufacture of Other Transport Equipment
20 - Manufacture of Furniture	31 - Manufacture of Furniture	36 - Manufacture of Furniture and Other Industries
21 - Manufacture of Miscellaneous Products	32 - Manufacture of Miscellaneous Products 33 - Maintenance, Repair and Installation of Machinery and Equipment	32 - Manufacture of Electronic Material and Communication Equipment 37 - Recycling

Table 3: Classification of Economic Activities (CNAE)

Industry Code[4]	DEP	DUR	EXP	TAN	LIQ	INV	LAB	EFD
1	7,09	0	0,607	2,903	2,871	0,1169	0,2200	0,11
2	5,248	0	0,989	4,159	2,086	0,0429	0,1711	-0,45
3	7,665	0	0,626	6,437	2,506	0,0826	0,3572	0,4
4	6,437	0	0,191	2,233	2,229	0,0408	0,4281	0,03
5	8,919	0	0,913	2,378	2,38	0,0519	0,3700	-0,14
6	9,525	1	0,772	4,977	2,055	0,1117	0,3055	0,28
7	8,632	0	0,598	8,915	2,117	0,2056	0,2003	0,15
8	9,745	0	0,06	5,128	1,704	0,0731	0,3270	0,2
9	6,776	0	0,287	2,236	1,622	0,2948	0,0977	0,33
10	8,154	0	1,069	4,589	2,909	0,0982	0,2230	0,855
11	10,072	0	0,507	4,668	2,553	0,1316	0,3164	0,23
12	8,107	1	0,276	8,231	2,064	0,1479	0,3015	0,06
13	6,064	1	1,011	6,684	2,551	0,1292	0,1964	0,09
14	7,043	1	0,382	2,482	2,24	0,0817	0,3526	0,24
15	9,381	1	3,912	35,026	2,912	0,0510	0,2558	1,06
16	9,381	1	1,075	1,786	2,638	0,0663	0,3325	0,77
17	8,832	1	1,3	1,162	2,438	0,0775	0,3608	0,45
18	10,559	1	1,008	7,197	3,046	0,1316	0,3095	0,39
19	10,559	1	2,015	0,988	2,514	0,1146	0,3187	0,31
20	8,968	1	0,257	4,072	2,369	0,0681	0,3815	0,24
21	9,381	1	0,343	2,109	2,543	0,0532	0,3612	0,47

Table 4: Industry technological characteristics

References

Theodore Wilbur Anderson and Cheng Hsiao. Estimation of dynamic models with error components. *Journal of the American statistical Association*, 76(375):598–606, 1981.

Manuel Arellano and Stephen Bond. Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *The review of economic studies*, 58(2):277–297, 1991.

Efraim Benmelech, Nittai Bergman, and Amit Seru. Financing labor. *Review of Finance*, 25(5):1365–1393, 2021.

Ben S Bernanke and Mark Gertler. Inside the black box: the credit channel of monetary policy transmission. *Journal of Economic perspectives*, 9(4):27–48, 1995.

Luca Dedola and Francesco Lippi. The monetary transmission mechanism: evidence from the industries of five oecd countries. *European Economic Review*, 49(6):1543–1569, 2005.

Milton Friedman and Anna Jacobson Schwartz. *A Monetary History of the United States, 1867-1960*. Princeton University Press, 1963. ISBN 9780691003542. URL http://www.jstor.org/stable/j.ctt7s1vp.

Mark Gertler and Simon Gilchrist. Monetary policy, business cycles, and the behavior of small manufacturing firms. *The Quarterly Journal of Economics*, 109 (2):309–340, 1994.

Anna Ilyina and Roberto Samaniego. Technology and financial development. *Journal of Money, Credit and Banking*, 43(5):899–921, 2011.

Frederic S Mishkin. Symposium on the monetary transmission mechanism. *Journal of Economic perspectives*, 9(4):3–10, 1995.

Gert Peersman and Frank Smets. The industry effects of monetary policy in the euro area. *The Economic Journal*, 115(503):319–342, 2005.

Claudio Raddatz. Liquidity needs and vulnerability to financial underdevelopment. *Journal of financial economics*, 80(3):677–722, 2006.

Raghuram Rajan and Luigi Zingales. Financial development and growth. *American economic review*, 88(3):559–586, 1998.

Eduardo Correia de Souza, Priscila Fernandes Ribeiro, and Eduardo Souza Mattos. Crédito do bndes, dependência de finança externa, e intensidade de p&d nos setores da indústria brasileira (1998-2014). *Estudos Econômicos (São Paulo)*, 50: 611–645, 2021.

John B Taylor. The monetary transmission mechanism: an empirical framework. *Journal of economic perspectives*, 9(4):11–26, 1995.

Jeffrey M Wooldridge. *Econometric analysis of cross section and panel data.* MIT press, 2010.