The Differential Sectoral Effects of Policy Shocks: Evidence from Turkey

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Abstract

This study is an assessment of the different ways in which various shocks affect the industrial sectors of an economy. Specifically, we examine how production in various industrial sectors are affected by interest rates, as well as exchange rates, money aggregates, aggregated industrial production, and overall price level innovations in the Turkish economy. Our analysis reveals that positive money aggregates and interest rate innovations generate their effects with the expected positive and negative signs, respectively, wherever they are statistically significant. However, the nominal exchange rate has significant effects in more cases than money and interest rates have, most of which are negative. Overall industrial production has significantly positive but short-lived effects on individual sectors, while the positive self-responses of the sectors last for an average of five months. An increase in the general price level has significantly positive effects on sectoral industrial production indices in one-third of the examined cases.

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1. Introduction

It is customary in economics to describe and summarize the effects of an economic policy as if they are the same in different cases. For instance, the effect of an expansionary monetary policy innovation is expected to be the same in two different regions of a country, or in two different sectors of an economy. However, discrepancies might exist between different economic entities belonging to the same class. Carlino and Defina (1998) argued that "*[the] nation [US] is composed of diverse regions that are linked but which might respond differently to aggregate economic shocks*". They gave the example of a large decline in crude oil prices that will affect energy-consuming and energy-producing regions of a country in different ways. Later, they provide evidence for the effect of monetary policy on different regions of the US.

In this paper, we investigate whether different macroeconomic (policy) shocks have different effects on different sectors of an economy. Economic theory suggests a number of channels through which monetary policy can affect various sectors differently. The degree to which firms are dependent on banks for credit (Bernanke and Blinder, 1988; Kashyap et al., 1993) and the ease with which banks are able to adjust their balance sheets (Kashyap and Stein, 1995) might lead us to expect that a monetary policy action would affect sectors differently. The reason for this is that different sectors can have different levels of capital intensity, input/output demand patterns and production planning strategies. All these suggest that their patterns of bank credit usage might differ. In addition to this, banks' flexibility in adjusting their balance sheets determines the extent of the credit volume available to a specific sector. Especially when we consider the possibility that the firms forming their working capital by extensive use of bank credit are concentrated in a given sector (even if not every sector has the same access to bank credit), we might expect one sector to be influenced differently than another sector with less dependence on bank credit when the interest rates change temporarily.

The employment composition of productive inputs is an important factor, as well. In any economy, not all sectors necessarily use the same composition of inputs; that is, some sectors might be more capital-intensive whereas others are more labor intensive. Thus, an increase in interest rates may affect the capital-intensive sectors more than labor-intensive ones. Similarly, the composition of the manufactured input and raw material needs of different sectors might be differently allocated between domestic and import sources; i.e. not

all sectors use the same combination of imported and domestically produced intermediate products. Therefore, the exchange rate movements may affect these sectors differently. For instance, a firm that imports more of its input can be affected to a larger extent by the depreciation of the local currency than a firm that imports less of its input. Another similar argument can be developed based on the trade orientation of the sectors. Importing sectors can be affected by currency depreciation differently from exporting ones, owing to their different operational natures.

Practices of informal economy (i.e. officially unrecorded economic activity) should also be considered while accounting for the reasons behind the degree or extent of the same policy shock on different sectors[1]. Under loose monetary policy, firms in the formal part of the economy can get credit from banks more easily compared to those in the informal part since the former has better book-keeping practices. If the firms of the formal economy are concentrated more in a specific sector, then that sector can be influenced more by negative shocks to the overall economy, compared to the less formalized sectors. Thus, the effect of monetary policy on each sector of economy will be different.

In this paper, we investigate the issue from an empirical perspective, using industrial production indexes and a set of macroeconomic variables of the Turkish economy. Specifically, we investigate the effects of the nominal exchange rate, short-term (overnight interbank) nominal interest rate, monetary aggregate and the general price level innovations on the industrial production in 29 sectors. In addition to these, the effects of overall industrial shocks on the sectors are considered. Based on our vector auto regression analyses, 10 out of the 29 sectors respond to money and interest rate, and 9 respond to general price level innovations, in a statistically significant manner. We should also mention that price level, money, and interest rate innovation effects had the expected signs wherever they are statistically significant, with only minor exceptions. On the other hand, in 17 of the 29 cases, a sector's production level significantly responds to nominal exchange rate innovations but the sign of the effects of exchange rate changes.

This study presents empirical evidence that monetary policy has different consequences in different sectors. Monetary policy disturbances can generally be defined in terms of monetary aggregates, like M1 or M2 (see Barro, 1977; Mishkin, 1983; King, 1983;

[1] The distribution of informal economy among sectors remains, more or less, a structural issue, which can be the topic of another analysis. Here, it is important to notice that a given firm can have part of its activity recorded and the remaining part unrecorded. In this way, following a policy innovation, it has the chance to increase or decrease the unrecorded fraction of its economic activity based on the nature of the innovation.

and Reichenstein, 1987), or interest rates (see Bernanke and Blinder, 1992; Sims, 1992), as reviewed in Christiano et al. (1999). These two variables are traditionally used as the measures of the monetary policy stance. Some other measures, like the non-borrowed- total reserves mix, are also used (see for instance, Strongin, 1995) so as to better extract the exogenous monetary policy innovations[2]. In our analysis, we employed the monetary aggregates and short-term interest rates together in order to capture the stance of monetary policy and the associated effects on the performance in different sectors. Such treatment of these variables should allow us to implicitly capture the endogenous policy effects.

In this study, we also employ shocks to the general price level and the exchange rate in addition to the money aggregate and interest rate shocks. Shocks to the general price level are used to assess the effects of inflation innovations. The nominal exchange rate, on the other hand can be thought of as an intermediate outcome of monetary policy, since it will be affected by the stance of monetary policy, or as being set directly by the Central Bank of Turkey (CBRT) in the past, as well as being shaped by the market forces. One can expect the nominal exchange rate to possess a significant role, as people might base their expectations about the future path of the economy on exchange rates. Berument and Pasaogullari (2003) can be examined for the effects of real exchange rate depreciation on output and inflation in Turkey. They suggest that the real depreciations are contractionary and inflationary even when external factors are controlled for. This motivates us to include nominal exchange rates and the general price level in our VARs. We study those shocks on the overall industrial production and sub-sectors' output, as well, in order to assess the effects of aggregate and sector-specific output innovations.

The use of the Turkish economic data has some advantages; Turkey offers a unique environment for assessing the stance of the monetary policy. Firstly, unlike some other central banks, which basically monitor the markets (i.e. under a currency board), the CBRT is actively involved in monetary policy setting during most of the sample period considered, either by influencing interbank overnight interest rates, some monetary aggregates, or by setting the exchange rate. Secondly, Turkey has experienced high and persistent inflation. The high variability of monetary policy changes and the higher level of inflation makes the relationships between money aggregates and macroeconomic indicators more visible. Hence, the detection of these relationships is easier[3]. These two reasons allow us to effectively

[2] Non-borrowed reserves data is not, for the time being, available for the Turkish economy; therefore, we could not employ it in our analysis.

[3] In this way, the probability of a *Type-II error*, accepting the null hypothesis when it is false, decreases.

employ Turkish data in our analysis so as to assess the effects of monetary policy and the associated economic outcomes in a reasonable manner.

In section 2, the VAR methodology that we have used is described. We present and discuss our empirical findings in section 3 before concluding the paper in section 4.

2. Specification

In order to assess the relationship between the set of relevant variables and industrial production of sectors, we employed vector auto regressive (VAR) models. In this analytical framework, a vector of endogenous variables (y_t), which is *kx1*, is regressed against its *n* lag values:

$$y_t = \Lambda_0 + \Lambda_1 y_{t-1} + \ldots + \Lambda_n y_{t-n} + \varepsilon_t \text{ where } E(\varepsilon_t \varepsilon_t') = \Omega \quad (1)$$

One may write Equation (1) in an infinite order vector moving average representation:

$$y_t = \varepsilon_t + \Pi_1 \varepsilon_{t-1} + \Pi_2 \varepsilon_{t-2} + \Pi_3 \varepsilon_{t-3} + \ldots \quad (2)$$

where the variance-covariance matrix of ε_t (Ω) is symmetric and positive definite. The Cholesky decomposition implies a lower triangular matrix P, such that $PP' = \Omega$. Therefore, Equation (2) can be rewritten as:

$$y_t = PP^{-1}\varepsilon_t + \Pi_1 PP^{-1}\varepsilon_{t-1} + \Pi_2 PP^{-1}\varepsilon_{t-2} + \Pi_3 PP^{-1} \varepsilon_{t-3} + \ldots \quad (3)$$

Similarly, Equation 3 can also be written as:

$$= \Gamma_0 v_t + \Gamma_1 v_{t-1} + \Gamma_2 v_{t-2} + \Gamma_3 v_{t-3} + \ldots \quad (4)$$

where $\Gamma_i = \Pi_i P$, $v_t = P^{-1}\varepsilon_t$ and $E(v_t v_t') = I$. Equation (4), which represents the vector of y_t as a function of the orthogonalized innovations, v_{t-i}, both can be used for impulse response function analysis. The partial derivative of each component of y_t with respect to each component of v_t yields the impulse response functions.

Our data set is monthly and it contains the overall industrial production index (IP, base year = 1997), the nominal exchange rate, wholesale price index (WPI, base year = 1997), overnight nominal interest rate, M1+Repo (M1R) and the production indices of the 29 sub-sectors from 1986:01 to 2004:02 (All data series are accessible from the electronic data dissemination system of the CBRT[4]). Table 1 gives a list of the 29 sectors that we have studied and their CBRT database codes. Y, P, E, M and S are the natural logarithms of the IP, the WPI, the exchange rate, M1R and the sub-sector industrial production, respectively; whereas the interest rate (R) enters into the analysis as is. In addition to these, we have also

[4] Accessible at http://tcmbf40.tcmb.gov.tr/cbt.html

included eleven binary dummy variables for the months from January to November and for the financial crisis periods of 1994 and 2001 as exogenous variables.[5]

In Table 2, we present the Johansen cointegration test statistics for each of the 29 sectors included in this study. The table specifically reports the eigenvalues and the λ_{trace} test statistics and suggests that there is at least one cointegrating vector among our six variables of concern, for each of the 29 sectors; i.e. the empirical setup employed in our analysis is based on a long-run relationship between the included variables. Consequently, following Sims, Stock and Watson (1990) and Lütkepohl and Saikkonen (1997), we used all data series in their (logarithmic) levels.

We use the orthogonalized residuals for each of our variables to represent the innovations (shocks) to the system, that is, we compute and report the responses of the sectors to shocks in other variables. More specifically, we employed the contemporaneous ordering of Y, P, R, E, M and S in our sector VAR specifications. This ordering implies that Y is not affected contemporaneously by the other variables, whereas it affects the rest of the variables contemporaneously. Prices do not affect the output but the remaining four variables do so contemporaneously. A similar order applies to the remaining variables such that sectoral shocks are affected by the preceding five variables but do not affect these five variables contemporaneously. Lastly, all these variables affect each other with lag. Impulse response functions are sensitive to the ordering of the variables. The assumption that we had here is that the CBRT does not know the current level of income and prices when it sets up its interest rate; but as the short-term interest rate is observed, exchange rates and money are determined contemporaneously. The reason why we placed the sectoral shock last is that it is the part of the economy which is most unlikely to affect the macroeconomic performance due to its size, but is affected the most. We have also employed alternative ordering schemes, but the basic result of the paper was robust (not reported here).

While determining the lag length of VAR, the Schwarz information criterion, which suggested a lag length of three, is used. The residuals are orthogonalized using the Cholesky decomposition to obtain a diagonal covariance matrix of innovations. The confidence intervals for the impulse response functions are then constructed by using bootstrap simulations with 2500 replications. The confidence bands are drawn at the 10% level of significance, unless otherwise stated.

[5] The dummy variable for December is omitted to avoid the dummy variable trap. The inclusion of all these dummies as exogenous variables allowed us to statistically control for the effects of seasonality and crises on the

3. Empirical Findings

In this section, we present the empirical findings of our analysis in 29 figures, i.e. one figure for each of the sectors that we have analyzed. Specifically, we report the impulse response functions of sectoral industrial production indices with respect to 1-unit shocks given to the variables of interest[6]. First the impulse responses are reported and discussed in detail for each sector under a separate heading. Because we discuss only the responses of sectoral production indices, the name of the dependent variable might be dropped while discussing the results below. Furthermore, the direction of the statistically insignificant responses are not discussed in order to save space. For ease in reading, figure numbers are mentioned in the sub-headings instead of in the text. Then, we summarize our findings with respect to the variables that the shocks are given to.

The shocks introduced to the VAR system can be interpreted as follows: A positive shock to the overall industrial production corresponds to an output innovation. A positive exchange rate shock indicates a unanticipated depreciation of the nominal exchange rate. An increase in the interest rate of the central bank and an increase in money supply could be interpreted as a contractionary and an expansionary stance of monetary policy, respectively. McCallum (1983), Bernanke and Blinder (1992) and Sims (1986, 1992) can be examined for the identification of the monetary policy innovations using the interest rates. The operational counterpart of an increase in money supply is an expansion of the liquidity in the financial markets, which corresponds to an expansion of the bank credit available to firms. In earlier literature, Barro (1977), Mishkin (1983), King (1983) and Reichenstein (1987) can be seen as part of the tradition of identifying monetary policy shocks with statistical innovations to monetary aggregates[7].

A shock to the general price level is by definition a market outcome, however, the economic agents do not constantly observe it. Therefore, a shock to the general price level represents a surprise jump of the general price level in a given month. Finally, a shock to a specific sector indicates whether and how the effect persists.

One can expect for all sectors a positive impulse response function (IRF) pattern for an output shock. Similarly, a sector-specific shock should affect the sector itself in a positive

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relationship that we are controlling for. The crises dummies are defined for April 1994, November 2000 and February 2001.

[6] In each figure, there are six panels showing the responses of a sector's production volume to 1-unit shock given to the variables included in the VAR specification. The central curve in each panel is the impulse response function plotted for a 24-months time span; where the enveloping curves stand for the confidence bands generated by bootstrap simulations with 2500 draws at 10% level of significance.

[7] See Leeper, Sims and Zha (1996) and Cochrane (1994) for a critical review of these strands of the literature.

manner in the subsequent periods. However, by the nature and motivation of this study, we avoid prescribing the signs of IRFs for shocks given to other variables. As far as a sector's self-response is considered, we can expect the IRF to last longer for the sectors that transmit their effects better to the overall economy.

3.1. Description of Sub-sector Cases

Mining and Quarrying (Figure 1)

A 1-unit positive innovation to Y, which is an aggregate output shock, affects the production volume in the mining and quarrying sector positively, instantaneously as well as in the 2nd and 3rd months, in a statistically significant manner. Exchange rate, money, price and interest rate innovations do not yield statistically significant effects. When there is a 1-unit shock to the production of the sector, the self-response of the sector is positive and statistically significant until the 7th month following the initial shock. Therefore, the self-momentum of production in mining and quarrying lasts for 7 months.

Coal Mining and Extraction of Peat (Figure 2)

An aggregate output shock contemporaneously and positively affects the coal mining and peat sector. A 1-unit shock to the nominal exchange rate has significantly positive effects after the 5th month. Expansion of M1R has a positive and near significant effect in the 2nd month. Price level and interest rate innovations do not have statistically significant impacts at all. Finally, the self-response of the sector lasts for 5 months. Afterwards, it remains positive but only near significant.

Crude Petroleum and Natural Gas (Figure 3)

On the production of crude petroleum and natural gas, exchange rate, money, price and interest rate innovations do not have statistically significant effects. The initial impact of an industry-wide positive shock turns out to be positive yet insignificant. Its effect is positive and near significant in the 2nd month and becomes negative after the 3rd month. However, the self-response of the sector lasts for 10 months, indicating a high level of persistence.

Metallic Ore Mining (Figure 4)

Money, price level and interest rate innovations do not have statistically significant effects on the production volume of metallic ore mining. An exchange rate innovation, on the

other hand, has a statistically significant and positive contemporaneous impact. An overall shock to the industry affects this sector positively in the contemporaneous period only. The self-response of the sector continues for 5 months.

Other Mining (Figure 5)

The results of the other mining sector resemble those of the metallic ore mining. However, a shock to the overall industry affects the other mining sector not only contemporaneously, but also between the 3rd and 6th months following the shock in a positive manner. A specific shock given to that sector's production volume has effects which last until the 4th month. Exchange rate, money, price and interest rate innovations do not have statistically significant effects.

Manufacturing Industry (Figure 6)

The results of the manufacturing sector are important in the sense that we can observe that the sector's production volume responds to all variables included in the VAR. First of all, an overall shock to the industry has positive effects on the manufacturing industry for 3 months, which is a statistically significant finding. A 1-unit exchange rate depreciation shock has statistically significant and negative effects between the 2nd and 10th months following the shock. A monetary expansion has significant effects as of the 2nd month after the shock and the impact is positive. The case of a price level shock is interesting in the sense that it does not have any significant effects until the 8th month, yet it has stably positive and near-significant effects after the 8th month. An interest rate increase of 1-unit affects the volume of manufacturing industry output negatively until the 4th month, and in a statistically significant manner. The self-response of the sector is significant and positive contemporaneously and it is statistically significant in the 3rd. month.

Food Products and Beverages (Figure 7)

The response of this sector to an industry level shock is positive and significant contemporaneously and in the 4th month. Exchange rate depreciation affects the sector negatively from the 3rd to the 12th months. A monetary expansion has significant and positive effects in the 3rd month. As the interest rates increase, the sector is affected negatively in the 2nd month and the self-response of the sector lasts for one month. For food products and beverages, we do not observe any significant impact of a price level shock.

Tobacco Products (Figure 8)

The effects of an industry level positive shock are interesting in the case of tobacco products. The contemporaneous effect, which is positive and statistically significant, becomes negative and statistically significant in the 1st month following the positive innovation. An exchange rate innovation has positive and near-significant effects between the 6th and the 9th months. A money shock has a statistically significant effect only in the 1st month, which is negative. Self-response of the sector lasts for 6 months. Price level and interest rate innovations seem to have no significant effects on the production of the sector.

Textile Industry (Figure 9) and Wearing Apparel (Figure 10) and Dressing of Leather (Figure 11)

An industry level shock has significant and positive effects only in the contemporaneous period whereas its effect becomes negative in the 4th and 5th months. Exchange rate depreciation affects the sector negatively in the 6th month. Monetary expansion has significant effects in the 2nd and the 4th months, which are positive. A price level shock has contemporaneous positive effects and an interest rate innovation has negative and significant effects in the 2nd month. The self-response of the sector's production volume is positive and significant until the 3rd month.

The case of wearing apparel production is similar to that of the textile industry with two exceptions. Firstly, the negative effect of an exchange rate innovation is significant in the 4th month. Secondly, the self-response of the sector lasts for 9 months once we ignore the insignificance in the 3rd month.

The dressing of leather is not significantly affected by exchange rate, money, price level, and interest rate innovations. An industry-wide shock has contemporaneous significant effects, while the self-response of the sector lasts for only 2 months.

Wood Products – except furniture (Figure 12)

An industry level shock has positive and contemporaneous effects on the production of wood products. Exchange rate and money shocks have no significant effects. A general price level innovation has near significant positive effects only after 12 months. Similarly, an interest rate shock has near significant positive effects after the 15th month. The self-response of the sector continues for 2 months.

Manufacture of Paper and Paper Products (Figure 13), Publishing and Printing (Figure 14)

An industry-wide shock has contemporaneous and positive effects on the manufacture of paper and paper products. Exchange rate depreciation initially affects the production volume in a negative manner, but this effect is not statistically significant. Its effects are significant and positive between the 10^{th} and 15^{th} months. Money, interest rate and price level innovations have no significant effects. Finally, the response of the sector to a specific shock is significant contemporaneously as well as during the 4^{th} to 7^{th} months.

In the case of publishing and printing, an industry-wide shock has significant positive effects for 2 months, and the positive self-response of the sector lasts for 2 months. The sector is not responsive to other variables of concern.

Manufacture of Coke, Refined Petroleum (Figure 15), Manufacture of Chemical Industry (Figure 16), Rubber and Plastic Products (Figure 17)

The manufacture of coke and refined petroleum only responds to industry-wide shocks and sector-specific shocks, where an industry-wide shock has significantly positive effects for the moment of the shock and the 1^{st} month. The momentum of the sector lasts for 8 months. Manufacture of chemical industry has a similar impulse response pattern with two differences: the effect of industry-wide shock is significant only in the contemporaneous period and the self-response of the sector lasts for 12 months. Exchange rate, money, price level and interest rates seem not to have significant effects on the sector. An important point regarding the rubber and plastic products is related to the pattern of the sector's self-response, in that a positive sector-specific innovation has positive and significant effects until the 4^{th} month, whereas this effect turns out to be negatively significant between the 6^{th} and 8^{th} months.

Manufacture of Non-metallic (Figure 18)

Manufacture of non-metallic products is affected positively by an industry-wide shock until the 4^{th} month except for the 2^{nd} month. An exchange rate shock has near significant and positive effects contemporaneously and significant negative effects from the 2^{nd} to the 6^{th} months. Money and interest rate shocks seem to have near significant positive effects in the 2^{nd} and 5^{th} months for money and the 4^{th} month for interest rate. In the case of a price shock, the initial impact is negative and statistically significant and the effect becomes positive and

significant only between the 3rd and 15th months except for the 4th month. The self-response of the sector is short-lived; i.e. it is spread over a single month.

Basic Metal Industry (Figure 19)

An industry-wide shock affects the basic metal sector positively until the 3rd month following the innovation. The sector's manufacturing volume is affected by a positive exchange rate innovation, i.e. a depreciation of nominal exchange rate, negatively in the 1st month. Money and interest rate innovations do not have any significant effects. A price level innovation has a positive effect throughout the time span of impulse responses; however, the effect is near significant from the 8th to 12th months only. Self-response of the basic metal industry continues in a significant manner for 3 months.

Metal Products – except Machinery (Figure 20)

In the case of metal products other than machinery, exchange rate, overall price level and interest rate innovations do not have a significant impact on the sector's performance. An industry-wide positive shock affects the sector positively until the 2nd month after the introduction of shock, but its effect is not statistically significant in the 1st month. A positive money innovation also has positive effects until the 2nd month, but again this effect is not statistically significant in the 1st month. The self-momentum of the sector is fairly long lasting, spread over a 15 months time horizon.

Machinery and Equipment (Figure 21)

Machinery and equipment manufacturing is affected by an industry-wide shock positively until the 3rd month following the shock. Exchange rate depreciation affects the sector's performance negatively from the 3rd to 10th months. A price-level innovation has near-significant positive effects from the 7th month onwards and an interest rate innovation negatively affects the sector in the 2nd and 4th months. The self-response of the sector is short-lived. Money innovations have no significant impact on the sector.

Office, Accounting, Computing Machinery (Figure 22)

The depreciation of the exchange rate negatively affects the manufacturing of office equipment during the 7 months following the depreciation shock, but this effect is not statistically significant in the 2nd month. Money and price level innovations do not have significant impacts. An increase in interest rates reduces the manufacturing volume of the

sector in the 2nd and 3rd months. The self-response of the sector is significant for 3 months and the sector is affected by an industry-wide shock only contemporaneously.

Electrical Machinery and Apparatus (Figure 23), Radio, TV, Communication Equipment (Figure 24), Medical, Precision, Optical Instruments (Figure 25)

Money, price and interest rate innovations do not have any significant effects on the manufacture of electrical machinery and apparatus. An exchange rate innovation, which is the depreciation of the nominal exchange rate, has a near significant and negative effect in 7th month after the shock is given. The positive effects of industry-wide and sector specific shocks last for 1 month.

In the case of communication equipment, radio and TV, exchange rate has significant negative effects between the 3rd and 10th months. An industry-wide shock has a significant contemporaneous positive effect and the self-response of the sector lasts for 4 months.

Medical, precision and optical instrument manufactures are affected positively in the 1st month by an industry-wide positive innovation. The self-response in this sector lasts for 6 months. A positive interest rate innovation has negative and significant effects on the sector's manufacturing volume until the 4th month. Exchange rate, money and price level innovations, however, do not have a significant impact.

Manufacture of Motor Vehicles, Trailers (Figure 26), Other Transport Equipment (Figure 27)

The manufacture of motor vehicles and trailers is sensitive to exchange rate, money and interest rate innovations. A depreciation of the nominal currency has negative effects on the sector between the 3rd and 9th months. A money innovation causes the volume of manufacturing to increase in the 2nd month. An interest rate increase causes the manufacturing volume to decrease until the 5th month after the shock is given. Industry-wide and sector-specific positive innovations have effects that last for 1 month and 6 months, respectively.

Regarding the manufacture of the other transport equipment, an exchange rate shock has negative effects between the 1st and 3rd months. Industry-wide shocks have effects lasting for 2 months and a sector-specific shock has an everlasting effect on the sector itself. Other variables do not seem to have significant effects.

Manufacture of Furniture (Figure 28)

The case of the furniture manufactures is interesting in the sense that a price level innovation has negative effects in the 3rd month. In this case, even the initial effect of an industry-wide shock is not statistically significant. However, the self-momentum of the sector does not die out before 15 months. The industry wide effect is statistically significant and positive for the whole sample except for the 1st month and between the 4th and 10th months.

Electricity, Gas, Water (Figure 29)

As far as the production of electricity, gas and water is concerned, we can say that an exchange rate innovation has significantly positive effects after the 11th month. A money innovation increases the production in the 2nd month and a price level innovation has positive and significant effects between the 5th and 16th months. The self-response of the sector is positive and lasts for 6 months.

3.2. Summary and Discussion

The twenty-nine sub-sector VARs, for which we have presented the impulse response functions, convey basically two types of information. The first concerns the significance of explanatory variables in the VARs, whereas the second concerns some comparisons between sectors included in our analysis. In this sub-section, we will provide a discussion of these issues.

As described before, for each sector of our sample, we have used the common template, in which the variables are ordered as overall industrial production, general price level, nominal interest rate, nominal exchange rate, money, and the sector's industrial production index. The shocks to overall industrial production have generated statistically significant responses in 27 out of our 29 sectors. This figure is 17 for the nominal exchange rate, 10 for money and interest rate, and 9 for general price level. Sector-specific production shocks have always been significant in our VARs and the average lifetime of a sectors' self-responses is about 5 months. Considering these observations, one can argue that the nominal exchange rate has been carrying more operational information for the sectors than money, general price level or interest rates. Moreover, the exchange rate, money, price-level and interest rate are not significant in 8 cases out of the 29 and all of these variables are significant in only 4 cases.

When we look specifically look at the effects of each variable, it is observed that upon a 1-unit shock to the general price-level increases the production in manufacturing industry, textile, wearing apparel, wood products (except furniture), manufacture of non-metallic, basic metal industry, machinery and equipment, and electricity-gas-water sectors. Only in the case of furniture is a decrease in production observed. For these sectors, except furniture, we can argue that the general price level has been one of the major driving forces of production, based on our data set and analysis.

The case of a 1-unit money innovation induces higher production levels in coal mining and extraction of peat, manufacturing industry, food products and beverages, textile industry, wearing apparel, metal products (except machinery), manufacture of motor vehicles and trailers, and electricity-gas-water. Production in the tobacco industry and manufacture of non-metallic falls following a 1-unit positive shock to M1R.

A positive 1-unit interest rate shock reduces the production volume of manufacturing industry, food products and beverages, textiles, wearing apparel, machinery and equipment, office-accounting-computing machinery, medical-precision-optical instruments, and motor vehicles-trailers. In the case of wood products (except furniture) the interest rate has a near significant positive impact, whereas in the case of manufacture of non-metallic, it has a near significant negative impact.

Finally, a 1-unit positive shock to the nominal exchange rate increases the production levels of coal mining and extraction of peat, metallic ore mining, tobacco products, manufacture of paper and paper products, and electricity-gas-water. With the same shock, the production level falls in manufacturing industry, food products and beverages, textile industry, wearing apparel, manufacture of non-metallic, basic metal industry, machinery and equipment, office-accounting-computing machinery, electrical machinery and apparatus, radio, TV, communication equipment, motor vehicles and trailers, and other transport equipment. For the sectors with a drop in production, we can argue that the exchange rate is a crucial factor in translating the imported cost elements into domestic currency. That is, a depreciation of the exchange rate elevates the average production costs of these industries.

As mentioned above, in the case of 8 sectors, the responses to exchange rate, money, price level, and interest rate innovations were not significant. These sectors can be listed as mining and quarrying, crude petroleum and natural gas, other mining, dressing of leather, publishing and printing, manufacture of coke and refined petroleum, chemical industry, and rubber-plastics products. Therefore, it is not surprising that, except for the dressing of leather and publishing and printing, sectors that basically feed the other sectors are not responsive to

financial/monetary variables. Their production, then, should be driven by inter-industry demand factors that we could not cover in this study. In these 8 cases, the dynamics are implicitly carried on the autoregressive terms and through innovations to overall industrial production.

As our summary of results demonstrates, the nominal exchange rate has been revealed as the variable that is significant in more cases than other financial variables. Neither M1R nor the overnight interest rates could achieve explanatory power of the exchange rate across sectors. This case might be indicative of a situation in which economic agents derive more information out of the nominal exchange rate developments, rather than look at the money and interest rate developments. Therefore, our simple template of VAR ordering repeated over the industrial sectors gives support to the observation that economic agents mostly use the exchange rate as the nominal anchor in their sector-specific decision-making processes.

4. Conclusion

The main motivation of this study is to investigate the effects of policy shocks on Turkish industrial production for 29 sectors. First, we have investigated for the existence of differential effects of monetary policy shocks. Using vector auto regression models of 6 variables with the same ordering for each sector, we have observed that monetary policy affects different sectors at different degrees even if the direction of the effects were the same. Moreover, the variables whose effects on individual sectors we observe were the overall industrial production (which is meant to be a measure of aggregate output), nominal exchange rate, interest rate and the M1+repo money aggregate. Each of these affected the various industrial sectors differently.

It was found that 10 of the 29 sectors respond to money and interest rate, and 9 of the 29 sectors respond to general price level innovations, in a statistically significant manner. We should also mention that price level, money, and interest rate innovation effects had their expected signs wherever they were statistically significant, with only minor exceptions. On the other hand, in 17 out of the 29 cases, a sector's production level significantly responds to nominal exchange rate innovations. However, the direction of responses to exchange rate changes.

All in all, this study presents statistical evidence on the different effects of policy shocks in different sectors. Further research is needed to assess in more detail the reasons behind these differences. More insights on the specific structure of each sector regarding the

technology, costs, and competition might be useful for a better understanding of the issues mentioned here. However, this is left to further studies.

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Figure 1. Mining and Quarrying

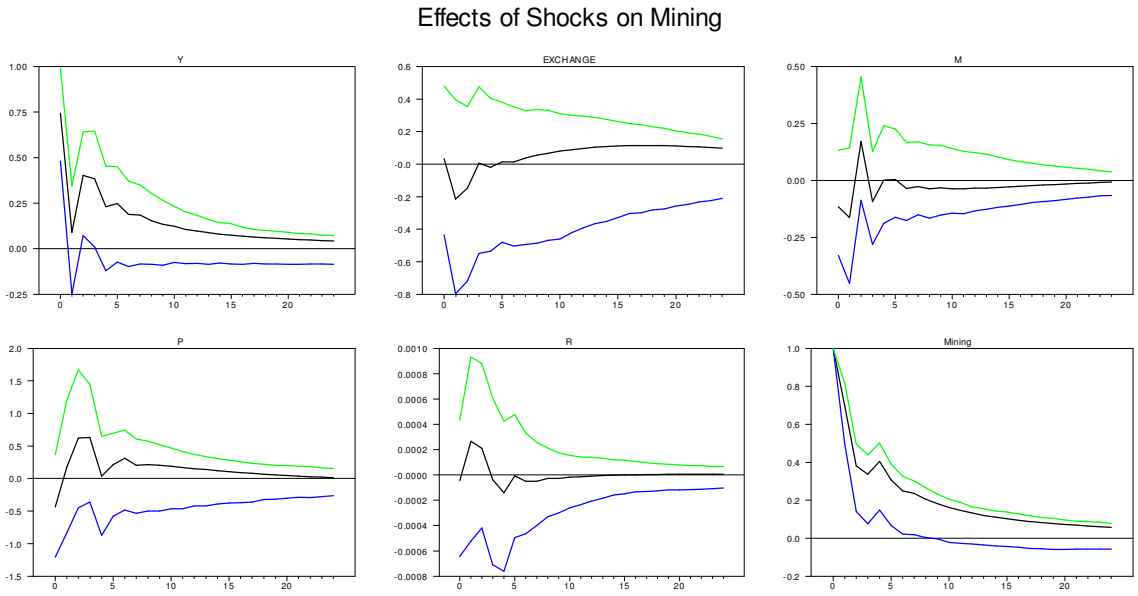

Figure 2. Coal Mining and Extraction of Peat

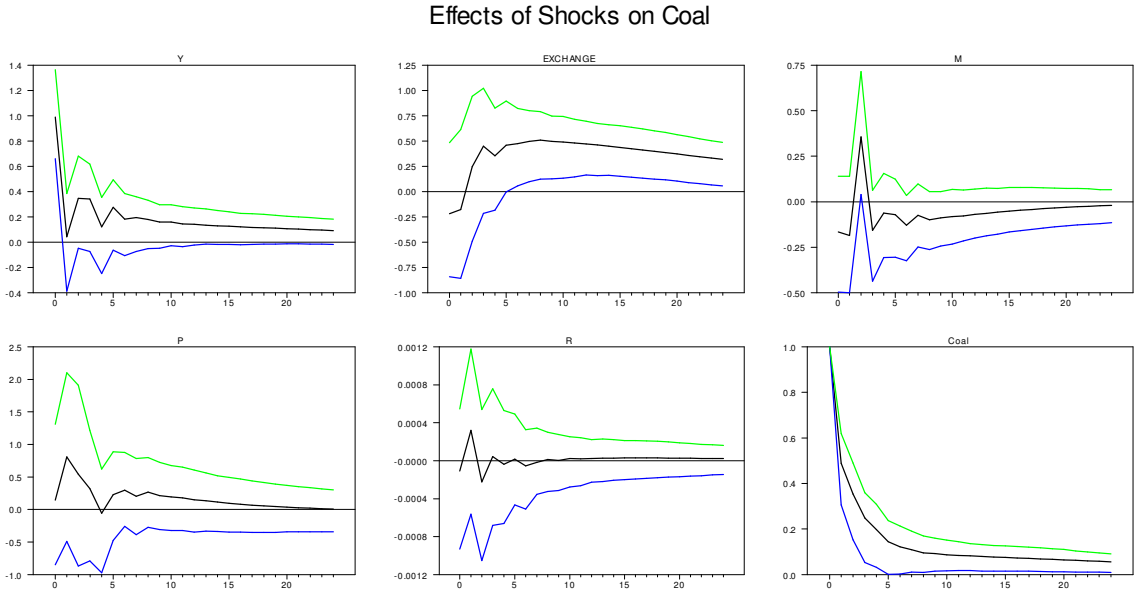

Figure 3. Crude Petroleum and Natural Gas

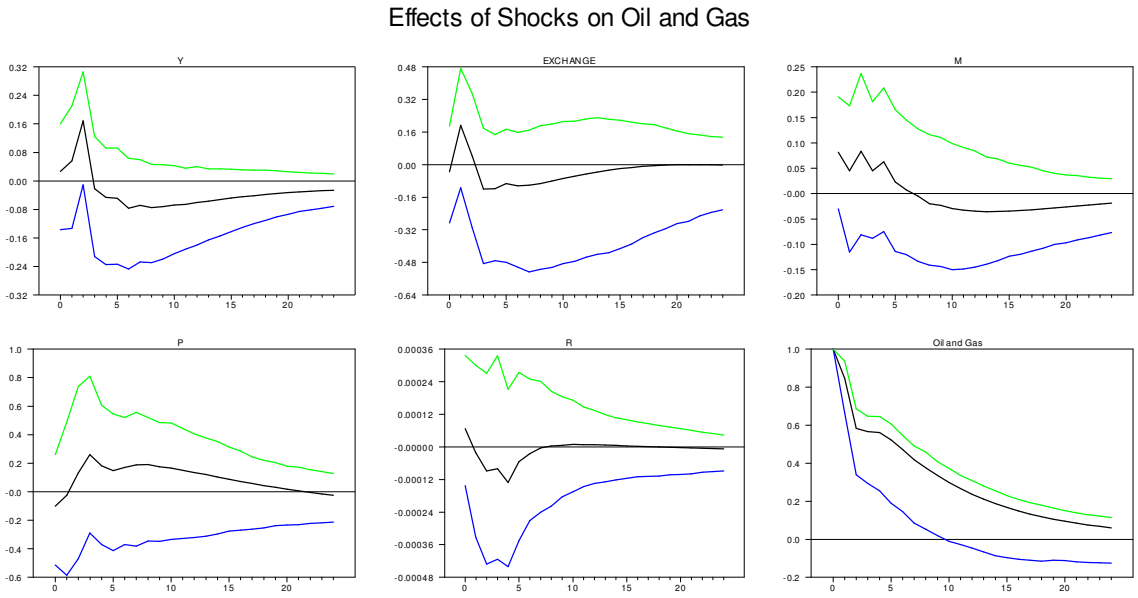

Figure 4. Metallic Ore Mining

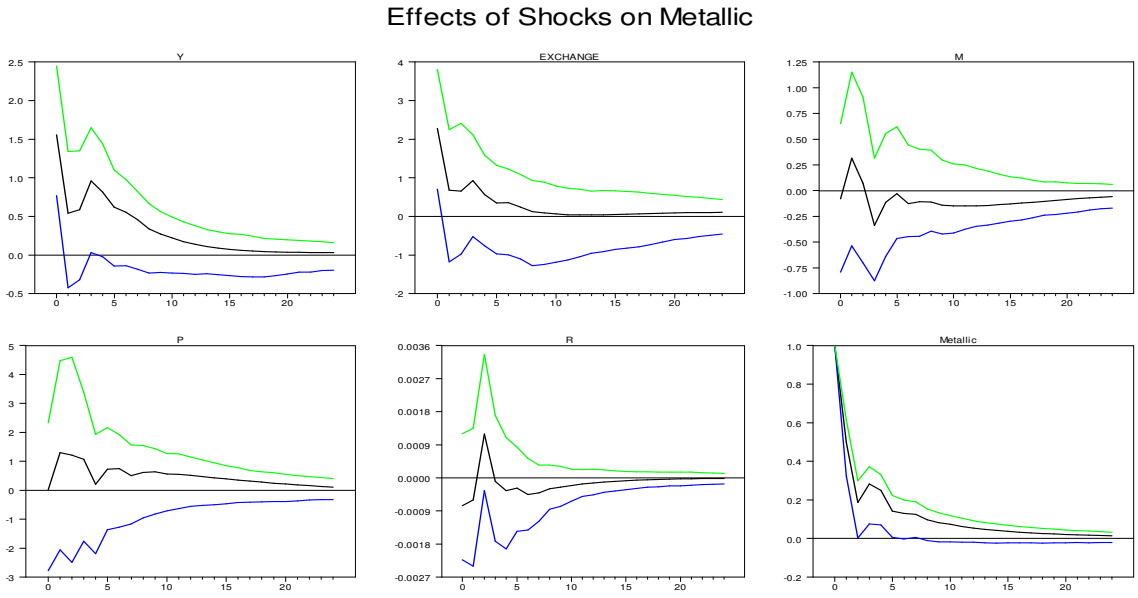

Figure 5. Other Mining

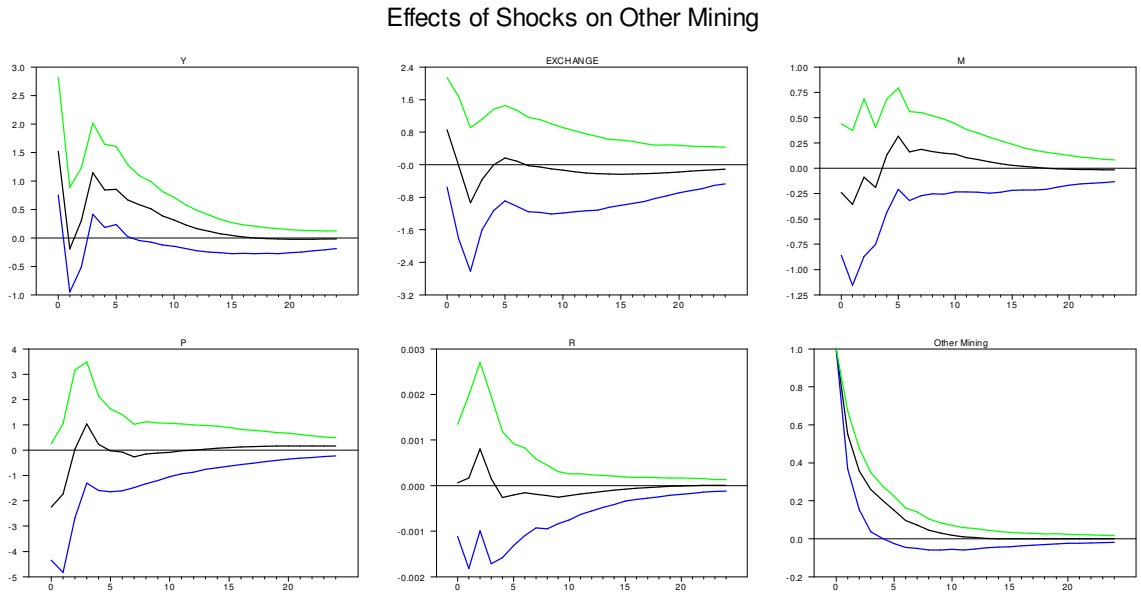

Figure 6. Manufacturing Industry

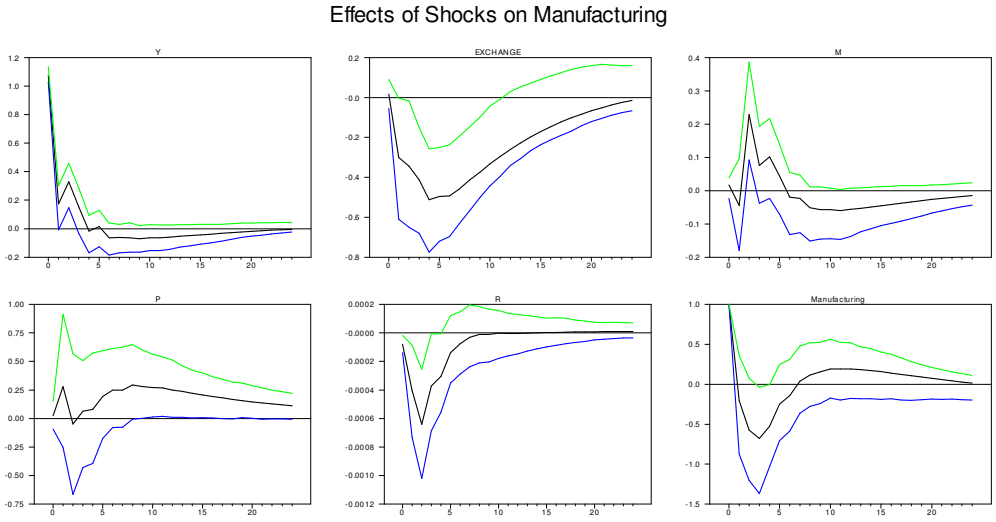

Figure 7. Food Products and Beverages

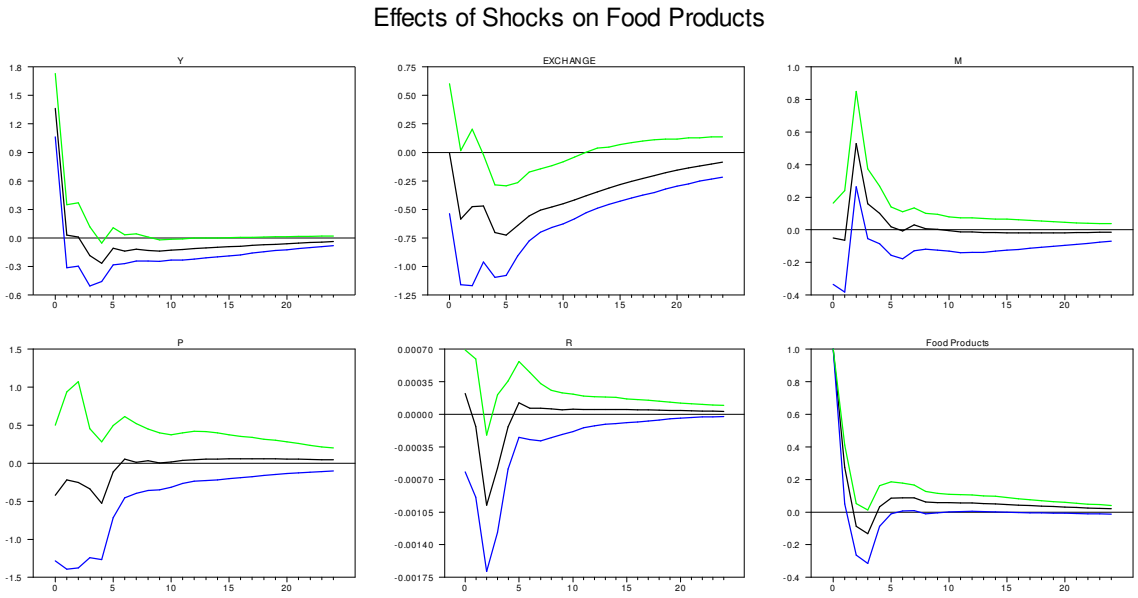

Figure 8. Tobacco Products

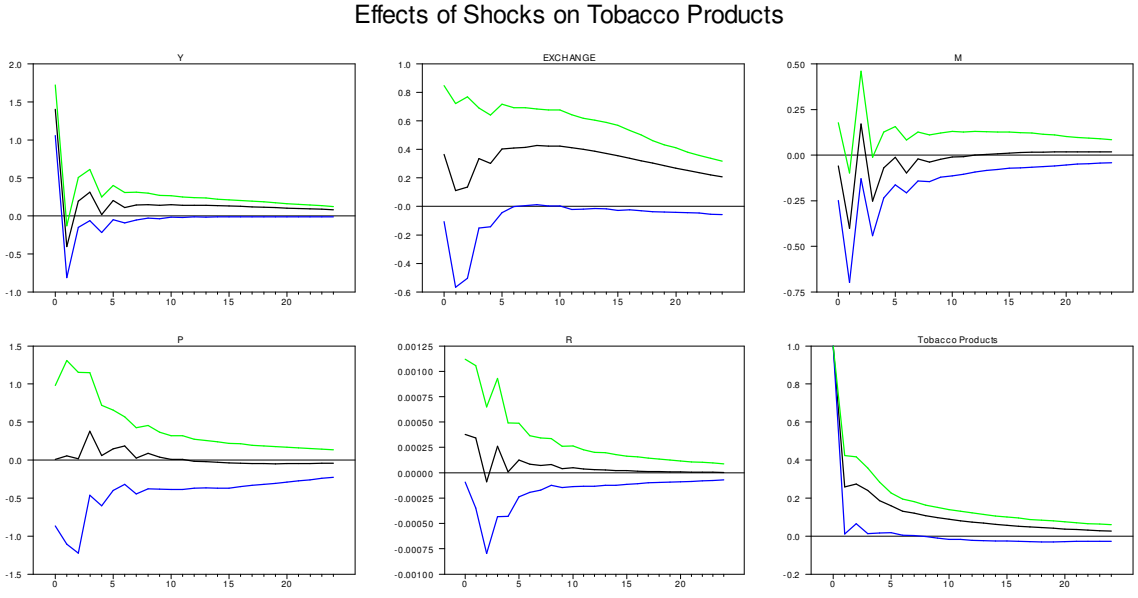

Figure 9. Textile Industry

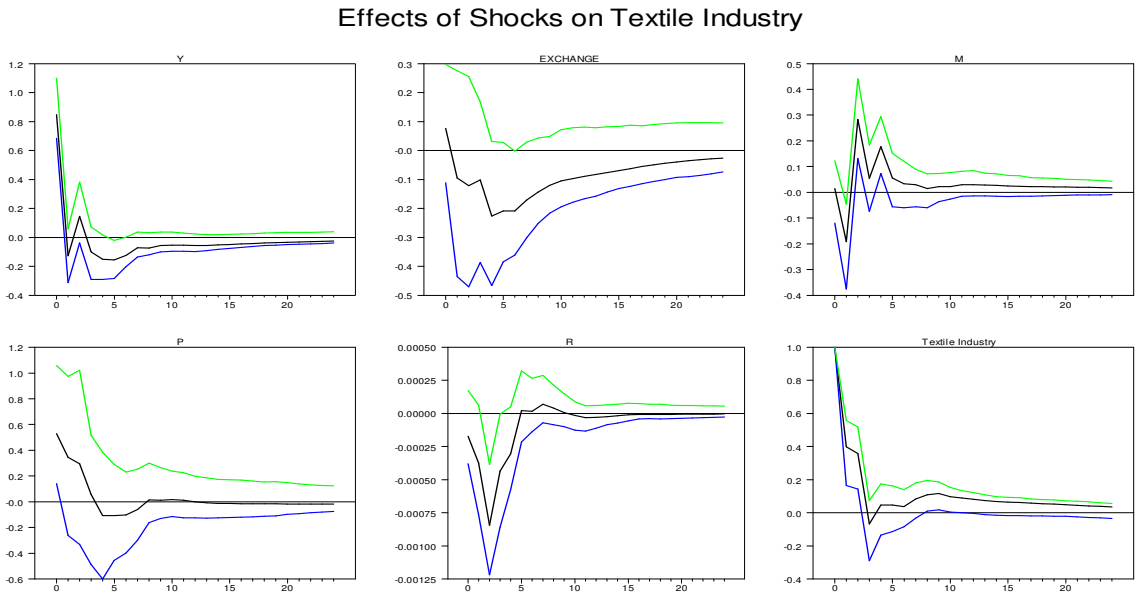

Figure 10. Wearing Apparel

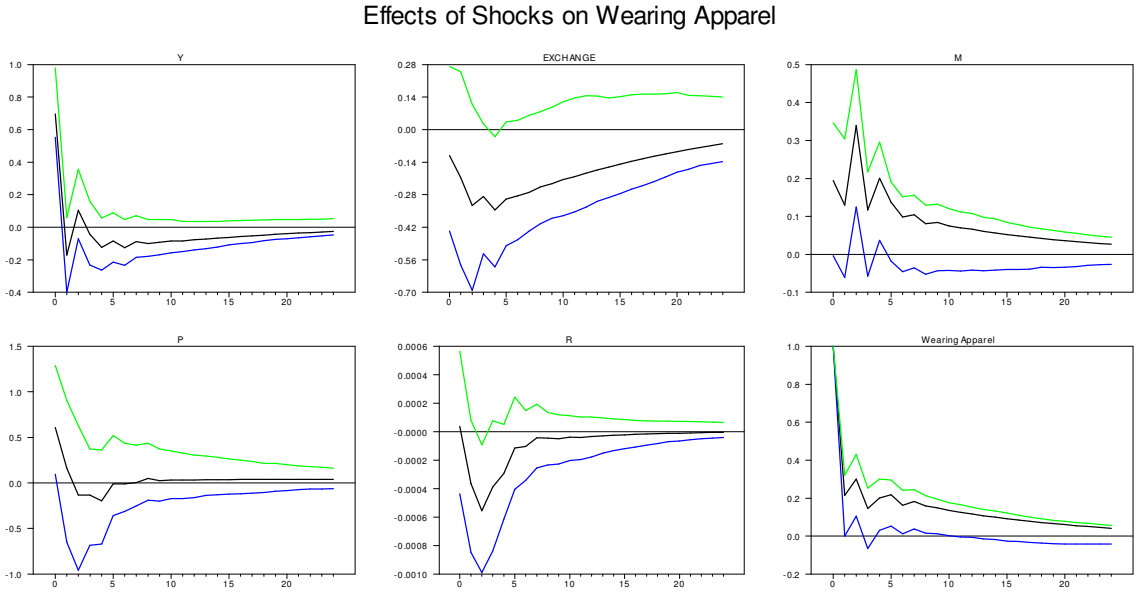

Figure 11. Dressing of Leather

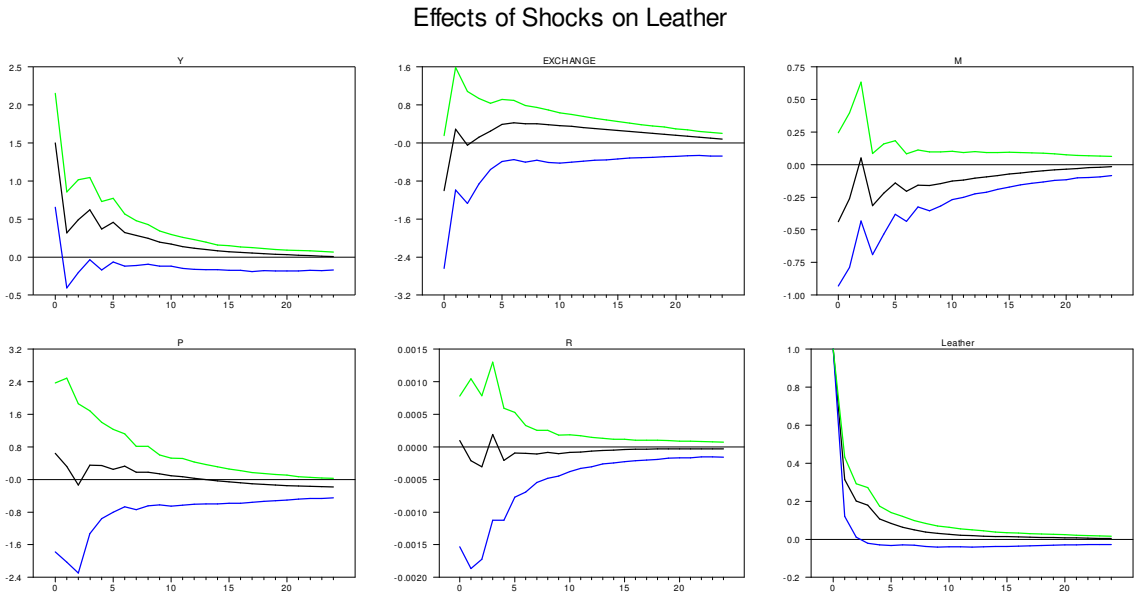

Figure 12. Wood Products –except Furniture

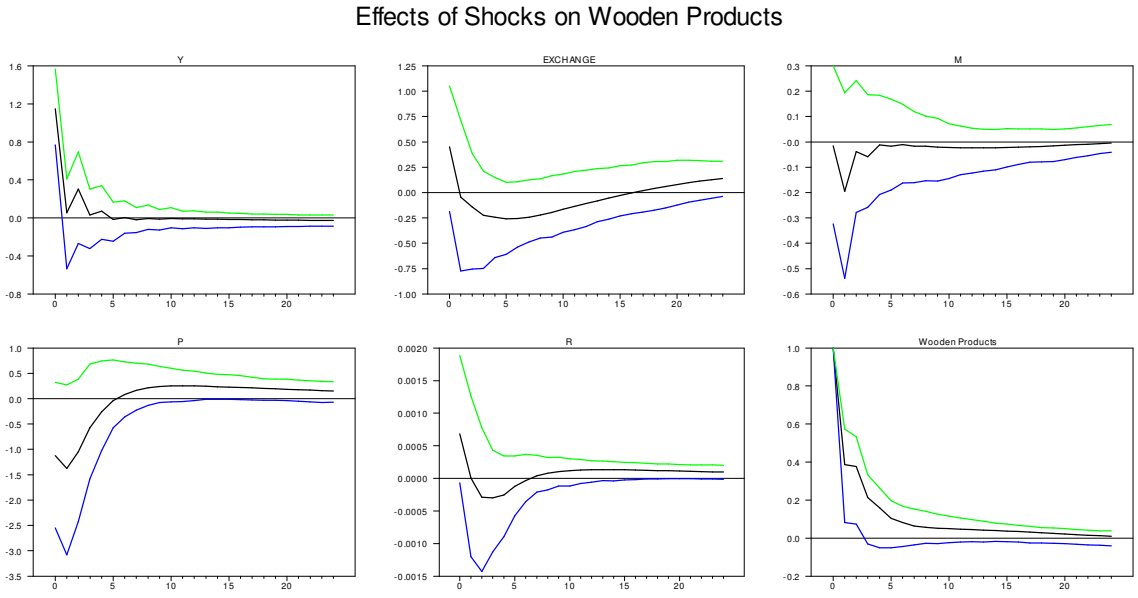

Figure 13. Manufacture of Paper and Paper Product

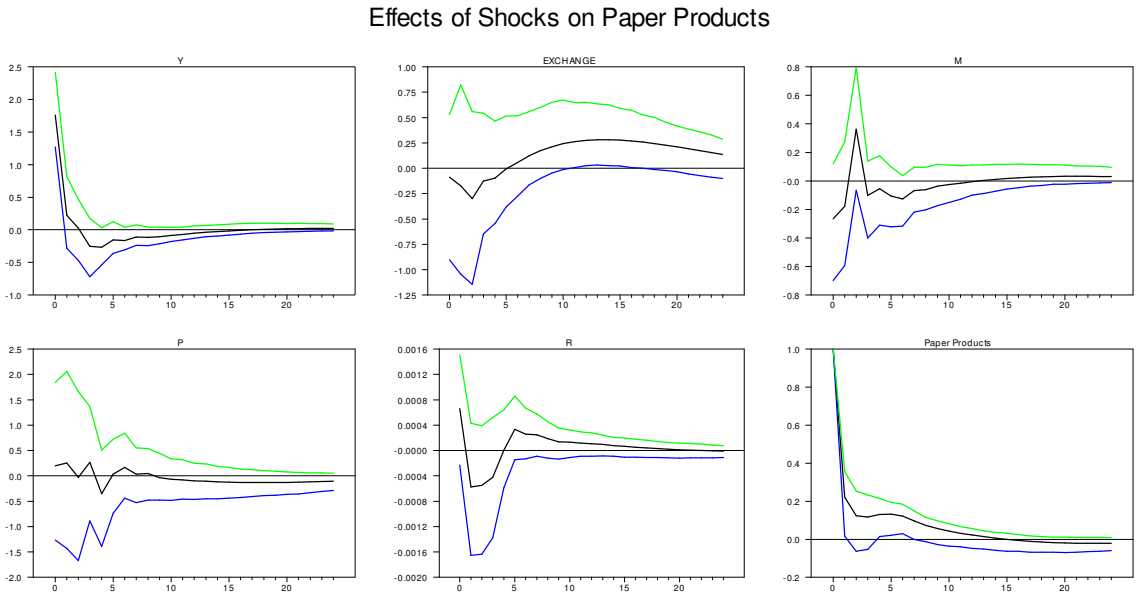

Figure 14. Publishing and Printing

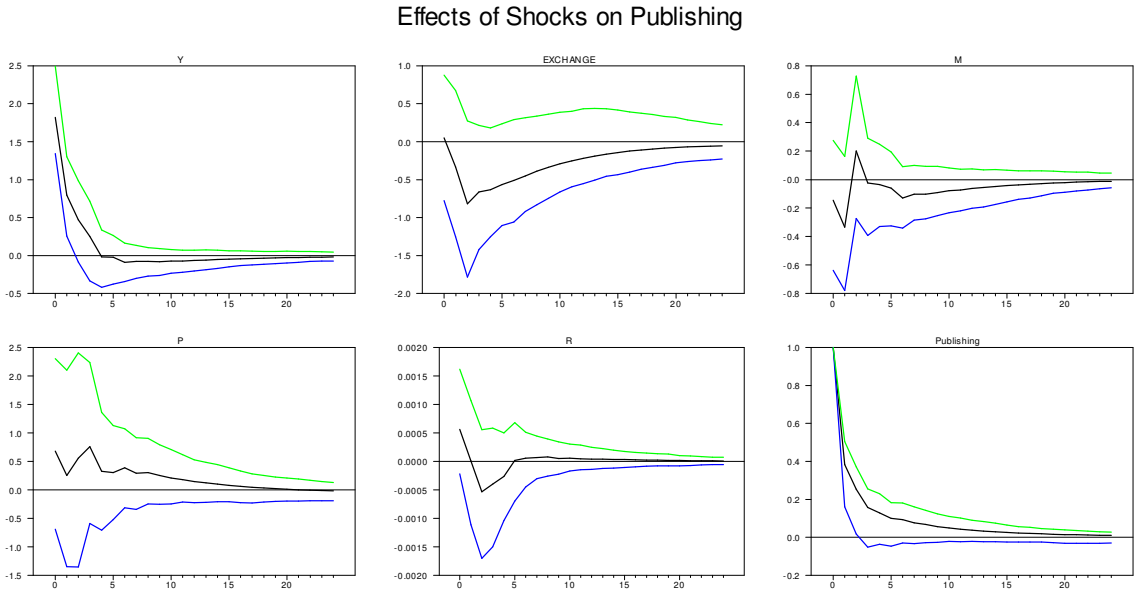

Figure 15. Manufacture of Coke, Refined Petroleum

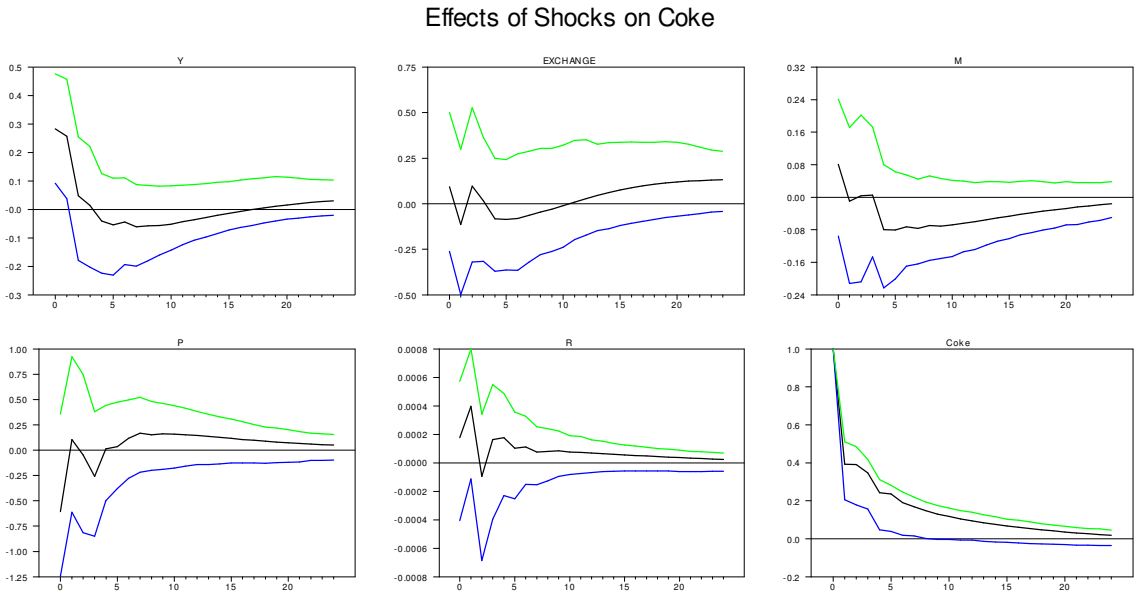

Figure 16. Manufacture of Chemical Industry

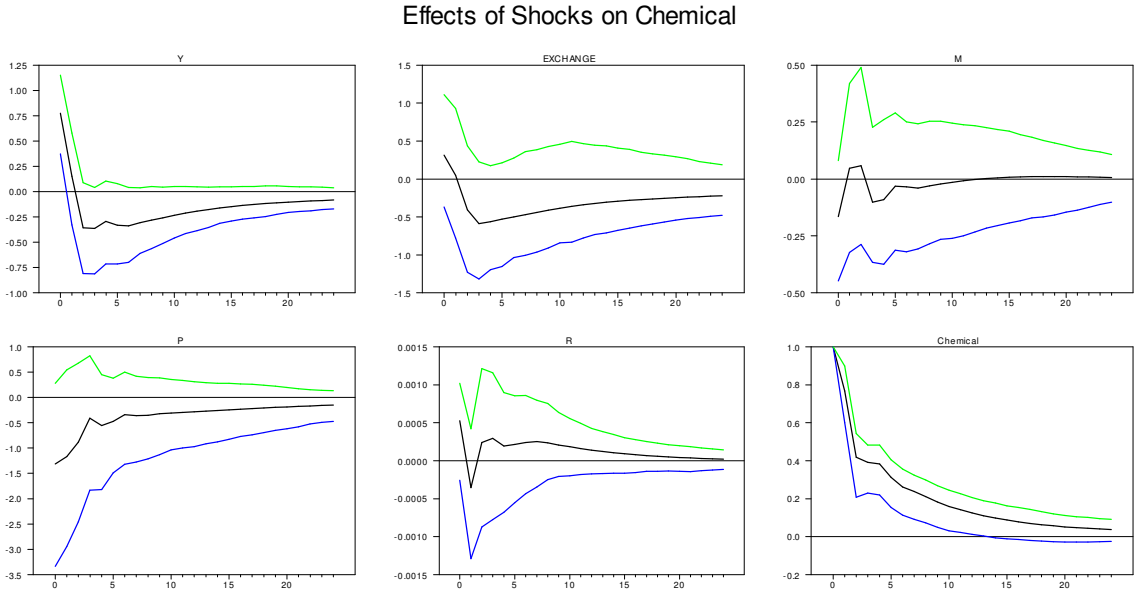

Figure 17. Rubber and Plastics Product

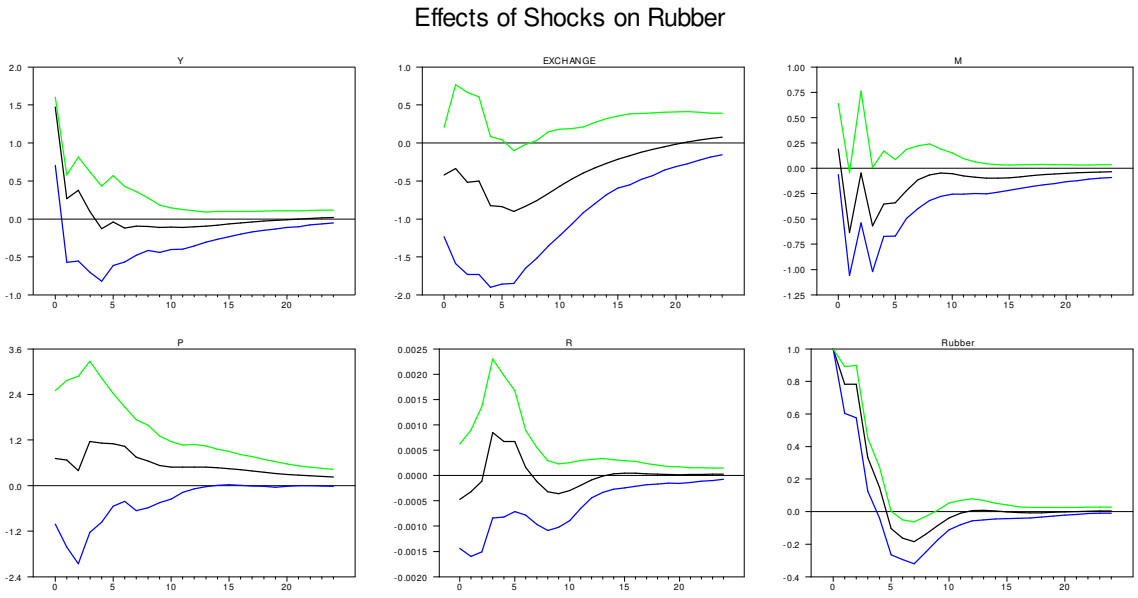

Figure 18. Manufacture of Non-metallic

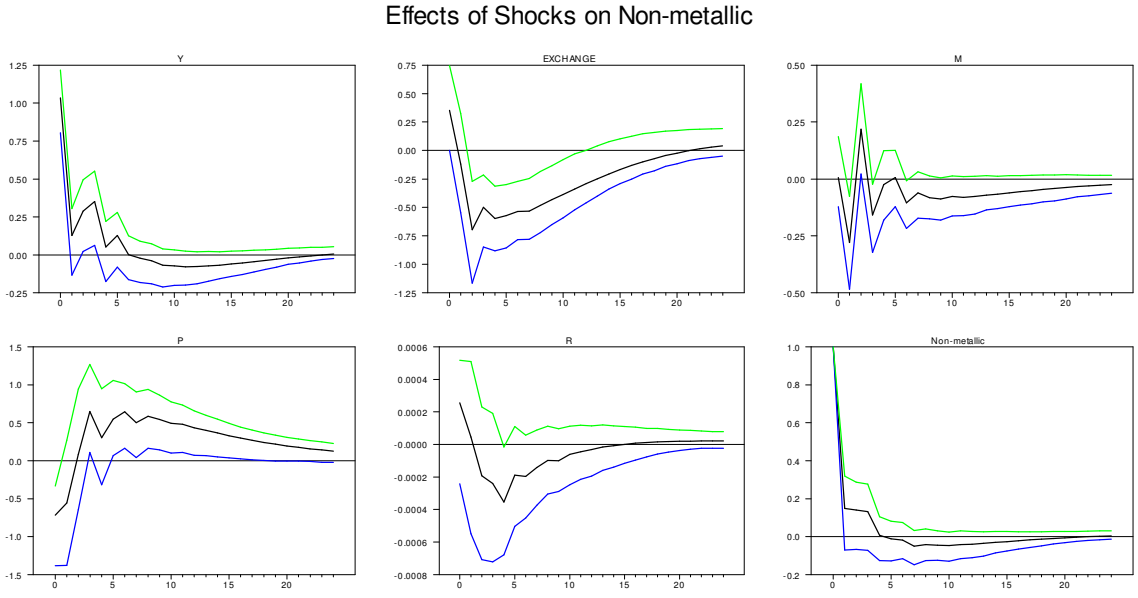

Figure 19. Basic Metal Industry

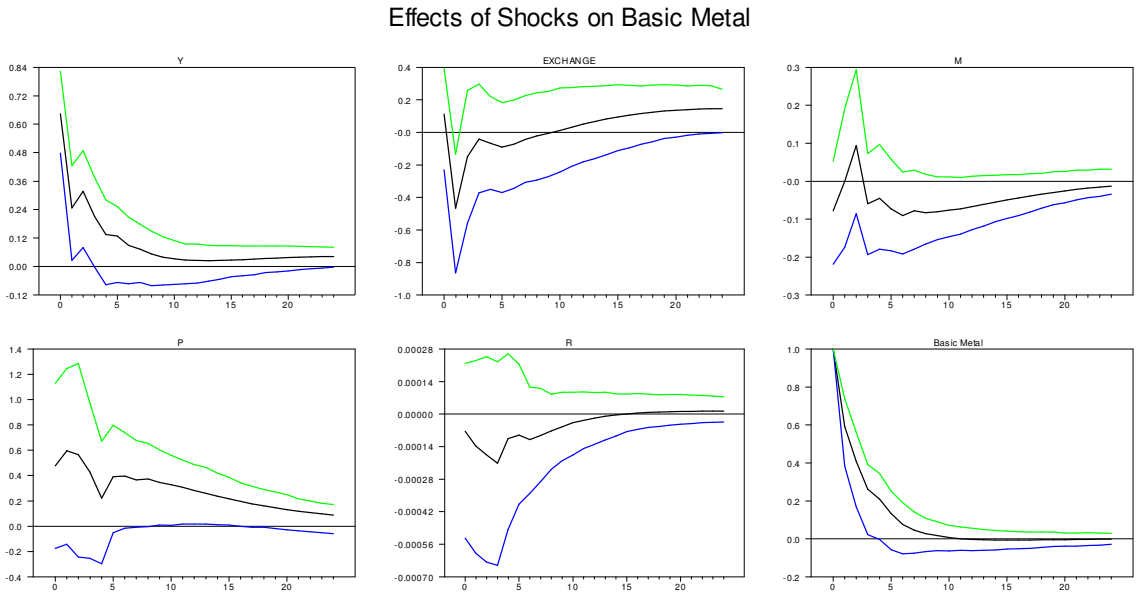

Figure 20. Metal Product –except Machinery

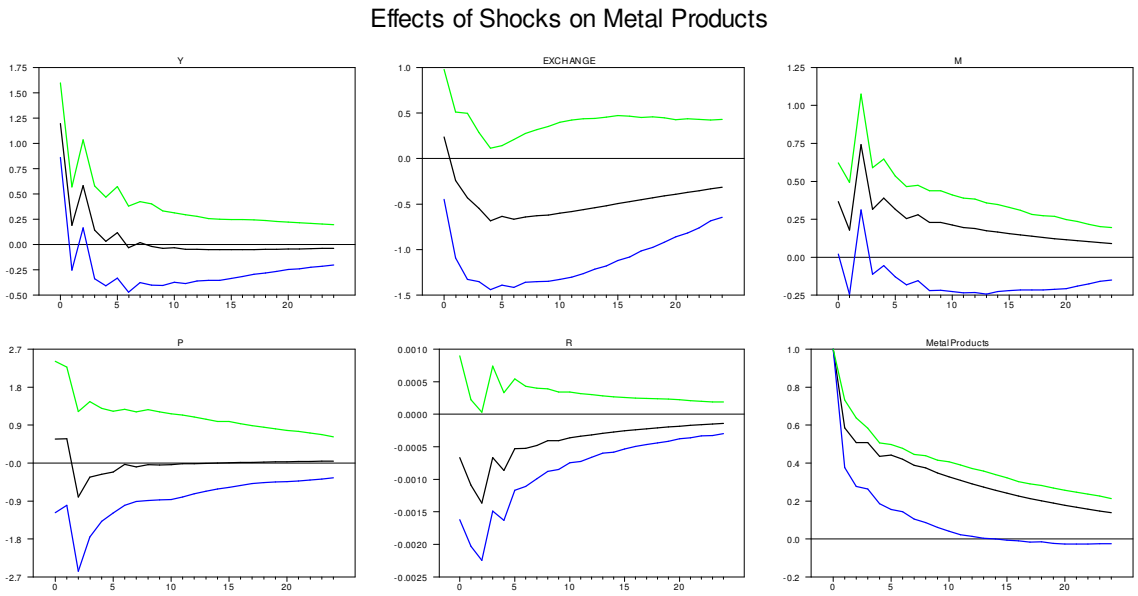

Figure 21. Machinery and Equipment

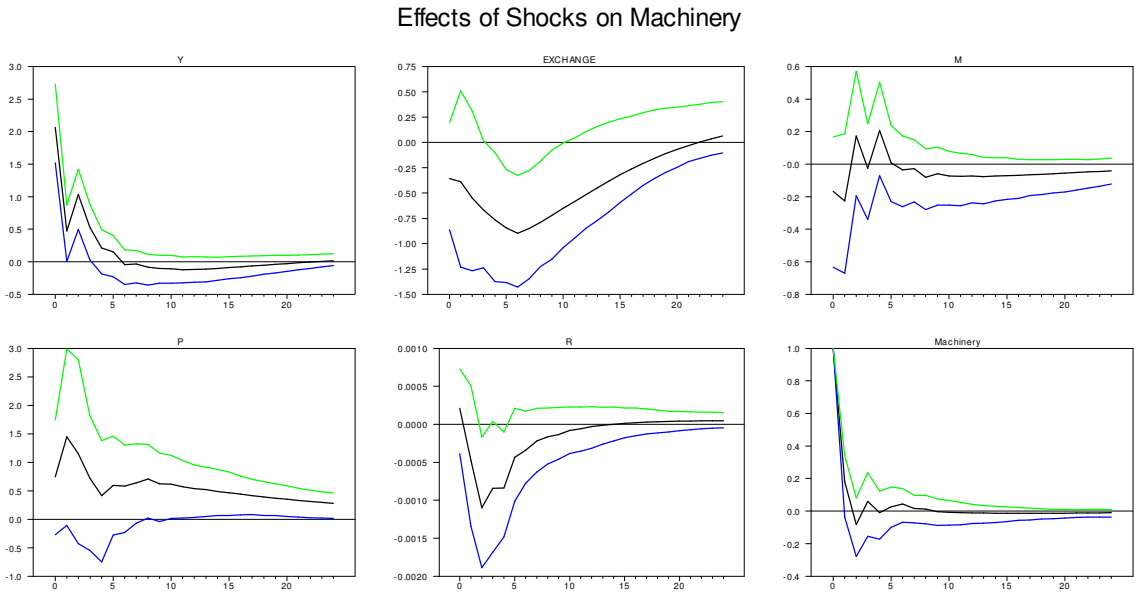

Figure 22. Office Accounting Computing Machinery

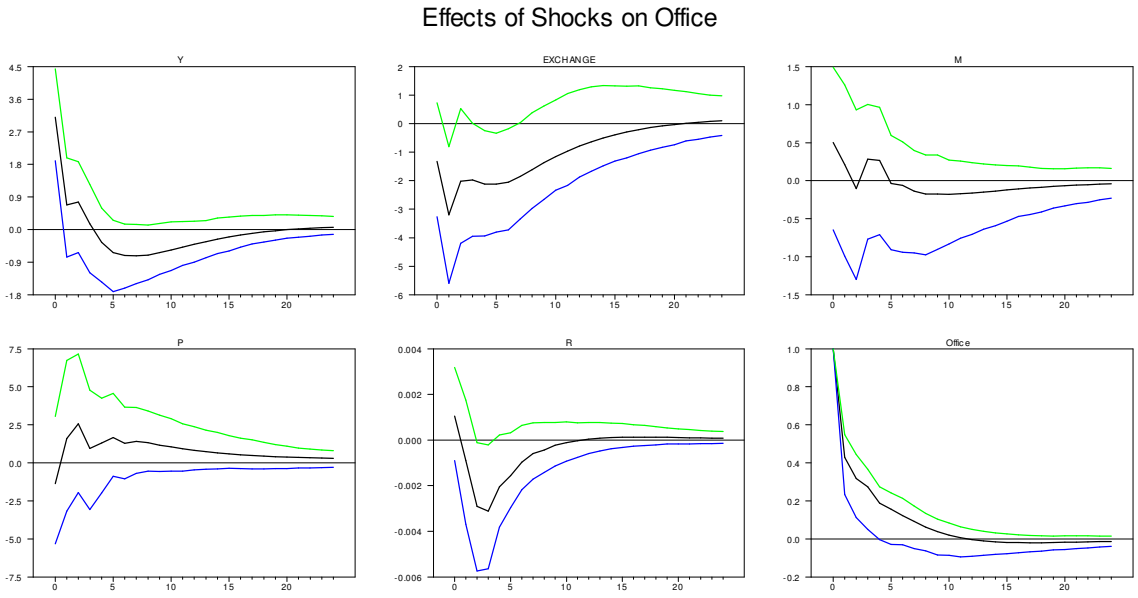

Figure 23. Electrical Machinery and Apparatus

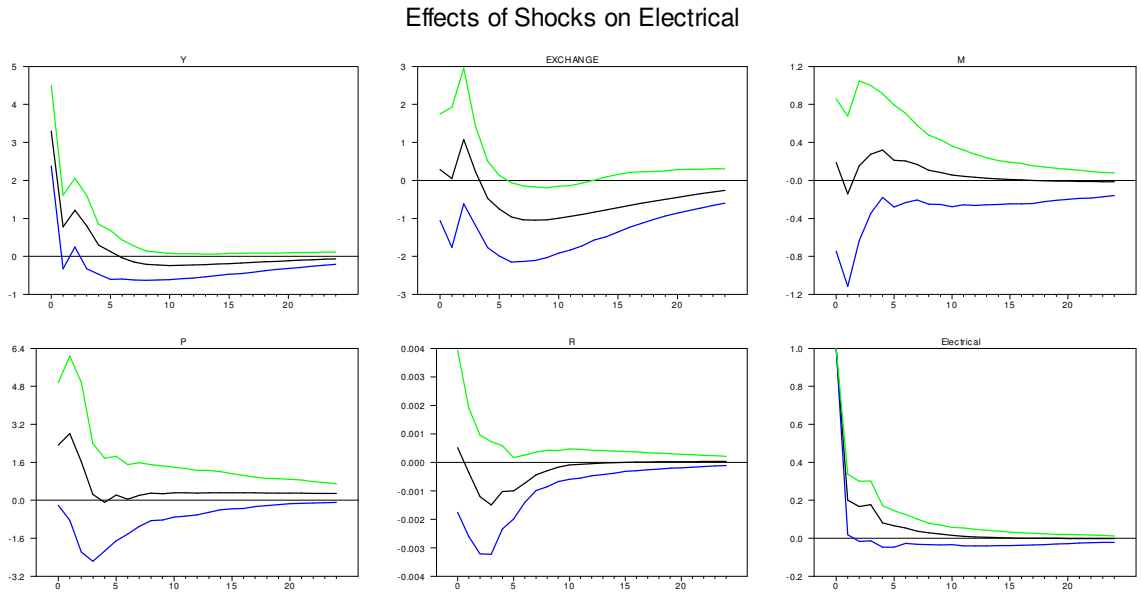

Figure 24. Radio, TV, Communication Equipment

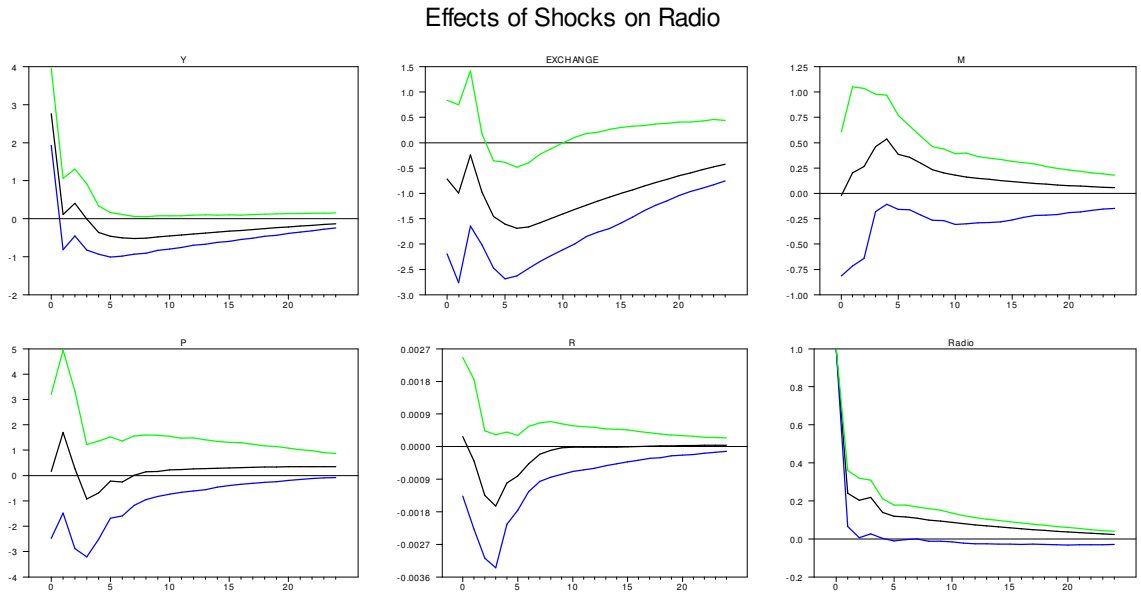

Figure 25. Medical, Precision, Optical Instruments

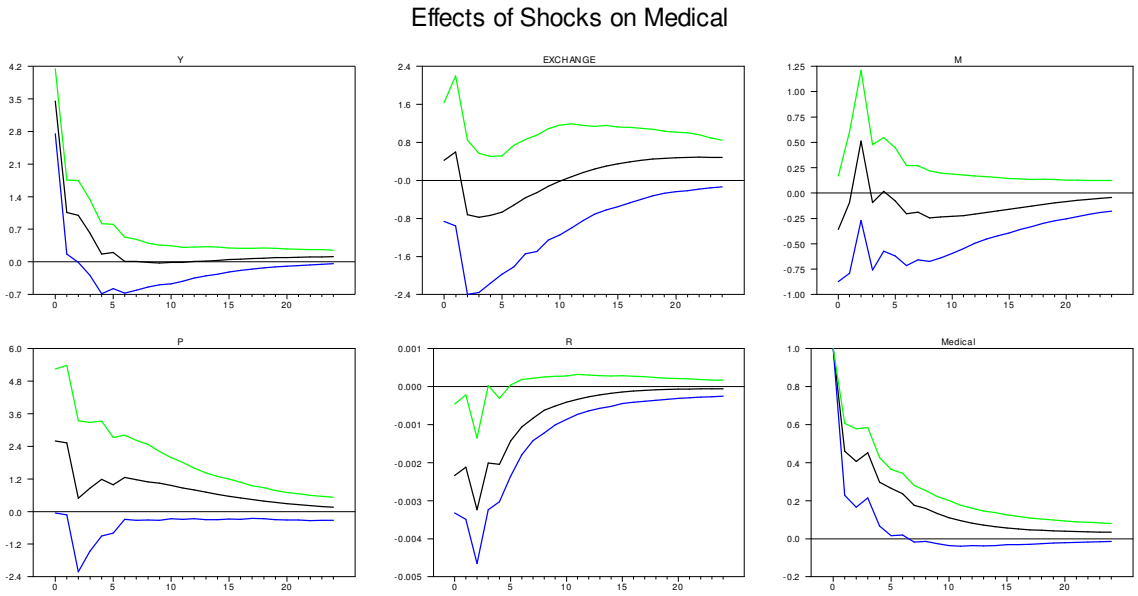

Figure 26. Manufacture of Motor Vehicles, Trailers

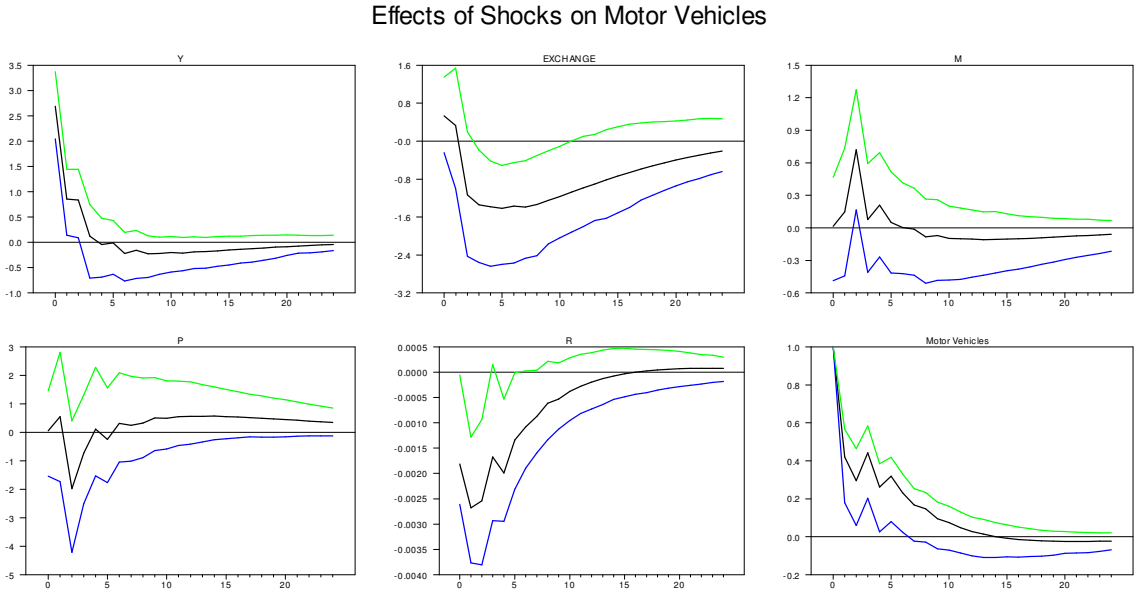

Figure 27. Other Transport Equipment

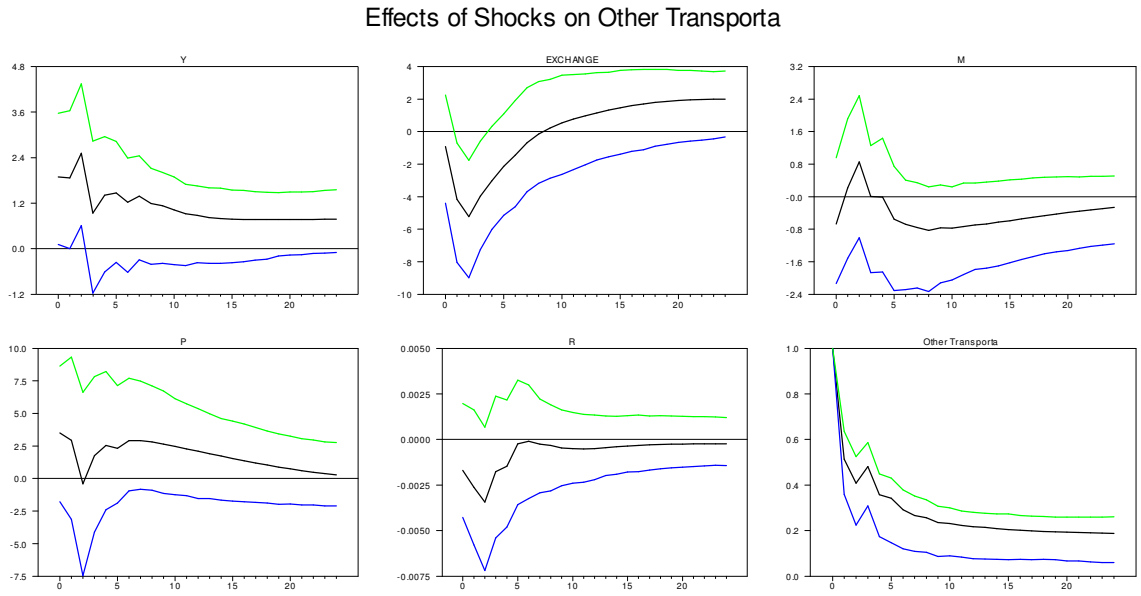

Figure 28. Manufacture of Furniture

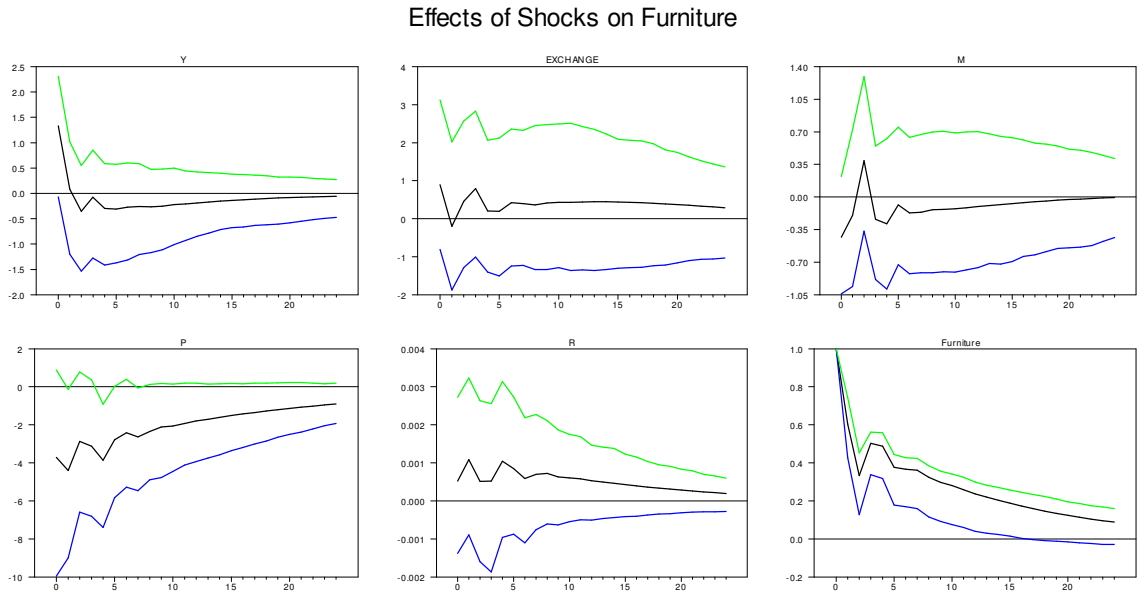

Figure 29. Electricity, Gas and Water

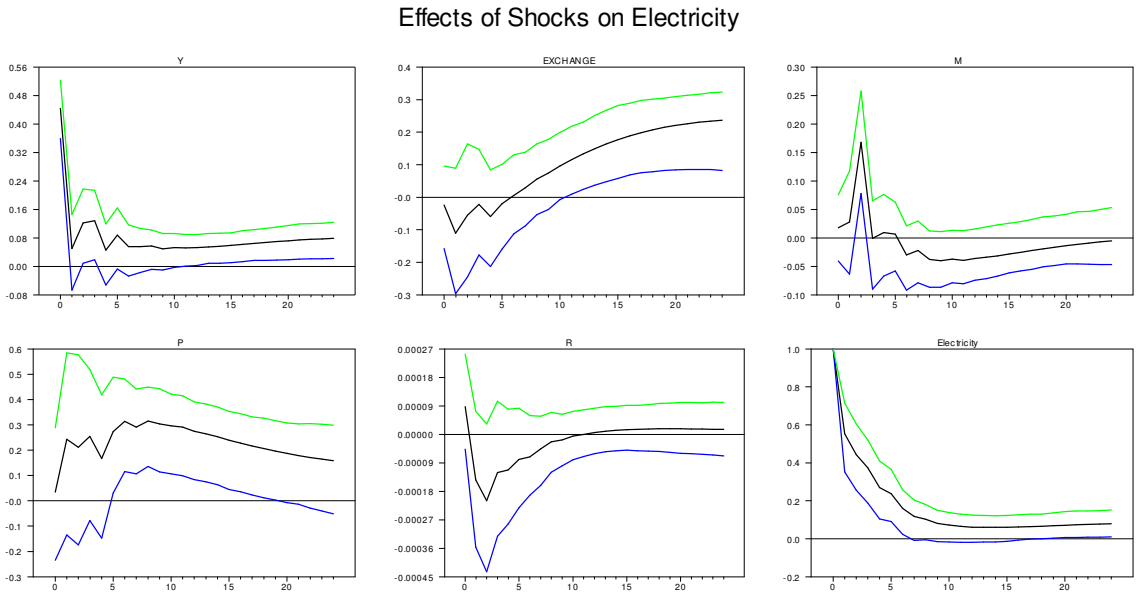

Table 1. Industrial Sectors Included in the Study*

Total Industry	TP.UR4.T01
Mining and Quarrying	TP.UR4.T02
Coal Mining and Extraction of Peat	TP.UR4.T03
Crude Petroleum and Natural Gas	TP.UR4.T04
Metallic Ore Mining	TP.UR4.T05
Other Mining	TP.UR4.T06
Manufacturing Industry	TP.UR4.T07
Food Products and Beverages	TP.UR4.T08
Tobacco Products	TP.UR4.T09
Textile Industry	TP.UR4.T10
Wearing Apparel	TP.UR4.T11
Dressing of Leather	TP.UR4.T12
Wood Products, Except Furniture	TP.UR4.T13
Manufacture of Paper and Paper Product	TP.UR4.T14
Publishing and Printing	TP.UR4.T15
Manufacture of Coke, Refined Petroleum	TP.UR4.T16
Manufacture of Chemical Industry	TP.UR4.T17
Rubber and Plastics Product	TP.UR4.T18
Manufacture of non-metallic	TP.UR4.T19
Basic Metal Industry	TP.UR4.T20
Metal Product, Except Machinery	TP.UR4.T21
Machinery and Equipment n.e.c.	TP.UR4.T22
Office Accounting Computing Machinery	TP.UR4.T23
Electrical. Machinery and Apparatus n.e.c.	TP.UR4.T24
Radio, TV, Communication Equipment	TP.UR4.T25
Medical, Precision, Optical Instruments	TP.UR4.T26
Manufacture of Motor Vehicles, Trailers	TP.UR4.T27
Other Transport Equipment	TP.UR4.T28
Manufacture of Furniture n.e.c.	TP.UR4.T29
Electricity, Gas and Water	TP.UR4.T30

* The right-hand column of the table provides the data codes for these sectors' industrial production indices for the Electronic Data Dissemination System of the CBRT.

Table 2. Cointegration Test Among the Variables of Interest

	Hypothesized Number of Cointegrating Equations					
	None	**At most 1**	**At most 2**	**At most 3**	**At most 4**	**At most 5**
Mining and Quarrying	*0.514*	*0.331*	*0.165*	*0.158*	*0.087*	*0.033*
	263.01**	144.59**	78.56**	48.90**	20.63*	5.643
Coal Mining and Extraction of Peat	*0.499*	*0.314*	*0.186*	*0.151*	*0.090*	*0.037*
	258.11**	144.48**	82.55**	48.74**	21.86*	6.228
Crude Petroleum and Natural Gas	*0.489*	*0.310*	*0.170*	*0.142*	*0.091*	*0.063*
	253.43**	143.22**	82.22**	51.57**	26.39**	10.67
Metallic Ore Mining	*0.506*	*0.333*	*0.205*	*0.145*	*0.096*	*0.036*
	268.20**	152.59**	86.17**	48.51**	22.78*	6.063
Other Mining	*0.515*	*0.341*	*0.165*	*0.154*	*0.078*	*0.044*
	265.08**	146.42**	78.01**	48.26**	20.79*	7.465
Manufacturing Industry	*0.520*	*0.321*	*0.282*	*0.159*	*0.141*	*0.048*
	300.02**	179.61**	116.03**	61.68**	33.21**	8.116
Food Products and Beverages	*0.539*	*0.357*	*0.280*	*0.160*	*0.122*	*0.048*
	311.92**	184.84**	112.20**	58.24**	29.58**	8.177
Tobacco Products	*0.509*	*0.363*	*0.201*	*0.162*	*0.082*	*0.038*
	277.07**	160.39**	86.36**	49.58**	20.41*	6.358
Textile Industry	*0.498*	*0.330*	*0.219*	*0.154*	*0.097*	*0.061*
	274.11**	161.12**	95.38**	54.75**	27.23**	10.33*
Wearing Apparel	*0.493*	*0.321*	*0.217*	*0.130*	*0.102*	*0.043*
	263.30**	151.77**	88.18**	47.98**	25.03**	7.259
Dressing of Leather	*0.504*	*0.328*	*0.177*	*0.141*	*0.116*	*0.038*
	264.04**	149.06**	83.76**	51.85**	26.78**	6.389
Manufacture of Paper and Paper Product	*0.501*	*0.358*	*0.216*	*0.163*	*0.121*	*0.030*
	282.28**	168.21**	95.49**	55.43**	26.16**	5.050
Publishing and Printing	*0.495*	*0.364*	*0.163*	*0.138*	*0.095*	*0.047*
	264.71**	152.37**	78.12**	48.81**	24.34*	7.958
Manufacture of Coke, Refined Petroleum	*0.496*	*0.347*	*0.237*	*0.146*	*0.039*	*0.026*
	264.01**	151.44**	81.50**	37.08*	11.06	4.367
Manufacture of Chemical Industry	*0.483*	*0.319*	*0.170*	*0.143*	*0.070*	*0.036*
	245.57**	137.24**	73.99**	43.30**	17.95	6.016
Rubber and Plastics Product	*0.500*	*0.319*	*0.269*	*0.158*	*0.131*	*0.037*
	286.18**	172.42**	109.29**	57.77**	29.49**	6.300
Manufacture of non-metallic	*0.627*	*0.347*	*0.203*	*0.146*	*0.144*	*0.041*
	327.80**	165.81**	95.78**	58.40**	32.51**	6.990
Basic Metal Industry	*0.507*	*0.349*	*0.164*	*0.143*	*0.117*	*0.038*
	268.75**	152.44**	81.98**	52.42**	26.97**	6.500
Metal Product, Except Machinery	*0.512*	*0.339*	*0.176*	*0.139*	*0.052*	*0.035*
	257.39**	139.53**	71.41**	39.55*	14.85	5.975
Machinery and Equipment n.e.c.	*0.520*	*0.338*	*0.195*	*0.155*	*0.116*	*0.043*
	279.07**	158.60**	90.80**	55.20**	27.51**	7.288
Office Accounting Computing Machinery	*0.512*	*0.345*	*0.218*	*0.147*	*0.083*	*0.039*
	274.97**	157.10**	87.56**	47.08**	20.98*	6.605
Electrical. Machinery and Apparatus n.e.c.	*0.503*	*0.360*	*0.180*	*0.143*	*0.088*	*0.031*
	266.43**	151.77**	78.48**	45.86**	20.48*	5.260
Radio, TV, Communication Equipment	*0.524*	*0.332*	*0.221*	*0.150*	*0.094*	*0.042*
	279.21**	157.39**	91.13**	50.12**	23.32*	7.059
Medical, Precision, Optical Instruments	*0.494*	*0.367*	*0.153*	*0.145*	*0.103*	*0.043*
	265.19**	153.32**	78.32**	50.98**	25.20**	7.297
Manufacture of Motor Vehicles, Trailers	*0.531*	*0.349*	*0.205*	*0.140*	*0.103*	*0.040*
	281.93**	157.66**	87.15**	49.45**	24.68**	6.857
Other Transport Equipment	*0.480*	*0.330*	*0.164*	*0.153*	*0.123*	*0.052*
	260.35**	152.99**	87.24**	57.76**	30.44**	8.809
Manufacture of Furniture n.e.c.	*0.501*	*0.337*	*0.163*	*0.152*	*0.049*	*0.030*
	251.40**	137.23**	69.81**	40.56*	13.47	5.156
Electricity, Gas and Water	*0.517*	*0.349*	*0.193*	*0.161*	*0.120*	*0.033*
	280.92**	161.42**	90.91**	55.63**	26.67**	5.630

(*) and (**) denote the rejection of the null hypothesis at 5% and 1% significance levels, respectively. For each sector, the eigenvalues (in *italics*) and the λ_{trace} test statistics are provided for the Johansen cointegration test. The critical values for the tests are not explicitly reported in the table; yet they are accessible in Osterwald-Lenum (1992).