Is There Military Keynesianism?

An Evaluation of the Case of France Based on Disaggregated Data

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Abstract
This article explores the effects of military expenditure on aggregate output in France, covering the period 1980-2010, within a Keynesian model. Our empirical results reveal that military spending stimulates output, even if non-military spending exerts higher impact. The originality of our contribution comes from the use of disaggregated data which allows us to characterize composition effects of military spending. We find that public spending in defense equipment stimulates aggregate output, whereas the rest of public military spending has no significant impact.

Keywords: military expenditure; aggregate output; cointegration; public capital; fiscal policy

Titre
Existe-t-il un keynésianisme militaire ? Une évaluation du cas français sur données désagrégées

Résumé
Cet article examine les effets des dépenses militaires sur la production agrégée en France, sur la période 1980-2010, avec un modèle keynésien. Nos résultats empiriques révèlent que les dépenses militaires stimulent la production agrégée, bien que les dépenses non-militaires exercent un impact plus élevé. Cependant, l'originalité de notre contribution provient de l'utilisation de données désagrégées. En effet, il est possible de caractériser des effets de composition des dépenses militaires : les dépenses d'équipement stimulent la production agrégée alors que les dépenses de fonctionnement n'ont pas d'impact significatif.

Mots-clés : Dépenses militaires ; production agrégée ; cointégration ; capital public ; politique budgétaire

1 Introduction

France has a specific defense[1] policy compared to Western European countries. Indeed, the independence vis-à-vis the US has been erected as a key feature of the French defense policy since the beginning of the 5th Republic. This independence means that France has developed independent nuclear deterrence and independent defense industry combined with a high level of defense spending. Besides, its position in NATO is ambiguous: France withdrew the integrated military command in 1966[2]. This policy has been called "French Grandeur" by Fontanel and Hebert (1997).

Obviously, these characteristics have economic implications on the level of defense spending. Some figures help to illustrate this point. The average defense burden between 1988 and 2010 (the ratio defense spending to GDP) is equal to 2.8%, according to SIPRI database (Stockholm International Peace Research Institute). Figure 1 plots defense burden of several countries. French defense burden, which is higher than Western European countries, is quite comparable to the UK but slightly lower than the US.
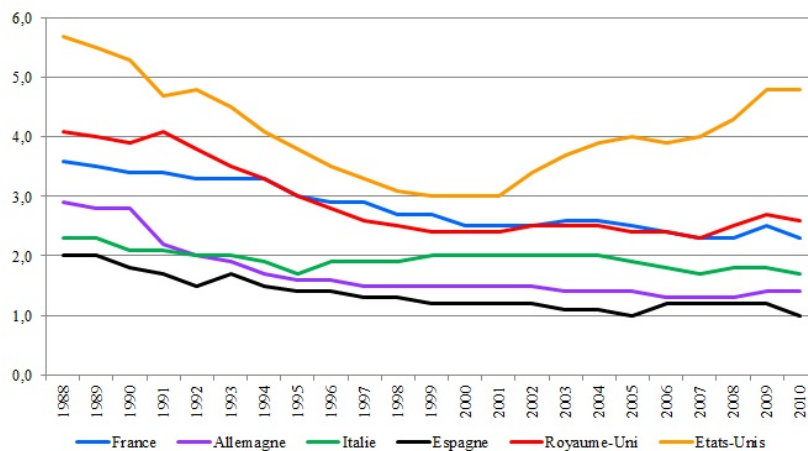

Figure 1: Evolution of the defense burden (% of GDP) from 1988 to 2010
Source: SIPRI

French annual statistical book also highlights three important areas: industry, employment and exports. The manufacturing share of the armament industry is equal to 8.4% in 2008 and rises since 1998. The Defense Ministry employs 8% of public workforce. The net exports of the armament industry are positive and this is the unique sector with a

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[1]In this paper, we consider the terms "defense" and "military" as synonymous.
[2]France joins the integrated military command in 2008.

positive balance.

The second implication of the French defense policy is the high level of military equipment in the defense budget. Figure 2 describes the evolution of the share of equipment between 1997 and 2010. From this figure, it appears that only three countries spend more than 20% of their budget on equipment: France, the UK and the USA. Smith (2009, p.106) argues that these countries adopt a "capital-intensive" defense strategy whereas other developed countries follow a "labour-intensive" strategy.
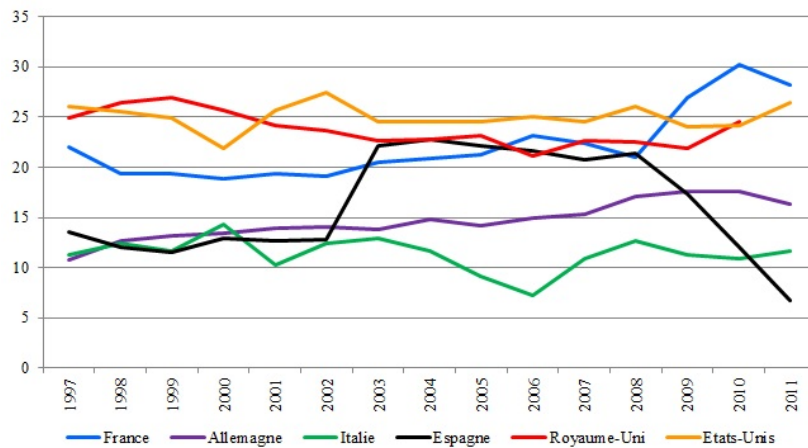

Figure 2: Share of equipment in the defense budget from 1997 to 2010
Source: NATO

Moreover, the French Defense Ministry is considered as the "first public investor". Table 1 reports some figures extracted from Government budget in LOLF format to illustrate this point: government budget, defense budget, investment budget (called "title 5") and investment initiated by Defense Ministry (mainly explained by the mission "Equipment"). Over the past few years, it appears that defense spending is responsible for 75% of public investment. Note that this contribution is not recent: decentralization, which starts at the beginning of the 1980's, leads the central government to delegate the public investment process to local administrations[1], so that defense sector becomes the principal vector of central public investment.

French Defense Ministry provides data concerning the use of the budget[2]. From 1980 to 2010, on average, half of the budget is devoted to personnel or non-equipment budget

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[1] For instance, in 2011, local administrations concentrate more than 75% of French public investment.

[2] This presentation of the budget follows the "1959 Ordonnance" which defines the objectives and means of defense policy.

Table 1: French budget (in billions euros)

Year	Budget	Defense	Investment spending	Investment from defense
2009	410	40.904	18	10.262
2010	427.4	40.675	14.9	10.077
2011	390	40.810	12.6	9.459
2012	314.4	41.227	12.7	9.327

(mainly wages and fuel). The other half is dedicated to equipment budget (mainly procurement of weapons and nuclear deterrence). Figure 3 plots the evolution of these two budgets. From this figure, we notice that non-equipment budget is rather stable while equipment budget is more changing.
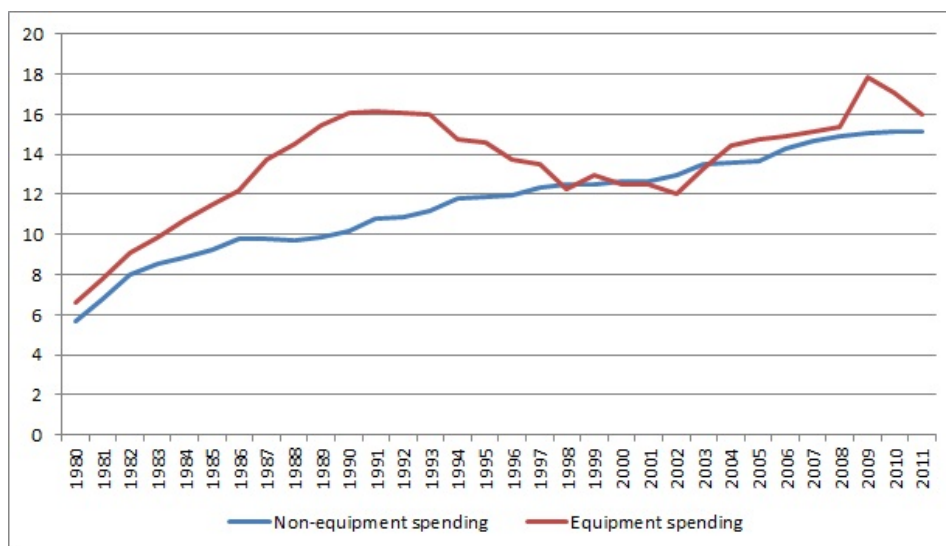

Figure 3: Composition of the French defense budget in billions of euros
Source: French Defense Statistical Yearbook

Evaluating the economic consequences of military expenditure requires to take into account these specificities. Such an evaluation is crucial given the economic and strategic contexts. From an economic point of view, France has an important public debt (close to 90% in 2012[1]), which leads to consider a fiscal consolidation strategy. Consequently,

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[1]Such a threshold has been pointed out by Reinhart and Rogoff (2010) as a turning point from which the effect of debt public turns to be negative. Even if this paper has been recently criticized by some scholars, it serves as a basis for policy-makers in the EU.

defense budget has suffered reduction over the past few years and will be constant in the most favourable scenario in the coming years[1].

However, France is involved in many peacekeeping interventions (Libya, Ivory Coast and Mali) over the few next years. The country wants to preserve a strategic position. Moreover, the two last white papers on defense and security highlight the new threats faced by France, mainly terrorism. Their recommendations are to adapt the defense format to these constraints: personnel reductions are planned but the equipment budget is preserved. To illustrate the political pressure faced by the military sector, Former Defense Minister, Mr. Gérard Longuet, declares the following: "Will the defense sector be an adjustment variable in the budgetary process? The answer is no. Will the defense sector be solidary to the national policy? The answer is yes."

Therefore, given the specificities of French defense policy, one has to seriously consider its consequences. Changes in defense spending have potential important effects as calculated by Ramey (2011) in the US case. Such changes are easier to identify because they directly correspond to periods of conflict.

As France is not involved in costly and lengthy conflicts, an other way to quantify the macroeconomic impacts is to use the concept of opportunity cost. As argued by Smith (2009, pp. 159-160), "with current shares of military expenditure, less than 5 per cent of GDP, the macroeconomic effects of military expenditure are probably small and decisions about defence budgets should be taken in terms of threats and opportunity costs, not macroeconomic effects." In defense economics literature, one opportunity cost is the guns vs butter trade-off illustrating the government's strategy to deal with scarce resources between two options: defense spending or civilian spending.

In order to evaluate this trade-off, our modelling choice focuses on the Keynesian approach initiated by Atesoglu (2002). This model allows us to discuss whether fiscal policy exerts any significant impact on aggregate output. This evaluation constitutes the first stage of our approach. As discussed previously, the major part of central public spending is from defense equipment. Thus, it may be useful to split military expenditure between equipment and non-equipment parts. This is the second step of our empirical work.

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[1]Note that the 2013 defense budget is equal to the 2012 defense budget, but in constant terms, it means a reduction.

Under these circumstances, defense equipment spending is considered as a public investment whereas defense non-equipment spending is considered as public consumption as the composition is mainly explained by wages and fuel. Our core hypothesis is that defense equipment is likely to have greater impact on aggregate output compared to non-equipment budget because it acts as public investment. Since Aschauer (1989), much attention has been paid to the economic impact of public investment. As argued by Romp and de Haan (2007) in a survey of the literature, a consensus emerges to point out that public capital positively affects economic growth even if the impact appears to be lower than the Aschauer's study.

This paper is organized as follows. Section 2 presents literature review with a specific focus on the case of France. Section 3 develops the theoretical framework needed for the empirical evaluation. Section 4 examines the data construction and their properties. Section 5 presents the empirical results by distinguishing baseline and augmented models. Section 6 concludes the article with a particular attention to the policy implications.

2   Literature review

In the growth literature, there is a famous puzzle relying to the absence of consensus between growth and defense spending. Indeed, since the pioneering study of Benoit (1973), the debate is still open. This fact is mentioned in several surveys, at different stages of the ongoing literature (see Chan 1985, Ram 1995 or more recently Dunne et al 2005). As documented in the introduction, it represents an important issue, given the economic importance of military expenditure.

Several reasons have been raised to explain this absence of consensus. A quick inspection of this oversized literature leads to consider numerous models with contradictory hypothesis. Besides, the choice of an appropriate econometric method is to be seriously considered and, once again, there is no consensus between cross-section, time series and panel estimates. Finally, the defense-growth relationship has been checked for a lot of country cases, leading to consider a specific analysis.

From a conceptual point of view, the absence of consensus can be explained by the multiplicity of channels by which defense spending affects growth. To sum up and in accordance with Dunne et al (2005), three channels are plausible. The first channel

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relies on Keynesian theory with two contradictory effects, one stimulatory thanks to the multiplier (for an empirical evaluation, see Atesoglu, 2002) and one depressing thanks to the crowding-out. The second channel lies with the competition between resources: defense spending implies positive spillovers through technological progress but also negative impacts through waste. The last channel consists in the provision of security. Lack of security may slow down the growth process but excessive defense spending could be perceived as a danger; for instance, Ades and Chua (1997) show how military expenditure contributes to regional instability, which is a negative determinant of growth.

Our focus is to draw major conclusions emerging from papers using Keynesian approach. Atesoglu (2002) is a starting point of an important and controversial literature. In his paper, he discusses whether fiscal and monetary policies have a positive or a negative impact on aggregate output in the US case over the period 1947 to 2000. He concludes that defense spending exerts a positive influence but non-defense spending has greater effect. This conclusion has been debated by Smith and Tuttle (2008) because they show that military expenditure has no influence but that a trade-off arises between defense and non-defense spending during periods of war. Brauer (2007) also casts doubt on the Atesoglu's results since he proved that the impact of military expenditure is not constant over time using rolling regressions. Pieroni et al (2008) point out the absence of consistent results over time in the UK and the US case: for the overall period, the impact of defense expenditure is positive but tends to be insignificant for the most recent periods. Atesoglu (2009) re-estimates the model for a slightly different period and confirms his first conclusion.

Some other countries have been examined in the literature. For instance, Halicioglu (2004) evaluates the Keynesian model for the case of Turkey. His results are in line with Atesoglu (2002). Shahbaz et al (2013) examine the Pakistani case and stress the negative influence of military expenditure on economic activity. Tiwari and Shahbaz (2013) conclude that the Indian economic growth is positively affected by defense spending while the impact turns to be negative after a threshold.

In the case of France, there are only few studies in the field of defense economics. This may be surprising given the specificities of the French defense policy, already presented in the introduction. As a consequence, some scholars have tried to quantify demand functions for the French case. As argued by Schmidt et al (1990), Jacques and Pi-

cavet (1994), Lelièvre (1996) and Coulomb and Fontanel (2005), economic factors exert a major impact. Specifically, budgetary process leads to consider defense sector as an expendable line.

There are only three studies exclusively dealing with the macroeconomic consequence of defense spending in France. Percebois (1986) shows, in a *ad hoc* model, that military expenditure crowds-out private investment and that its influence on growth is undetermined. Aben (1988) examines numerous consequences of the defense burden and shows that defense spending is not a relevant tool for public policy. Recently, Malizard (2013) finds, within an atheoretical approach, that there is a bi-directionnal causality between economic growth and military expenditure. The analysis of impulse response functions reveals that, in the long run, defense spending positively affects growth, whereas non-defense spending has no effect.

To sum up, our contribution appears to be original in two different ways. First, it is the unique contribution of the defense-growth relationship for France using a Keynesian formulation. Second, our approach allows to differientiate equipment and non-equipment budgets as their effects are, *a priori*, different.

3   Model

In this section, we present the formal model used in our empirical analysis. We start by the description of the Atesoglu's (2002) work which uses modern keynesian theory in order to evaluate fiscal and monetary policies. We then extend this approach in order to integrate the composition of defense spending. Our core hypothesis lies with the fact that equipment budget has higher potential effects on output compared with non-equipment budget.

Atesoglu (2002) proposes a simple framework, based on the theoretical propositions of Romer (2000) and Taylor (2000). This new approach replaces the LM curve with the idea that the central bank follows a real interest rate rule rather than targeting the money supply. Consequently, the real interest rate is exogenous. The model assumes that aggregate output (Y_t) is defined as follows:

$$Y_t = C_t + I_t + X_t + M_t + NM_t \tag{1}$$

where C_t denotes real consumption, I_t real investment, X_t real net exports, M_t real military expenditure and NM_t real non-military expenditure. Within this representation, the underlying assumption is that military effects are not identical to non-military effects. Given the real interest rate (R_t) is exogenous, the assumptions concerning the right side variables are as follows:

$$C_t = d + e(Y_t - T_t) \tag{2}$$

$$T_t = n + gY_t \tag{3}$$

$$I_t = h - iR_t \tag{4}$$

$$X_t = l - mY_t - nR_t \tag{5}$$

where T_t denotes real taxes. Equation (2) is the consumption function, combining an autonomous component and the marginal propensity to consume disposable income; equation (3) is the taxes function, depending to income; equation (4) is the investment equation describing a negative relationship between capital accumulation and real interest rate; finally equation (5) is the net exports equation, where real interest rate and output are the two arguments[1]. We solve equations (1) to (5) for Y_t and get the reduced form of the model:

$$Y_t = \alpha_1 + \alpha_2 M_t + \alpha_3 NM_t + \alpha_4 R_t \tag{6}$$

where $\alpha_1 = \frac{d - en + h + l}{1 - [e(1-g) - m]}$, $\alpha_2 = \alpha_3 = \frac{1}{1 - [e(1-g) - m]}$ and $\alpha_4 = \frac{-(i+n)}{1 - [e(1-g) - m]}$. The empirical implementation of the model consists in the estimation of each *alpha* parameter. Equation (6) is referred as the baseline model. Atesoglu (2009) makes the following hypothesis: α_2, $\alpha_3 > 0$ and $\alpha_4 < 0$, namely fiscal policy exerts a positive impact on aggregate output, however, as explained in the literature review, the question is an empirical one.

Now, we amend the model in order to capture the two opposite forces arising from the disaggregation of defense spending. Our hypothesis is the following: defense equipment spending is considered as public investment and so its impact on aggregate output is greater than defense non-equipment spending.

The basic idea of this hypothesis is simple, defense equipment is mainly composed by

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[1]Atesoglu (2002) indicates the differences between his own formulation and the basic Keynesian theory.

arms procurement and nuclear activities, which may generate positive spillovers on private productivity. For instance, it has been argued by several scholars, such as Ruttan (2006), that the defense sector is crucial for economic activity through the development of innovations. On the contrary, non-equipment spending is principally composed by wages which do not contribute to foster private productivity. Given the decomposition of defense spending, we obtain the following equation:

$$Y_t = \beta_1 + \beta_2 non - equip_t + \beta_3 equip_t + \beta_4 NM_t + \beta_5 R_t \tag{7}$$

where $\beta_1 = \frac{d-en+h+l}{1-[e(1-g)-m]}$, $\beta_2 = \beta_3 = \beta_4 = \frac{1}{1-[e(1-g)-m]}$ and $\beta_5 = \frac{-(i+n)}{1-[e(1-g)-m]}$. This equation is called the augmented model and given our hypothesis, we postulate that $\beta_3 > \beta_2$. As previously, assumptions concerning non-military spending and real interest rate lead us to consider $\beta_4 > 0$ and $\beta_5 < 0$. The effectiveness of fiscal policy is evaluated thanks to the coefficients β_3, β_4 and β_5, the question of the order between these coefficients is still an empirical one.

4 Data

In order to estimate equations (6) and (7), economic and military variables are needed. All these variables are given for the period 1980-2010. The economic variables are detailed in the following list:

- ly_t is the log of real GDP. It comes from the AMECO database.

- r_t is the real long run interest rate, based on central government bonds of 10 years. It comes from the AMECO database.

- lnm_t is the log of real non military expenditure. It is provided by INSEE. Only state expenditures are included. Non-military expenditure is calculated as the difference between total public spending and defense spending.

All these variables are expressed in real terms, using the GDP price deflator.
The military variables come from the "Annuaire Statistique de la Défense 2011-2012", the French statistical book of defense, provided by the Defense ministry. From 1980 to 2012, it provides the global budget of Defense ministry but also decomposes this

budget between non-equipment budget and equipment budget. The construction of each variable is detailed in the list below:

- lm_t is the log of real defense spending.

- $lnon - equip_t$ is the log of real non-equipment budget. Non-equipment budget refers to "title 3" according to the 1959 ordonnance. Title 3 is mainly composed by wages and fuel.

- $lequip_t$ is the log of real equipment budget. Equipment budget refers to "title 5" according to the 1959 ordonnance and is mainly composed by nuclear deterrence activities and arms procurement.

All these variables are expressed in real terms, using the GDP price deflator. We also compute the defense variable by using alternative price deflator: several scholars argue (for instance in the French case, Foucault, 2012) that military equipment is somewhat specific compared to civilian expenditure. Rather than using GDP price deflator, we use the price deflator for fixed capital formation. The rationale is easy to understand since we already stated that defense equipment is a major part of public investment[1]. Table (2) presents the descriptive statistics for our sample.

Table 2: Descriptive statistics

	y_t	m_t	nm_t	r_t	$non - equip_t$	$equip_t$
Mean	1427.571	27.674	324.236	3.890	13.746	16.255
Median	1395.034	26.778	332.301	3.659	13.856	15.878
Maximum	1801.645	33.423	415.083	6.991	14.796	20.360
Minimum	1032.206	21.182	227.610	1.462	12.845	12.687
Std. dev.	259.698	3.196	49.139	1.760	0.426	0.422

Data computed in real billions euros

The evolution of both parts of military expenditure is disconnected. Indeed, we note that non-equipment expenditure is quite stable for the overall period whereas equipment expenditure fluctuates a lot as indicated by the standard deviation (see Table

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[1]Note that there is no price deflator specifically dedicated to public investment.

(2)). Given the stability of non-equipment spending, the fluctuations of defense spending are broadly explained by equipment spending and this is why we observe a peak of equipment budget in 2009, consequently to the government policy to circumscribe recession. In order to model this peak (unusual given the overall trajectory), we use a dummy variable which takes the value of 1 in 2009 and 0 otherwise.

In order to adequately evaluate the influence of monetary policy, one has to pay attention to the status of the Central Bank. In France, the Central Bank, called "Banque de France" became independent in 1993, following the conditions in participating to the creation of the Euro. The independence has been erected as a pillar of the European Central Bank, which replaced Banque de France in 1999. Then, to capture these transformations, we use a dummy variable with the value of 1 after 1993 and 0 otherwise.

5 Empirical results

In this section, we provide the results of our empirical estimation. First of all, we analyse the properties of each individual variable, by checking the existence of an unit root process. Then, we estimate the baseline model and finally examine the augmented model.

5.1 Unit root tests

Before turning to the estimations, one has to pay attention to the time series properties of each variable. To this end, we use Augmented Dickey-Fuller (ADF) and Philipps Perron (PP) tests. The Dickey-Pantula strategy serves as a basis: we first check the unit root hypothesis for the differenced variables and then turn to the level variables. Table (3) presents the results of these tests.

Model 3 includes a constant and a trend as deterministic variables in the estimated equation, model 2 has only a constant and model 1 has no deterministic variables. As indicated in Table (3), it appears that all variables are non stationary in level but stationary in first differences, so that they are characterized by a unit root process.

For the overall period, each variable suffers from exogenous shocks, for instance economic crisis or the end of the Cold War. Such event may have consequences on the existence of the unit root hypothesis. As a consequence, we further check this hypothesis with the

Table 3: Unit root tests

		Level			First differences	
Variable	Model	ADF	PP	Model	ADF	PP
ly_t	1	2.743	7.115	2	-3.474	-3.980
lm_t	1	-0.292	0.375	1	-3.347	-3.37
lnm_t	1	6.497	4.786	1	-2.336	-2.155
r_t	3	-3.466	-0.574	1	-9.138	-9.676
$lnon-equip_t$	1	-0.415	0.895	1	-5.450	-5.520
$lequip_t$	1	0.273	0.139	1	-2.251	-3.041

Table 4: Zivot-Andrews unit root test

	Model A		Model B		Model C	
Variable	ZA statistics	TB	ZA statistics	TB	ZA statistics	TB
ly_t	-2.854	1988	-3.832	2006	-3.813	2006
lm_t	-3.009	1992	-3.046	2004	-3.684	1996
lnm_t	-4.659	2006	-4.245	2003	-4.242	1993
r_t	-3.791	1997	-3.269	1998	-4.015	1996
$lnon-equip_t$	-4.402	1987	-4.445	1989	-4.013	1993
$lequip_t$	-3.533	1994	-2.328	2003	-2.867	1994

Critical values at 1% level are equal to -5.34 for model A, -4.8 for model B and -5.57 for model C.

Zivot-Andrews test, which tests whether a variable is stationary or not by controlling the existence of an endogenous break. This test is based on three models: model A considers a level shift, model B allows for a level break in the trend and model C combines both previous breaks. The null alternative is the existence of a unit root process while the alternative implies that the variable is stationary with a break occurring at an unknown period. Table (4) presents the results of the Zivot-Andrews test.

From Table (4), all variables are characterized by a unit root process, even if we control the existence of a structural break. The results of Zivot-Andrews test are robust for the three specification. However, the different times of break are not easily interpretable.

5.2 Baseline model

Given the fact that all variables are $I(1)$, it is first necessary to check for the existence of a long run cointegrating relationship. Otherwise, the classical spurious regression problem arises. In order to check for the existence of this long run cointegration relationship, we use two tests: the trace test and the maximum eigenvalue test. These tests are computed for an intercept in both cointegrating equation and VAR. For the baseline model, the results are presented in Table (5). Classical Johansen based tests (Trace and Max Eigenvalue tests) are indicated in Panel A and Saikkonen and Lütkepohl test in Panel B.

Table 5: Cointegration tests, baseline model equation (6)

Panel A: Johansen based tests				
Rank	Trace statistic	Critical value	Max Eigenvalue statistic	Critical value
$r=0$	67.031	54.682	36.109	32.715
$r=1$	30.921	35.458	17.577	25.861
$r=2$	13.344	19.344	8.635	18.520
Panel B: Saikkonen and Lütkepohl test				
Rank	LR value	Critical Value		
$r=0$	57.57	46.20		
$r=1$	25.92	29.11		

Critical values are computed at 1% level.

Given the existence of structural breaks in each variable, it is also crucial to check for the existence of a cointegration relationship by using cointegration test that allows structural breaks. This is done with the Gregory and Hansen (GH) test. This test is based on three models: model C considers a level shift, model C/T a level shift with a trend and model C/S a regime shift. As in the Zivot-Andrews test, the break date is unknown. The null hypothesis of the GH test is the existence of a unit root in the residuals and then the rejection of the cointegration relationship while the alternative assumes the existence of cointegration relationship. The results of the GH test is presented in Table

$(6)^1$.

Table 6: Gregory and Hansen test, baseline model

	ADF test value	Break date	Critical value
Model C	-6.123	1987	-5.77
Model C/T	-6.755	2005	-6.05
Model C/S	-6.886	1988	-6.51

Critical values are computed at 1% level.

From Tables (5) and (6), we note that all the tests conclude to the existence of an unique and robust vis-à-vis structural breaks long-run relationship. The next step is then to estimate the long run coefficients associated to the model. Several methods exist and the Johansen approach is the most common of all. The results are presented in table (7). The estimates are normalizing on ly by setting its coefficient at -1.

Table 7: Long run estimates - Baseline model

Constant		lm_t	lnm_t	r_t
-0.367		0.538***	0.923***	-0.068***
(0.572)		(0.089)	(0.097)	(0.011)

Std. dev. in brackets, *** denotes significance at 1% level.

From Table (7), all the coefficients are significant at a 1% level. It appears that the expectations regarding the signs of the coefficients are confirmed. Fiscal policy has a positive impact on aggregate output but monetary policy through real interest rate exerts a negative influence. A 1% rise in real defense spending implies a 0.54% rise in real output and a 1% rise in real non-defense spending leads to a 0.92% rise in real GDP whereas a 1% rise in real interest rate negatively influences real output of 0.07%. Then, the results indicate that fiscal policy has a greater impact than monetary policy.

Besides, fiscal policy is not homogeneous by comparing the coefficients associated to defense expenditure and non-defense expenditure. According to Table (7), the latter

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[1]In Table (6), we present the results obtained with the ADF statistic computed with a trimming parameter equal to 15%. Note that Z_α^* and Z_t^* statistics (not reported here) are consistent with the results presented here.

exerts a larger positive influence than the former. This finding is consistent with past literature using Keynesian approach. However, the fact that defense expenditure implies a positive impact on aggregate output lies with the major role played by Defense Ministry in the provision of public investment.

In order to further examine the economic impact of military spending, we present the results of the VECM representation associated with the baseline model in Table (8).

Table 8: VECM representation - Baseline model

Dependent variable	Δly_t	Δlm_t	Δlnm_t	Δr_t
Error correction term	-0.149*	-0.365**	-0.686***	-0.712
	(0.082)	(0.169)	(0.168)	(0.587)
Adjusted R^2	0.319	0.444	0.533	0.492

Std. dev. in brackets, *** denotes significance at 1% level, ** at 5% and * at 10% respectively.

In Table (8), the error correction term associated with Δly_t, Δlm_t and Δlnm_t are significant with a negative sign while the error correction term associated with Δr_t is not. As a consequence, Δly_t, Δlm_t and Δlnm_t adjust to maintain the long run relationship presented in Table (7). This result is in accordance with Atesoglu (2002, 2009).

Short run causality is examined thanks to the Granger causality test in the VECM representation of the model. It appears that both military and non-military expenditure Granger cause aggregate output. Moreover, real GDP, defense spending and real interest rate cause non-defense spending.

To sum up, our results reveal that fiscal policy exerts a positive influence on aggregate output, both on long run and on short run whereas monetary policy negatively affects real GDP.

5.3 Augmented model

We are now adressing (equation 7), following the same empirical strategy. As a first step, we check the existence of a long-run cointegrating relationship. The results of trace and maximum eigenvalue tests are presented in Table (9). Note that these tests consider an intercept in both cointegration relation and VAR. We also present the GH

test in Table (9).

Table 9: Cointegration tests, augmented model

Panel A: Johansen based tests

Rank	Trace statistic	Critical value	Max Eigenvalue statistic	Critical value
$r = 0$	94.831	77.819	42.094	39.370
$r = 1$	52.737	54.682	21.473	32.715
$r = 2$	31.263	35.458	17.863	25.861

Panel B: Saikkonen and Lütkepohl test

Rank	LR statistics	Critical Value		
$r = 0$	75.7	67.21		
$r = 1$	43.95	46.20		

Panel C: Gregory and Hansen test

Model	ADF test value	TB	Critical value	
Model C	-6.82	2004	-6.05	
Model C/T	-6.39	1996	-6.36	
Model C/S	-6.94	1988	-6.92	

Critical values are computed at 1% level.

As previously, the tests lead to the same conclusion, namely an unique and robust cointegrating relationship even when we control for the existence of a structural break. Consequently, we use the same estimation strategy to compare it with the baseline model, which gives a direct comparison between both estimated equations. Once again,

Table 10: Long run estimates - Augmented model

Constant	$lnon-equip_t$	$lequip_t$	lnm_t	r_t
-1.877	0.011	0.548***	1.045***	-0.050***
(1.652)	(0.173)	(0.145)	(0.233)	(0.013)

Std. dev. in brackets.

expectations concerning each coefficient are confirmed. Indeed, non-defense expenditure positively influences real GDP whereas real interest has a detrimental impact on aggregate output. Moreover, defense equipment spending has a positive impact while defense

non-equipment spending is not significant, thus confirming our expectations concerning the composition of military expenditure.

When we compare baseline and augmented models, we obtain reliable results. It appears that fiscal policy stimulates real GDP (except non-equipment expenditure) but the influence of non-defense expenditure is greater than the influence of equipment expenditure. Moreover, monetary policy inversely impacts economic activity.

The magnitude of each coefficient is also close between both models: the coefficient associated with non-defense expenditure nearly equals 1 in both specifications, the coefficient associated with real interest rate is close to 0.5 and the coefficient associated with equipment expenditure is very related to the coefficient associated with defense expenditure in the baseline model.

The examination of Table (10) reveals that the positive influence of defense spending detected in the baseline model is exclusively explained by defense equipment spending, since defense non-equipment spending exerts no significant impact. This point is in line with our expectations developed in section 3. Several reasons may be raised.

Defense equipment expenditure has a positive impact on aggregate output. In that way, it is possible to characterize its impact as a public investment. Equipment expenditure is likely to stimulate private productivity through technological spillovers. The composition of defense equipment may illustrate the relationship between the defense and civilian sectors. Indeed, defense equipment is mainly composed by arms procurements and nuclear deterrence activities. For the latter, the civilian industry benefited from the development of defense activities decided by de Gaulle.

Defense non-equipment spending is composed by wages. Even if these expenditures may have a positive impact, it has been argued that they do not foster private productivity. In this way, it is possible to characterize this part of military expenditure as public consumption.

Under these circumstances, our results indicate that defense equipment spending acts as public investment given the positive influence detected on aggregate output. This conclusion is not so surprising since defense equipment represents the major part of central public investment. On the other hand, defense non-equipment spending acts as public consumption, with no statistical significant influence on aggregate output.

The examination of Table (11) reveals that only the error correction terms associated

Table 11: VECM representation - Augmented model

Dependent variable	Δly_t	$\Delta lnonequip_t$	$\Delta lequip_t$	Δlnm_t	Δr_t
Error correction term	-0.071	-0.152*	-0.601*	-0.646***	-4.463
	(0.075)	(0.083)	(0.328)	(0.132)	(7.183)
Adjusted R^2	0.445	0.512	0.286	0.718	0.183

Std. dev. in brackets, *** denotes significance at 1% level, ** at 5% and * at 10% respectively.

with fiscal policy are significant with the correct sign. Then, $\Delta lnonequip_t$, $\Delta lequip_t$ and Δlnm_t adjust toward the long run relationship previously presented. Besides, the augmented model appears to be relevant since the adjusted R^2 for each variable (except for r_t) is higher with this specification than the adjusted R^2 with the baseline model. Note that information criteria[1] confirm this point.

Short run causality indicates that no variable Granger-causes real GDP and real interest rate. Non-equipment expenditure is Granger-caused by aggregate output, equipment expenditure and non-defense expenditure. Non-defense expenditure is Granger-caused by all other variables. These results indicate a complex relationship among fiscal variables. Previous articles dealing with the French case already mentioned the trade-off between defense spending and non-defense spending (see Coulomb and Fontanel, 2005) and the trade-off in the composition of defense spending (see Foucault, 2012).

6 Conclusion

In this article, we examine the influence of fiscal and monetary policies on aggregate output in France since 1980. Our main focus is to quantify the impact of defense spending through aggregated and disaggregated data. Despite its remarkable features in terms of defense policy, the case of France has not been frequently evaluated in the literature. This paper is consequently filling this gap.

Our article is also original because we use disaggregated data. The rationale for this strategy is the following. Defense equipment expenditure represents the major part of central public investment whereas defense non-equipment expenditure is likely to be

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[1]Not presented here, available upon request

considered as public consumption. Under these circumstances, we postulate that the economic impact of defense equipment expenditure is greater than its non-equipment counterpart. The empirical analysis sheds light on this assumption.

In the baseline model, defense expenditure is considered in its globality. The estimation of this model reveals that fiscal policy exerts a positive impact on aggregate output but non-military expenditure is a better tool than its military counterpart. This result is in line with a part of the literature using the Keynesian approach.

In the augmented model, we split defense expenditure into its two components: equipment expenditure and non-equipment expenditure. The estimation of this model confirms the superiority of non-defense expenditure compared to the two parts of defense expenditure. However, it appears that only military equipment spending exerts a significant and positive influence on aggregate output.

The rationale for such a result lies with the composition of both parts of defense expenditure. Non-equipment expenditure is mainly explained by wages and fuel which do not improve private productivity and then exert little influence on real GDP. Equipment expenditure is mainly composed by arms procurement and nuclear activities. Positive technological spillovers may arise from these spendings, as documented by Ruttan (2006).

Moreover, the result obtained in the augmented model suggests that the positive impact of defense spending detected in the baseline model can be solely attributed to defense equipment spending since non-equipment spending exerts no significant impact. Moreover, the coefficient of military expenditure in the baseline model and the coefficient of equipment expenditure in the augmented model are quite similar.

However, in any case, non-defense spending presents a larger impact than defense spending in the baseline model and defense equipement spending in the augmented model. This point may reflect the choice of successive governments for a civilian keynesianism: from 1980 to 2010, non-defense spending has increased by 80% in real terms whereas defense spending has remained quite stable. Since military expenditure is not primarily concerned by economic stabilization purposes, it is not a surprise to exhibit a rather low impact on aggregate output and in any case a lower impact compared to non-defense spending.

In terms of economic policy recommendations, this analysis validates the idea that de-

fense equipment may act as a public investment whereas defense non-equipment can be seen as public consumption. The effects of both parts of defense spending are consistent with the following assumptions: equipment expenditure exerts a higher impact than non-equipment expenditure. Such a conclusion is consistent with the macroeconomic literature on public investment, initiated by Aschauer (1989).

The White Paper on Defense and Security, published in 2013, presents the future orientations of French Defense Policy, under two constraints. The first one is related to budget and its main consequence is to freeze future budgets on the 2012 level; the second one is related to strategy and assumes the need to proceed with the modernization of defense capabilities. Given these two constraints, one key recommendation is to increase the defense equipment budget at the expense of the defense non-equipment budget. Our results show that such a strategy is appropriate in terms of economic impacts. Our point is that one should rather focus on the quantity of spending than on its quality.

In this article, we evaluate the influence of defense spending only through the economic prism. Even if such an evaluation is essential to provide some indications in order to streamline the defense burden, it does not include critical factors associated with the first goal of defense: security. Future researches will focus on both economic and security aspects to draw a more general picture of defense influence.

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