


A Comparison of the Macroeconomic Effects of Increased Defence Spending in Poland and Germany

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Abstract

The aim of the article is to quantify and compare the macroeconomic effects of defence spending in the Polish and German economies. Estimating these effects is of particular importance in the context of the substantial increase in defence expenditures in Poland and Germany resulting from the war in Ukraine. The research is based on a dynamic stochastic general equilibrium model that takes into account both demand-side and supply-side mechanisms. The impulse response functions calculated based on the models estimated for the two economies show that the impact of defence spending on GDP is much stronger in Poland than in Germany. Furthermore, the empirical results indicate that in the Polish economy, defence spending also stimulates labour and consumption to a greater extent than in the German economy.

Keywords: defence spending, government spending, fiscal policy

JEL: E62, H30, H50



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Introduction

The war in Ukraine increased government defence spending in many European Union (EU) countries. A particularly strong increase in defence public expenditure occurred in Poland and Germany. In Poland, it jumped from 2.3% of GDP in 2021 to 3% in 2023, while in Germany, it rose from 1.5% to almost 2%. Thus, defence expenditure increased by more than 30% in both countries.

In the context of the rapid increase in defence spending, an assessment of the impact of this expenditure on economic activity becomes especially relevant. There is a broad literature concerning the long-term macroeconomic effects of defence spending changes (Carter, Ondercin, and Palmer 2021). In the long term, the key issue is the impact of defence spending on the formation of capital and the efficient use of resources (Lobont et al. 2019; Mohanty, Panda, and Bhuyan 2020). In the medium term, however, the impact of defence spending on household behaviours is crucial. Its strength largely depends on whether households make decisions based on current or permanent income. In theory, in more developed economies, the share of households that make decisions based on permanent income (i.e., Ricardian households) is higher, reducing the impact of government spending on GDP (Mankiw 2000; Coenen and Straub 2005; Galí, López-Salido, and Vallés 2007). Therefore, considering the heterogeneity of households allows for a more precise estimation of the macroeconomic effects of increased defence spending.

The article aims to quantify and compare the macroeconomic effects of defence government spending in Poland and Germany based on a model that considers the heterogeneity of household behaviours in these countries.

A presentation of the results of such an analysis is especially justified in the context of:

- the increased importance of defence spending as a result of the outbreak of the war in Ukraine,
- the projected economic slowdown in the EU and, therefore, the significant role of fiscal policy in stimulating economic activity (Auerbach and Gorodnichenko 2012; Afonso, Baxa, and Slavik 2018).

The added value of the study is that it is the first comparison of the impact of an increase in defence spending in EU countries after the outbreak of the war in Ukraine, based on a model which considers the heterogeneity of households. Eurostat quarterly data from 2000–2021 were used to estimate the parameters of the models for the Polish and German economies.

The structure of the article is as follows. Firstly, there is a literature review on the impact of defence spending on economic activity. This is followed by the presentation

of the assumptions of the theoretical model based on which the macroeconomic effects of defence spending in Poland and Germany are compared. The next section presents the empirical results for the Polish and German economies, i.e., impulse response functions that show the impact of defence spending on GDP, consumption, and employment. The final section concludes.

Literature review

There is a long-lasting debate concerning the impact of defence spending on economic activity (Alptekin and Levine 2012; Carter, Ondercin, and Palmer 2021). Benoit's (1978) seminal paper indicates the strong and significant positive impact of defence spending on long-term economic growth. However, later empirical studies give mixed findings – both positive and negative effects of defence government spending on economic growth have been reported (Ali 2012; d'Agostino et al. 2012; Yilgör, Karagöl, and Saygili 2014; Compton and Paterson 2016; Hung-Pin and Wang 2022; Karamanis 2022; Clark et al. 2023).

Alptekin and Levine's (2012) meta-analysis indicates a positive correlation between defence spending and long-term economic growth, primarily in developed countries. After analysing approximately 170 studies, Dunne and Tian (2013) found a negative long-term relationship in about 44% of cross-sectional studies, while about 20% indicated a positive relationship, and about 40% an ambiguous relationship. The literature review shows that medium-term and short-term effects of defence expenditures on output are usually positive. The impact on macroeconomic activity in the medium and short run was estimated by Ramey and Shapiro (1998), Eichenbaum and Fisher (2005), Ramey (2011) and Owyang, Ramey, and Zubairy (2013), among others.

Ramey and Shapiro (1998) studied the post-war US economy. Their research allowed them to distinguish three exogenous fiscal shocks associated with a strong increase in defence spending: the Korean War, the Vietnam War, and the Soviet invasion of Afghanistan. The three episodes were extended by Ramey (2011) to four by adding an additional variable for the 2001 terrorist attack on the Pentagon and the World Trade Centre. The defence spending multiplier in this research is positive and relatively high.

Barro (1981) found that defence spending has a different impact on GDP depending on whether it is temporary or not – the short-term effects of a temporary increase in defence expenditure are usually stronger than the short-term effects of a permanent change in defence expenditure. On the other hand, Sheremirov and Spirovska's (2015) panel research, conducted on over one hundred countries, indicates a significant difference between the macroeconomic effects of defence spending on the purchase of durable goods and the macroeconomic effects of defence expenditure on the purchase of non-durable goods and services.

There is no consensus on a theoretical framework for estimating the impact of defence spending on economic activity. Some researchers use an atheoretical approach, like vector auto-regressions and testing for Granger causality (e.g. Chowdhury 1991; Kusi 1994; Kollias et al. 2004). For example, Kollias et al. (2004) used causality tests to examine the relationship between defence spending and economic growth in EU countries between 1961 and 2000. They found that the causality of economic growth on defence expenditures occurs more frequently than the causality of defence expenditure on GDP. It may indicate that those countries would decide on the size of defence spending by considering the economic situation rather than defence spending being the cause for stimulating economic activity.

However, most estimates are based on economic theory. Four types of model dominate the estimation of the economic effects of defence spending:

- Models based on the Feder–Ram supply-side model (Feder 1982); for example, it was used by Biswas and Ram (1986) to analyse the impact of defence expenditure on economic long-term growth;
- Supply-side real business cycle models with elastic prices (e.g. Baxter and King 1993); they are more often used to analyse the short- and medium-term rather than the long-term impact of government spending on economic fluctuations effects of defence spending;
- Demand-side models, based on IS-PC-MR (i.e. IS curve/Phillips Curve/Monetary Rule) and Romer (2000) models; they have been used to analyse the economic effects of defence spending by, among others, Atesoglu (2002);
- New-Keynesian dynamic stochastic general equilibrium models; they consider both supply-side and demand-side factors (e.g., Lorusso and Pieroni 2017; Becerra-Vicario et al. 2020).

Our research uses the last of the above-mentioned methodologies. The main reasons are:

- dynamic stochastic general equilibrium models are especially useful when estimating the short-term and medium-term impact of fiscal policy on economic activity, i.e., the focus of our research;
- New-Keynesian dynamic stochastic general equilibrium models consider both demand-side and supply-side factors, which enables the most comprehensive analysis of the impact of increased defence spending on macroeconomic variables.

The model

As indicated in the previous section, the model on which the research is based includes both demand-side and supply-side factors. In accordance with the demand-side approach initiated by Keynes (1936), along with the increase in government spending, there is multiplied growth in aggregate demand and, as a result, output. Hicks (1937) and Hansen's (1953) famous IS-LM model was created as a result of extending the simple demand model to include the LM curve. The money market weakens the impact of government spending on output due to the increase in demand for money resulting from higher output. This, in turn, leads to an increase in the interest rate, crowding out part of the investment. Consequently, the demand-side effects of fiscal policy depend on money market conditions, e.g., they are particularly strong in the case of zero interest rates and liquidity traps (Eggertsson and Krugman 2012).

At the same time, however, the demand-side effects of fiscal policy on GDP do not depend significantly on what type of government spending is increased. In particular, the demand-side effects of fiscal policy should not significantly differ, whether it is defence spending or any other type of government spending.

A different situation occurs in the case of supply-side effects of government spending. In this case, government spending affects the economy not only at the aggregate level, but also at the micro level by the impact it has on households' and firms' decisions. This impact is mainly due to the wealth effect (Aschauer 1988; Baxter and King 1993). Consequently, the impact of fiscal policy on household decisions depends on the substitutability of a given government spending relative to household consumption (Karras 1994; Kwan 2006; Ercolani and e Azevedo 2014).

Thus, when analysing the supply-side effects of government spending, two kinds of spending should be distinguished: (1) expenditure that is not a substitute for private consumption and (2) expenditure that is partly a substitute for private consumption. Defence spending is not a substitute for private consumption, while non-defence spending is partly a substitute for private consumption (e.g. government spending on healthcare and education is partly a substitute for private expenditure on healthcare and education).

The model analysed in this study is a New-Keynesian dynamic stochastic general equilibrium model with heterogeneous households. As Campbell and Mankiw (1989) indicated, it is reasonable to distinguish between two groups of households based on the role of current income and permanent income in their decision-making. Such a disaggregation is particularly justified when analysing fiscal policy, as each of the above groups of households responds differently to changes in fiscal policy (Galí, López-Salido, and Vallés 2007).

Households that make decisions based on permanent income, i.e., they consider the future development of their income in optimisation decisions, are often referred to in the literature as Ricardian households. The name derives from the fact that for this group of households, there is a Ricardian equivalence between financing government spending with public debt and with lump-sum taxes (Barro 1974). Households that make decisions only based on current income are referred to as non-Ricardian households. This is because, in their case, Ricardian equivalence does not occur. Potential reasons for the non-existence of Ricardian equivalence include a finite planning horizon, a lack of access to the credit market, short-sightedness, or following practical rules (e.g. Galí, López-Salido, and Vallés 2004).

Ricardian households make their decisions to maximise the expected value of the following sum of discounted utilities (Christiano and Eichenbaum 1992):

$$E_t \sum_{t=0}^{\infty} \beta^t \ln \left(C_t^R + \gamma G_t^{non\ defence} \right) + \vartheta (1 - L_t^R), \quad (1)$$

where:

E_t – expected value in period t ,

β – discount factor,

C_t^R – private consumption of Ricardian households,

$G_t^{non\ defence}$ – non-defence spending (government spending which is partly a substitute for private consumption),

γ – rate of substitution between private consumption and non-defence spending,

L_t^R – labour of Ricardian households,

ϑ – parameter that describes the role of leisure (free time) in Ricardian households' preferences,

$\beta \in (0,1)$,

$\gamma \in (0,1)$,

$\vartheta > 0$.

Consequently, in decisions concerning their consumption level, Ricardian households only consider government spending that is partly a substitute for private consumption (that is, non-defence spending). Non-Ricardian households make their decisions only based on their current budget constraint. They spend all their current income on consumption and taxes, which means that their budget constraint is as follows:

$$P_t(C_t^{NR} + T_t^{NR}) = W_t P_t L_t^{NR}, \quad (2)$$

where:

C_t^{NR} – consumption of non-Ricardian households,

L_t^{NR} – labour of non-Ricardian households,

T_t^{NR} – taxes paid by non-Ricardians,

P_t – price level,

W_t – wages.

Aggregation results in:

$$C_t^R + C_t^{NR} = C_t, \quad (3)$$

$$L_t^R + L_t^{NR} = L_t, \quad (4)$$

$$T_t^R + T_t^{NR} = T_t, \quad (5)$$

where:

C_t – aggregate consumption,

L_t – aggregate labour,

T_t – public revenue from taxes.

Taxes are paid by both groups of households; however, in accordance with Ricardian equivalence, the distribution of taxes over time only affects the decisions of non-Ricardian households (Barro 1974).

The final good is allocated for consumption, investment, and two analysed types of government spending. Thus, aggregate demand is a sum of the following components:

$$C_t + I_t + G_t^{defence} + G_t^{non\ defence} = Y_t, \quad (6)$$

where:

I_t – investment,

$G_t^{defence}$ – defence spending,

Y_t – output.

The final good is produced based on intermediate goods, according to Dixit and Stiglitz's (1974) aggregator:

$$Y_t = \left(\int_0^1 y_t(i)^{\frac{1}{1+\lambda_{p,t}}} di \right)^{1+\lambda_{p,t}}, \quad (7)$$

where:

$y_t(i)$ – intermediate good of type i ,

$\lambda_{p,t}$ – parameter that describes the markup,

$\lambda_{p,t} > 0$.

Intermediate goods are produced by companies operating within monopolistic competition. The production function for each intermediate good is given by the following formula:

$$y_t(i) = A_t k_t^\alpha(i) l_t^{-\alpha}(i) - FC_t \quad (8)$$

where:

A_t – total factor productivity,

$k_t(i)$ – capital used to produce intermediate goods of type i ,

$l_t(i)$ – labour used to produce intermediate goods of type i ,

FC_t – fixed cost,

α – private capital elasticity of output,

$\alpha \in (0,1)$.

Levels of aggregate capital and aggregate labour are defined by the following equations:

$$K_t = \int_0^1 k_t(i) di, \quad (9)$$

$$L_t = \int_0^1 l_t(i) di, \quad (10)$$

where:

K_t – aggregate level of capital.

The aggregate capital increases according to a standard capital growth equation:

$$K_t = (1 - \delta)K_{t-1} + I_t, \quad (11)$$

where:

δ – depreciation rate,

$\delta \in (0,1)$.

Ricardian households, unlike non-Ricardian households, derive their income not only from labour but also from capital. Income from capital, in turn, depends on the interest rate. Interest rates result from monetary policy, which is conducted according to the Taylor (1993) rule. It means that:

- the higher the output compared to its potential level, the higher the interest rate set by the central bank,
- the higher the inflation compared to the inflation target, the higher the interest rate set by the central bank.

It is assumed that both prices and wages are set according to the Calvo (1983) setting. The probability that, in a given period, the household will set the wage rate and firms will set prices does not depend on their previous decisions (Erceg, Henderson, and Levin 2000; Kollmann 2001):

$$W_t = \left((1 - \xi_w) W_{IND,t}^{\frac{1}{\lambda_{w,t}}} + \xi_w W_{OPT,t}^{\frac{1}{\lambda_{w,t}}} \right)^{-\lambda_{w,t}}, \quad (12)$$

$$P_t = \left((1 - \xi_p) P_{IND,t}^{\frac{1}{\lambda_{p,t}}} + \xi_p P_{OPT,t}^{\frac{1}{\lambda_{p,t}}} \right)^{-\lambda_{p,t}}, \quad (13)$$

where:

$W_{IND,t}$ – indexed wage,

$W_{OPT,t}$ – wage optimized by households,

ξ_w – the probability that households will optimize wages,

$P_{IND,t}$ – indexed price,

$P_{OPT,t}$ – price optimized by firms,

ξ_p – the probability that firms will optimize prices,

$\xi_w \in (0,1)$,

$\xi_p \in (0,1)$.

The structure of the model means that defence spending has both supply and demand effects on the economy.

The changes in defence spending are described by the following autoregressive process:

$$G_t^{defence} = (1 - \rho_g)^n \bar{G}_{defence} + \rho_g G_{t-1}^{defence} + \zeta_{defence,t}, \quad (14)$$

where:

ρ_{τ_g} – parameter that describes the persistence of defence spending disturbances,

$\bar{G}_{defence}$ – the average level of defence spending,

$\zeta_{defence,t}$ – fiscal policy disturbances concerning the level of defence spending,

$\rho_g \in (0,1)$,

$\bar{G}_{defence} > 0$,

$\zeta_{defence,t} \sim N(0, \sigma_{defence}^2)$.

The effects of an increase in defence spending

The macroeconomic effects of an increase in defence spending in Poland and Germany were analysed based on impulse-response functions, which were calculated for the presented model estimated for the Polish and German economies. The parameters were estimated separately for each country based on Bayesian estimation (Adolfson et al. 2007) and calibration. The Eurostat quarterly data from 2000–2021 for the Polish and German economies were used to estimate the parameters of the models.

The impact of an increase of 1% GDP of each type of analysed defence spending on GDP, consumption and employment in Poland and Germany is presented in the study. The impulse response functions show the changes defined as percentage points of the initial level of each variable. The impact of an increase in defence spending in Poland and Germany on GDP is shown in Figure 1.

The impulse response functions show that the defence spending multiplier is substantially higher in Poland than in Germany. In Poland, the defence spending multiplier initially equals 0.75, which is only slightly lower than unity. By contrast, the defence spending multiplier in Germany is initially only 0.47. Thus, the results of the study show that in the Polish economy, the impact of defence spending on GDP is 60% stronger than in the German economy.

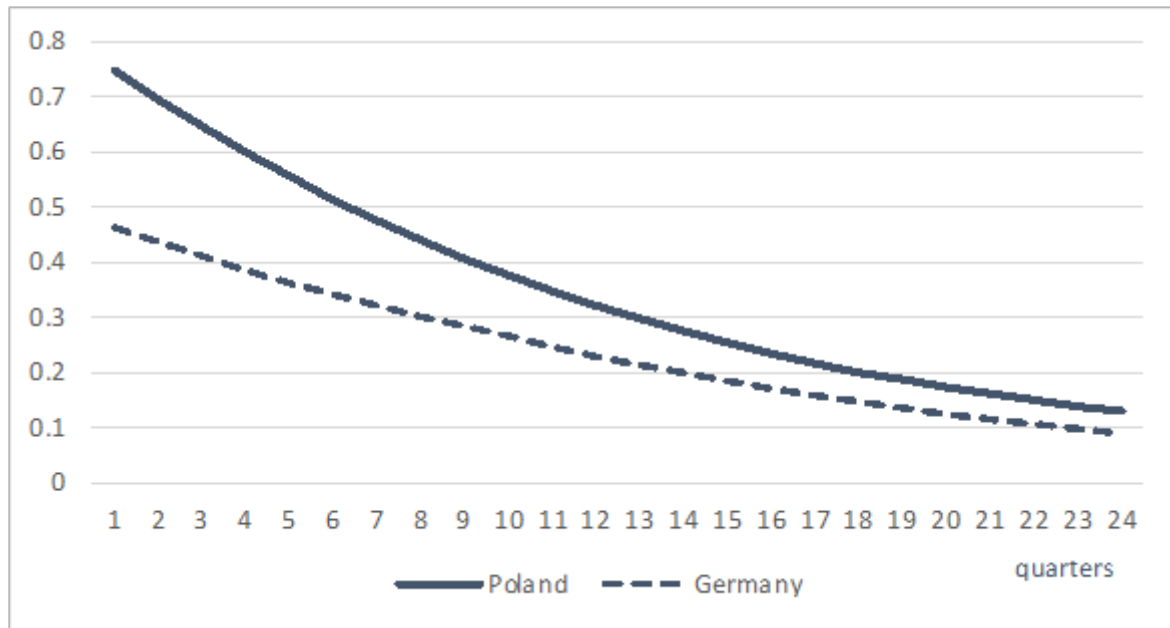


Figure 1. Impact of an increase in defence spending on GDP in Poland and Germany

Source: own study based on Eurostat n.d.

The relatively high value of the defence spending multiplier in Poland results from the fact that:

- Defence spending is not a substitute for household consumption expenditures, decreasing the crowding-out of households' private consumption;
- The relative role of households making decisions on their current rather than permanent income is higher in Poland than in more developed economies, which, in accordance with the consumption function, leads to a relatively high increase in household consumption and stimulates output.

In Germany, the former occurs as in Poland, while the latter is weaker. This is because, in more economically developed countries, the role of non-Ricardian households is smaller.

At the same time, it can be observed that changes in the GDP growth rate caused by the increase in defence spending are temporary and fade over time in both Poland and Germany. This is because defence spending does not directly increase the productive capacity of the economy.

As indicated earlier, the interrelationship between government spending and consumption is important for the impact of defence spending on the economy. The effects of an increase in defence spending on consumption in analysed countries are shown in Figure 2.

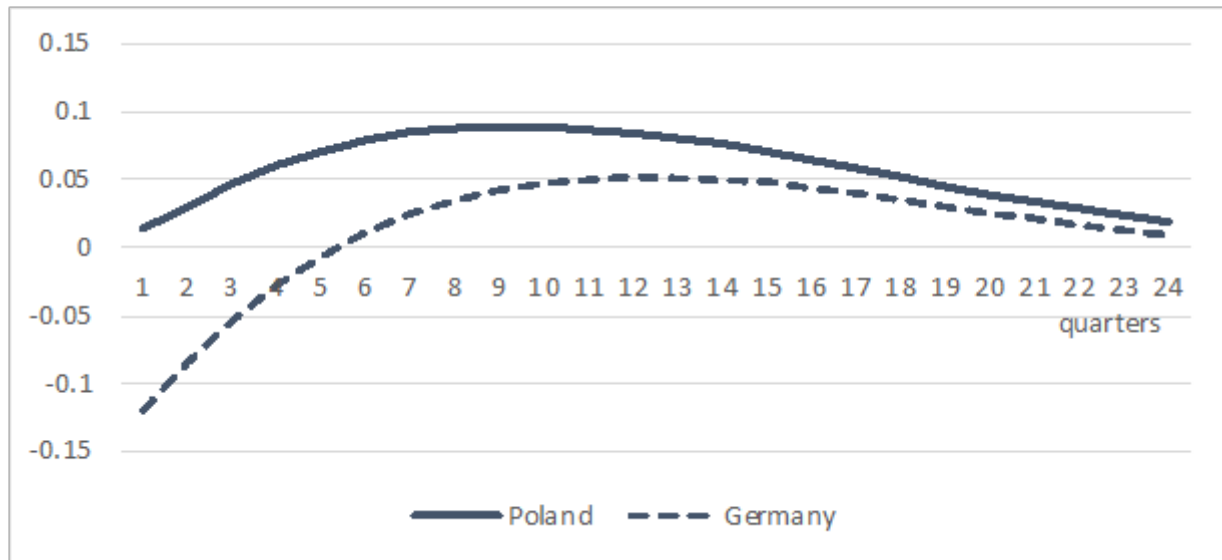


Figure 2. Impact of increase in defence spending on consumption in Poland and Germany

Source: own study based on Eurostat n.d.

In both economies, the changes in consumption caused by the increase in defence spending are small due to defence public expenditure affecting consumption in two opposite directions:

- An increase in defence spending causes a rise in aggregate demand and disposable income, which, according to the consumption function, leads to higher consumption;
- An increase in defence spending causes a crowding-out effect, i.e., a higher interest rate pushes out households' private consumption.

The first effect mainly affects households that make decisions based on their current income (non-Ricardians). The second effect mainly impacts households that make decisions based on permanent income (Ricardians). As a result, the initial response of consumption to the increase in defence spending in Poland and Germany is different. In the Polish economy, consumption grows, whereas in the German economy, it is initially reduced. Consumption in Poland grows immediately after the increase in defence spending because the demand-side effect that results from the growth in current disposable income prevails. According to the consumption function, the growth of current disposable income in the Polish economy leads to a substantial increase in consumption, stronger than the decrease in consumption due to the crowding-out effect. By contrast, in Germany, the crowding out effect, which concerns Ricardian households, initially prevails. After a certain time, however, consumption increases in both economies. This is presumably because the crowding-out effect is relatively weaker for defence spending than for other types of government spending, as it is not a substitute for private consumption (Christiano and Eichenbaum 1992).

In addition to GDP and consumption, the study also examines the impact of an increase in defence spending in the Polish and German economies on labour, as employment is one of the key macroeconomic variables that show the condition of the economy.

The impact of an increase in defence spending on labour is shown in Figure 3.

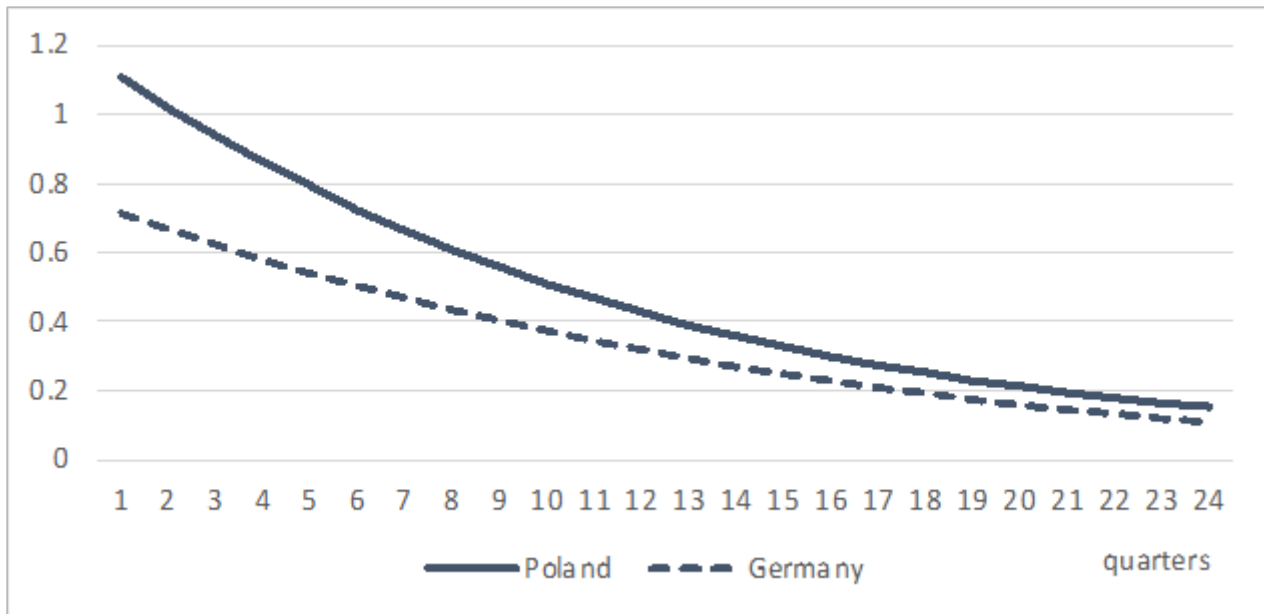


Figure 3. Impact of increase in defence spending on labour in Poland and Germany

Source: own study based on Eurostat n.d.

The results obtained for employment, based on the calculated impulse response functions, are similar to those for GDP. That is, as a result of the increase in defence spending, employment grows much more strongly in Poland than in Germany. In both economies, the percentage rise in employment is higher than the percentage increase in GDP. This is because an increase in defence spending, as in the case of other kinds of government spending, has a different impact on the short-term development of each factor of production. An increase in defence spending raises the level of employment much more strongly than the level of capital (which may even decline). Thus, the boost in GDP is driven by higher employment in both countries.

However, the impulse response functions also show that the impact of defence spending on the growth rate of employment is temporary. It diminishes over time, especially fast in the case of the Polish economy. As a result, in both Poland and Germany, GDP growth is also temporary. It means that an increase in defence spending does not have a long-term impact on economic growth in those countries, although it enhances short-term economic activity.

Conclusion

The research compared the macroeconomic consequences of a rise in defence spending in Poland and Germany. Impulse response functions calculated based on the models estimated for the Polish and German economies show that an increase in defence spending raises GDP in both countries. However, the impact on GDP is much stronger in Poland than in Germany. These results are in line with the theoretical predictions. The role of Ricardian households (i.e., households that make decisions based on permanent income) is higher in more developed economies, which results in defence spending having a lower impact on GDP in the German economy.

The results of the study also indicate that in Poland, defence spending enhances labour and consumption more than in Germany. The differences between the countries are particularly apparent in the case of the impact of defence spending on consumption. The impulse response functions show that, in Germany, an increase in defence spending causes a reduction in consumption that lasts more than one year. This is due to a strong crowding-out effect among Ricardian households. In contrast, the impulse response functions for Poland indicate that consumption increases immediately after the rise in defence spending. The reason for this is the greater role of non-Ricardian households, whose consumption depends on increased current income; therefore, the crowding-out effect is weaker.

To sum up, the research shows that an increase in defence spending is a more effective tool to stimulate economic activity in Poland than in Germany. As a result of an increase in defence spending, GDP, employment, and consumption rose in the Polish economy more than in the German economy.

Still, there are two interesting fields for further research:

- It would be worth investigating whether there is a more general inverse relationship between the level of economic development and the effectiveness of defence spending in stimulating the short-term economic activity;
- The question remains whether and under what conditions an increase in defence spending, which actually does not directly increase household utility, stimulates economic activity in a way that not only boosts GDP but also benefits households.

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Porównanie makroekonomicznych efektów zwiększenia wydatków na obronność w Polsce i w Niemczech

Celem artykułu jest porównanie makroekonomicznych efektów wydatków na obronność w gospodarce polskiej i niemieckiej. Oszacowanie tych efektów ma szczególne znaczenie w kontekście silnego wzrostu wydatków na obronność w Polsce i Niemczech w wyniku wybuchu wojny w Ukrainie. Badanie oparte jest na dynamicznym stochastycznym modelu równowagi ogólnej, który uwzględnia zarówno mechanizmy popytowe, jak i podażowe. Funkcje reakcji na impuls obliczone na podstawie modeli oszacowanych dla gospodarki polskiej i niemieckiej ukazują, że oddziaływanie wydatków obronnych na PKB jest znacznie silniejsze w Polsce niż w Niemczech. Ponadto uzyskane wyniki empiryczne wskazują, że w polskiej gospodarce wydatki na obronność w większym stopniu niż w gospodarce niemieckiej stymulują również zatrudnienie i konsumpcję.

Słowa kluczowe: wydatki na obronność, wydatki rządowe, polityka fiskalna