**Rusty Guns and Buttery Soldiers: Unemployment and the Domestic Origins of Defense Spending**

**Supplementary Files**

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**A: The Wales Pledge on Defense Investment**

Responding to “new security challenges (NATO 2014)” at its 2014 Wales Summit, allies pledged to invest 2% of GDP in defense and 20% of that defense investment in equipment and related research and development by 2024. While in the past only Defense Ministers (generally favorable to increasing defense spending) endorsed similar guidelines privately, the Wales pledge is notable for having been taken by heads of state and government. While the pledge has been criticized for weak consensus language (Dempsey 2015), the fact remains that by the end of 2015, 21 Allies had halted or reversed declines in defense spending, while five had met NATO’s two percent guideline, an increase from four in 2014 (NATO 2015). Moreover, the importance of the pledge is clear in allies’ discussions with one another. By addressing not only top-line defense investment but disaggregated investment in the form of equipment, the pledge highlights that burden-sharing is about more than just top-line expenditures. This example is illustrative of why understanding why states choose to invest the way they do within defense budgets is also critical to understanding burden-sharing across the Atlantic and beyond.

The pledge, paragraphs 15 and 16 of the Wales Summit Declaration, reads:

1. We agree to reverse the trend of declining defence budgets, to make the most effective use of our funds and to further a more balanced sharing of costs and responsibilities. Our overall security and defence depend both on how much we spend and how we spend it. Increased investments should be directed towards meeting our capability priorities, and Allies also need to display the political will to provide required capabilities and deploy forces when they are needed. A strong defence industry across the Alliance, including a stronger defence industry in Europe and greater defence industrial cooperation within Europe and across the Atlantic, remains essential for delivering the required capabilities. NATO and EU efforts to strengthen defence capabilities are complementary. Taking current commitments into account, we are guided by the following considerations:
   * Allies currently meeting the NATO guideline to spend a minimum of 2% of their Gross Domestic Product (GDP) on defence will aim to continue to do so. Likewise, Allies spending more than 20% of their defence budgets on major equipment, including related Research & Development, will continue to do so.
   * Allies whose current proportion of GDP spent on defence is below this level will:
     + halt any decline in defence expenditure;
     + aim to increase defence expenditure in real terms as GDP grows;
     + aim to move towards the 2% guideline within a decade with a view to meeting their NATO Capability Targets and filling NATO's capability shortfalls.
   * Allies who currently spend less than 20% of their annual defence spending on major new equipment, including related Research & Development, will aim, within a decade, to increase their annual investments to 20% or more of total defence expenditures.
   * All Allies will:
     + ensure that their land, air and maritime forces meet NATO agreed guidelines for deployability and sustainability and other agreed output metrics;
     + ensure that their armed forces can operate together effectively, including through the implementation of agreed NATO standards and doctrines.
2. Allies will review national progress annually. This will be discussed at future Defence Ministerial meetings and reviewed by Heads of State and Government at future Summits.

**B: Defense Investment as a Countercyclical Tool**

There may some question of the utility of defense investment as a countercyclical tool, due to the long periods of planning and procurement associated with many defense outlays. While I contend that countries use flexibility within defense budgets to use defense investment for non-defense purposes in both the short- and the long-term, table 2 in the main paper and table E4 below both demonstrate that the analysis is also robust to the use 5-year moving averages for the key variables. Table E5 also demonstrates the robustness of my analysis to the use of *Nonperforming Loans,* the natural log of the ratio of nonperforming (bank) loans to the total loan portfolio for a given country-year, in the 2SLS analysis in the place of housing price shocks. Banking shocks often accompany housing shocks (Reinhart and Rogoff 2009, Kaminsky and Reinhart 1999), so these nonperforming loans serve as an additional instrument with which to evaluate the robustness of my analysis.

There may also be some question as to the relative weight of military personnel in national economies, and the distribution of that weight among countries. Using World Bank data for both military personnel and populations, Figure A1 below demonstrates that, in 2013 military personnel represented from .06% of the population (Iceland) to 1.3% of the population (Greece) in 2013, and that the average weight of military personnel in national populations was .4%. Major countries facing different strategic situations such as the United States, France, and Poland are all very close to this average. Feldstein (2008) estimates the effect of a 15% boost in recruiting in the U.S. military to be 30,000 new jobs in one year.

Additionally, there may be concerns regarding the role of equipment expenditures as an instrument of domestic stimulus. While it is true that they can play such a role, equipment expenditures are likely to have a less immediate impact on labor markets. More importantly, only a small number of the states studied (and a small number of states in the world) have robust domestic defense industries. Figure A2 Demonstrates that mean equipment expenditures between the five countries in the study with significant defense industries (France, Germany, Sweden, the United Kingdom, and the United States) is over 50% higher than those without - states whose domestic economies stand to gain from equipment expenditures tend to make such expenditures, and those who do not spend far less on equipment. Figure A3 further depicts the bivariate correlation between the weight of domestic R&D in an economy and the weight of equipment expenditures in that economy.

Finally, there may be concern about the effect of the widespread use of commercial offsets in the sale and purchase of defense articles. While countries without defense industries often receive offsets from the seller, there is no reason to believe that such offsets would have an effect approaching that of other forms of stimulus, including personnel expenditures. Offsets are by their nature a fraction of the purchasing cost of the equipment: “*“In 2014, U.S. firms reported entering into nine new offset agreements with members of the EDA valued at $1.68 billion* (U.S. Department of Commerce, Bureau of Industry and Security, 2016, p. 20)*,” approximately 3% of the approximately $50 billion in equipment spending among EDA members that year.*

Among the four categories of expenditures measured by NATO and the EDA, personnel expenditures are the most susceptible to use by states seeking to accrue private benefits. Equipment expenditures are widely seen as central to collective defense, evidenced by the 20% guideline in the Wales Pledge. Since few of the states studied engage in unilateral military operations, and because NATO adheres to an approach known as “costs lie where they fall” when it comes to operations (Rasmussen 2010), O&M expenditures are also unlikely to be used for particularistic purposes. Infrastructure is also unlikely to be used extensively for particularistic purposes: while NATO defines infrastructure spending as “Infrastructure expenditures include NATO common infrastructure and national military constructions,” in practice, no ally spent more than 8.5% of its defense budget on infrastructure, and Poland, Norway, and the Baltic states are five of the top seven infrastructure investors (NATO 2015), suggesting that infrastructure related to addressing conventional challenges from the East may be a primary driver of those expenses.



**Figure B1: Mean Military Personnel Per Capita, 2013**



**Figure B2: Mean equipment expenditures for countries with and without significant domestic defense industries.** This confidence interval bar graph demonstrates that among EDA member states that report the weight of defense research and development in their economies, those with significant defense industries (France, Germany, Sweden and the United Kingdom) spend significantly more on equipment than do those without.



**Figure B3: Domestic Defense Industry and Equipment Expenditures**

**C: Summary Statistics and Bivariate Correlations**

Table C1 contains summary statistics for the key variables in the analysis, including these controls. The first five columns are devoted to the full sample used in the study. The final four columns are means by quartile of the instrument representing housing price shocks, the importance of which I describe below. *Military Burden* is the percentage of GDP devoted to military expenditures, the most commonly used measure of defense investment in the literature, and a favored measure of both NATO and the EDA. *Personnel*, *equipment*, *operations & maintenance (O&M)*, and *infrastructure* are the proportions of national defense budgets allocated to each one of those categories of defense expenditure, as reported by states, then verified and published by NATO and the EDA. These disaggregated defense expenditures are my key dependent variables, with my closest analysis reserved for *personnel*, which correlates negatively with each of the other three categories of expenditure.

Moreover, on the side of the dependent variable, simply disaggregating standard defense investment data into the four categories used by both NATO and the EU helps capture some of the more nuanced components of burden sharing behavior. From a policy standpoint, this technique of disaggregation helps clarify the relationship between “inputs” focused approaches and “outputs” focused approaches.[[1]](#footnote-1) Such large-*n* analysis is complementary to detailed case studies. Quantitative measures disaggregated in this way capture some of the same features of state behavior that recent qualitative studies do – taking advantage of those quantitative measures improves analysis and allows scholars to be assess whether their findings can be generalized beyond the cases they have studied in detail. It also offers insights into behavior that policy-makers are not likely to acknowledge in public – such as shifting resources away from areas they pledged to allies to invest in in order to stimulate domestic economies (Becker, 2017).

The share of defense budgets allocated to the four categories identified by NATO and the EU is the best available indicator to capture such burden-shifting. For example, doing so captures not simply numbers of personnel (which depend largely on population), or raw expenditures on personnel, but the extent to which governments *prioritize* personnel spending relative to other areas. While very few European countries can expect any stimulus effect from equipment[[2]](#footnote-2) or operations, they can still hope for some effect by, for example, avoiding personnel cuts, increasing salaries, or maintaining retirement pay while cutting O&M.[[3]](#footnote-3)

**Table C1: Summary Statistics**



Table C2 reports the correlations among my dependent and independent variables and the battery of control variables in my model, which are summarized in Table 1 in the main paper. Unemployment is positively correlated with the share of personnel in overall defense spending, and is negatively correlated with the share of defense spending in GDP, and the share of equipment, O&M, and infrastructure in defense spending. These correlations are consistent with the theory that countries shift the burden of domestic unemployment to their allies by spending less on defense goods that benefit the group and more on defense goods that may generate private benefits. Also as theorized, unemployment is negatively correlated with my housing instrument – negative price shocks in the housing market are associated with higher unemployment in subsequent years.

**Table C2: Bivariate Correlations**



**Figure C1: Bivariate Correlations, Full Sample**



**Figure C2: Bivariate Correlations, by Country**



**D: Detailed Discussion of data sources, importance of inclusion of non-NATO EU Member States, and extension of analysis beyond the Transatlantic Security Community**

Data reporting across NATO is quite uniform: the available data is as close to such a “consistent basis” as a scholar could hope for. The data is reported and verified over the course of the NATO Defense Planning Process (NATO, 2014). During the most recent cycle, for example, prior to the 2016 NATO Defense Ministerial Meeting, NATO’s Defense Policy and Planning Committee (DPPC), the senior advisory body to the North Atlantic Council (NAC) on defense matters, reviewed, discussed, and agreed data from each ally. After multiple reviews of the document by both the DPPC and the NAC, as well as defense planning experts from NATO HQ, the data was reviewed and agreed by defense ministers at the June 2016 Defense Ministerial and released to the public in the form of the data set used in this analysis.[[4]](#footnote-4) As in many areas (Reynolds, 2010), the EDA has largely replicated NATO’s data process.

Burden-sharing is an issue not just among NATO allies, but among all members of the transatlantic security community, which also includes the 6 EU Member States that are not NATO Allies (Sloan, 2005). Overlapping membership of the EU and NATO means that, in practice, all 34 states are bound to mutual defense by either Article 5 of the Washington Treaty, Article 42.7 of the Treaty of the European Union, or both. Finland and Sweden are Enhanced Opportunity Partners of NATO (NATO, 2014), and would surely be operational partners in time of conflict in Europe; Austria participates in NATO Special Operations activities (NATO, 2015). Theoretical frameworks designed to study alliance burden-sharing therefore can and should be extended to EU members alongside NATO allies. Moreover, including additional states in my analysis allows me to conduct further robustness checks, evaluating differences in behavior among varying configurations of organizational membership. There is no analytical cost to including additional states, and the results are substantively similar if they are excluded.

At present, disaggregated defense spending data is only available for members of NATO and the EU. However, given the appropriate data, the analysis in this paper could be extended to other regions. Whitten and Williams (2011) suggest that states experiencing relative peace are more likely to use defense resources for electoral purposes, but Becker (Becker, 2017) suggests that even U.S. Allies in less wealthy and peaceful parts of the world engage in similar top-line burden-sharing behavior to Europeans. Given the appropriate disaggregated data, scholars could evaluate the extent to which this pattern persists within defense budgets.

**E: Robustness Analysis – Theory, Data, OLS, Alternative Samples, and Tests of Validity of Instrument**

Defining burden-sharing as a collective-action problem, Olson and Zeckhauser hypothesized that an ally’s military burden would correlate positively with the size of that member’s national income, particularly as it related to that of other allies (Olson & Zeckhauser, 1966, p. 274). This pure public good hypothesis held until the mid-1960s.

Sandler and Forbes (1980) theorize that the shift from Massive Retaliation to Flexible Response caused Alliance security to cease being a public good and become a joint product. As Alliance strategy moved from deterrence to protection, the benefits of membership became increasingly excludable, and the burden of collective defense was shared more equally.

International security scholars have explained alliance persistence and solidarity as an institutional artifact of the distribution of power and the proximity of threats during the Cold War (Mearsheimer, 1990, p. 6), with special emphasis on threat as a driver of both alliance formation (Walt, 1985) and durability (Walt, 1998). Threat behavior, capacity, and proximity therefore all figure into my statistical models. Institutionalists explain alliance persistence as a function of institutional adaptability (Wallander, 2000, p. 706), or as deriving from the domestic institutions of member states. The comparative politics literature focuses on domestic institutions and politics (Risse-Kappen, 1996, p. 358; Leeds, 1999, p. 579). I control for durability of organizational membership, veto points, and the orientation of the party in power to address these contributions.

Building on the models presented by defense economists and the theories proffered by security scholars, Becker and Malesky (2017) identified Atlanticism in strategic culture[[5]](#footnote-5) as a potential driver of operating expenditures, and noted that personnel expenditures appear to crowd out other types of expenditures. I seek to build on this analysis by estimating the effect of unemployment on both aggregate and disaggregated military spending, which no scholar has done to date.

*Alternative Models*

Although the 2SLS model in the main paper makes use of exogenous variation in unemployment, I replicate my analysis using Ordinary Least Squares and Error Correction Models. Doing so allows me to explicitly incorporate key independent variables identified in the literature into my analysis, confirming the robustness of the 2SLS results.

The first set of controls I add are drawn from the collective action literature, which addresses existing macroeconomic conditions and states’ ability to free-ride. “Spillins” is the natural log of the defense expenditures of all other states in the study (Sandler and Hartley, The Political economy of NATO: Past, Present, and Into the 21st Century 1999). Free-riding may also take the form of using defense budgets for particularistic purposes, such as stabilizing domestic economies in times of crisis, which would affect allocation of resources among the four categories this paper covers. The analysis below confirms these canonical hypotheses and the value of disaggregating expenditures: in the fully specified OLS model, spillins are negatively correlated with military burden, equipment, and O&M expenditures, but are strongly positively correlated with personnel expenditures. GDP (log) captures changes in overall economic output, which is a critical determinant of top line military expenditures (Olson and Zeckhauser 1966). Population is the natural log of a state’s population in a given year. The logic of collective action can apply to population size similarly to how it applies to the size of a state’s economy (Sandler and Hartley, The Political economy of NATO: Past, Present, and Into the 21st Century 1999), and population is also a reasonable proxy for labor supply (Sandler and Hartley 1995).

States may also respond to threat when making decisions on defense budgeting (Sandler and Hartley, The Political economy of NATO: Past, Present, and Into the 21st Century 1999). For this reason, I generate a variable to capture threat from the most relevant state actor in the European context: Russia. Following the approach of Walt (1985), this variable consists of Russia’s overall military expenditures to proxy capability (SIPRI 2015), the proportion of Russia’s GDP devoted to defense expenditures (SIPRI 2015), manually-coded variable capturing Russian intent based on behavior, and the natural log of a capital’s distance from Moscow to capture proximity. Vulnerability to non-state threats may also shape states’ resource-allocation decisions. For this reason, I also include the number of citizens killed by terrorism (National Consortium for the Study of Terrorism and Responses to Terrorism (START) 2015) in my analysis. Variations in how states respond to these two forms of threat are at the heart of current NATO debates on strategic orientation (Hagel 2015). The extent to which larger states can exclude smaller states from the benefits of their defense investment may also affect resource allocation decisions (Sandler and Hartley 1999), so I include an indicator variable for NATO strategy excludability in my analysis.

My analysis also controls for important variables relating to the domestic political economies of the relevant states. Right-leaning party controls for whether a right- left- or center-leaning party controls the government in a particular state (Beck, et al. 2001), since that may affect how states respond to housing shocks, banking crises, or unemployment (Hibbs 1977), as well as how states may allocate defense resources more generally. Controlling for veto points, a comprehensive measure of all actors with the ability to thwart policy change including independent executives, multiple legislative bodies, and number of parties in the ruling coalition (Beck, et al. 2001), addresses the influence of domestic political checks and executive autonomy on the transmission of macroeconomic variables to defense budgeting choices (Gartzke and Gleditsch 2004). Auerswald and Saideman (2014) explicitly link such domestic institutional variables to questions of transatlantic burden-sharing in the context of operations in Afghanistan. Transitioning from a conscript force to an all-volunteer force may also affect how states allocate defense resources and how macroeconomic variables’ effects transmit to defense choices (Sandler and Hartley 1995, Jehn and Selden 2002, Hartley 2003). The generosity of unemployment benefits (Scruggs, Jahn and Kuitto 2014) may affect this transmission as well. I use a one-year lag for these four variables because policy implementation is almost certain to lag changes in alliance politics, threat levels, or changes in government.

Debt, Deficit, Spending Consolidation and Excessive Deficit Procedure account for the role of a state’s fiscal position in its response to my key independent and instrumental variables, both as a matter of domestic fiscal policy, but particularly with regard to constraints imposed by membership in the European Union and the Eurozone (Heipertz and Verdun 2010). I use a 1-year lag and 5-year moving averages for both deficit and debt, since policy makers likely make policy in year y in response to Figures Erom previous years.

*Defense Economics Literature on Employment and Defense Spending*

Single-state studies on the relationship between defense investment, unemployment (Barker, Dunne, & Smith, 1991; Abell, 1992; Yildirim & Sezgin, 2003; Huang & Kao, 2005; Malizard, 2014), and various measures of national wealth (Aschauer, 1989; Caruso, 2012) offer conflicting views of the direction and significance of such relationships. Only Griffin et al. (1982, p. 113) estimate the effect of unemployment on defense investment, finding that, in the United States, “unemployment in the unionized sector and rate of growth of monopoly profits” significantly affect “variation in military expenditures as a percentage of GNP.” I seek to expand on this analysis by disaggregating the dependent variable.

Cross-national studies offer more generalizable insights about the relationship between defense investment and various measures of economic wellbeing. However, they vary in their conclusions regarding the effect of military expenditures on employment (Paul, 1996; Zhong, Chang, T., Tang, & Wolde-Rufael, 2015). Ramey (2012) uses multiple identification strategies to analyze the economic effect of aggregate defense spending on individual US states and on the United States as a whole. She finds a significant crowding-out effect between government spending and private investment, but also finds that increases in government spending result in lower unemployment, through an increase in government, rather than private employment. This process is consistent with the idea that governments respond to unemployment by increasing resources devoted to defense personnel, while decreasing those allocated to investing in equipment and R&D. Several studies (Abell, 1992; Barker, Dunne, & Smith, 1991; Malizard, 2015; Paul, 1996; Tang, Lai, & Lin, 2009) highlight the importance of disaggregating the dependent variable. However, only a handful of scholars (Hooker & Knetter, 1994; Malizard, 2015) have studied the relationship between various measures of economic activity and welfare and disaggregated military expenditures, none using cross-national panel data, a gap I seek to address.

Table E1 reports Ordinary Least Squares (OLS) regressions of the proportion of defense expenditures devoted to personnel against unemployment rates for all 27 countries for which the full suite of controls is available, disaggregated by the four categories of military expenditure identified by NATO and the EDA, as well as by simple military burden. The analysis is also robust to the use of observations from the entire 33-state sample as available. Specifically, I estimate the following equation using OLS:



Y*it* is the percentage of country *i’*sdefense budget devoted to personnel (and later each other category of defense expenditure) during year *t*. UEM*it* is a country’s unemployment rate in a given year. Note that the independent variable has a 1-year lag: the effect of unemployment on personnel expenditures is unlikely to manifest until the following year, as simultaneous responses to unemployment are extremely unlikely. X*it* is a matrix of control variables, discussed in detail above, employed to address omitted variable bias. Among these variables, large allies’ ability to exclude small allies from benefits of defense investment, threat variables, party in power, debt, and deficit are modeled with 1-year lags as well, reflecting the practical likelihood of a lag between changes in these variables and effects on policy. As the time period covered is relatively small compared to the number of observations and the data may experience panel-specific shocks, I employ PCSE (ε) (Beck & Katz, 1995). The effect of unemployment in year *y-1* on disaggregated defense expenditures in year *y* () is the coefficient of interest throughout the paper.

For the fully specified model, data is only available for the 27 NATO allies that report defense spending.[[6]](#footnote-6) To ensure that the results are not an artifact of this omission of non-NATO EU Members, Panel E replicates the analysis in Models 1, 3 and 4 with the full sample of states and years for those models which it was possible (1-4). The results are substantively similar: the coefficient on unemployment are large, positive and statistically significant across each model, and is actually slightly larger Panel E.

The results of my OLS analysis yield the following estimatF:

Yit = 1654+ (.554\*UEM)- (19.87\*SPILLINS)+(10.33\*lnGDP)- (87\*lnPOP) +(.005\*TERRORISM)

The first seven columns report personnel as the dependent variable, column eight reports overall military burden, and is followed by column each for equipment, O&M, and infrastructure. Columns 7-14 employ country and year FE.

It is important to note the results displayed in column eight at the outset – in the fully specified model, there is no relationship between unemployment and overall military burden. This relationship indicates that states do not appear to respond to unemployment by significant changes in overall defense investment, especially since the denominator for this (and only this) variable is GDP, which covaries with unemployment. Since the disaggregated data reflects proportions allocated to the different subcomponents within defense budgets, this covariance is not an issue with the other variables. The fact that states appear to respond to unemployment by shifting resources within defense budgets, and not to or from defense budgets indicates that the use of defense budgets for non-defense purposes is masked within those budgets themselves, which is consistent with my hypotheses. It is for this reason that disaggregation is so important. Column 8 also corresponds with existing analysis on burden-sharing, in particular with “spillins” having a negative relationship with overall defense spending.

Columns one through seven illustrate the relationship that I hypothesize between unemployment and personnel expenditures. The first column shows a strong, positive correlation between unemployment and personnel expenditures. Column two confirms that this relationship is roughly linear, but with some acceleration in the third quartile of unemployment rates (those states experiencing the next to most unemployment), indicative of a possible threshold effect. On balance, this analysis suggests that the linear specification remains appropriate.

Columns three through six progressively introduce the control variables discussed in above, grouped into those associated with collective action and joint product theories (column three), the effect of threat on defense investment (column four), as well as domestic (column five) and European (column six) political economies. Column seven introduces country and year FE.

The coefficient on the unemployment rate in year *y-1* is stable, large, and statistically significant throughout. The coefficient of .554 reported in column seven, significant at the 1% level, is striking – a 1 percentage point increase in the rate of unemployment in year y-1 is associated with a .554 percentage point increase in personnel expenditures. In the case of the United States, this would equate to nearly $4 billion in 2015.

The fully specified model in column 7 also shows that other states’ defense investment (“Spillins”) has a large, negative and statistically significant relationship with personnel expenditures, with the same being the case for overall military burden (column 8), and equipment and operational expenditures (columns 9 and 10). This is incconsistent with the notion of free-riding, which would predict that when states feel more secure that others’ defense investment is protecting them, they are likely to turn defense resources to particularistic interests like employment. Allies appear to follow the U.S. lead in reducing personnel expenditures, once we have controlled for country fixed effects. Allies facing a terrorist threat appear to shift resources into personnel, which is consistent with French actions following recent attacks.

Column eight reports the fully specified model with military burden as the dependent variable, discussed above. Column nine reports the results of the fully specified model with equipment investment as the dependent variable. The coefficient of -.388, significant at the 1% level, is almost as striking as that on personnel expenditures, and illustrates a substitution effect – states experiencing unemployment in *y-1* appear to be shifting scarce defense resources from equipment into personnel in year *y*. Again using the United States as an illustration, this coefficient would translate into a reduction of nearly $4 billion in equipment expenditures in 2015. $4 billion could buy, for example, approximately 7 F-22 aircraft, or nearly a thousand Abrams tanks. Column 11 depicts a small, but significant negative relationship between unemployment and infrastructure expenditures. Taken together, columns eight through 11 suggest that as unemployment increases, states shift resources from all three of the other categories of defense expenditures and into personnel: aggregated defense spending data masks the possible use of military expenditures as an economic stabilizer, and disaggregating the data makes identifying this behavior possible.

Columns 12-14 address another metric of burden-sharing which is illustrative, though slightly less applicable to a study seeking to ascertain the effect of unemployment on the allocation of resources within defense budgets. Unemployment is associated with an increase in overall share of military expenditures among the 33 states studied, but a decrease of twice that figure in equipment expenditures. While the coefficient on the share of group-wide personnel expenditures is small and insignificant, the apparent shift of resources to defense budgets but away from equipment is consistent with the notion of countries using defense budgets for non-defense purposes. Columns 15-17 include the full sample and confirm the results of the previous models.

Leveraging a panel data set of disaggregated defense spending data this way helps to address the aggregation problem noted in the extant literature, and shows a strong correlation between unemployment and disaggregated defense expenditures. Using country and year FE analysis in the fully specified model confirms that the results are not an artifact of country-specific shocks, particular aspects of a state’s history or culture, or particular historical shocks experienced across states.



**Table E1: OLS Replication of Main 2SLS Analysis**

In Table E2, I replicate this analysis using an Error Correction Model (ECM). Following the conventions of the field, I estimate the ECM using the following specification:



(4)

where βk captures the effect of short-run changes and β0 captures how quickly the dependent variable returns to equilibrium. The results are consistent with those described above. The use of an ECM helps confirm that the OLS results described above are not simply a reflection of underlying trends in both military expenditures and unemployment, and that the relationship between unemployment and disaggregated defense expenditures is relatively consistent over time. A comparison between the coefficients on first difference and the lagged personnel and equipment variables is instructivF: while states appear to respond to unemployment by shifting resources into personnel in the short-term, the effects of such shifts on equipment expenditures persist in the long-term. This reflects a critical policy challenge – shifting resources away from equipment procurement can affect an unpredictable array of bureaucratic and industrial variables in ways that persist longer than policy-makers may imagine, particularly in a monopsonistic market setting. The large, positive and significant coefficient for military burden on short-term changes in spillins in indicates that free-riding remains an issueTaken in sum, the results of the ECM confirm those of the OLS model.

Following De Boef and Keele, I plot in Figure E1 below the cumulative change in spending on personnel after a one standard deviation change in Unemployment (about 2.71 points). The line graph plots the cumulative short- and long-term effects after a country experiences increasing on declining unemployment.  The solid line shows that after each movement, the effect an increase in unemployment would gradually build in personnel investment, until 24 years after an increase in unemployment the concerned country would spend 5 percentage points more on personnel relative to that at the beginning of the period. The effect is even larger for equipment spending.



*Variables excluded from 2SLS Analysis*

The 2SLS models exclude all variables except GDP because they are not plausibly correlated with both my instrumental variable (housing shocks) and my dependent variable (personnel expenditures). The OLS relationship between spillins and each of the dependent variables is indicates that spillins are not a particularly powerful predictor of burden-shifting. There is also no theoretical reason to believe that other countries’ military expenditures would correlate with housing prices in a particular country, other than through GDP, which remains in the 2SLS model.

Population is associated with burden-shifting in the OLS models, suggesting that allies do not see defense as a public good. There is no statistically significant relationship between population and housing prices, nor is there a theoretical reason to believe there should be.

While strategic excludability should make burden-shifting less likely, there is no reason to believe that it would correlate with housing prices (and it does not)

Threat (from Russia) would theoretically make burden-shifting less likely. In the fully-specified model, however, states more exposed to Russia spent less on defense and on equipment, indicating that they were confident that their allies would protect them from Russian aggression. Since the 2014 Wales Pledge on Defense Investment, however, states more exposed to Russia have increased defense spending markedly, suggesting that they see fulfilling the pledge as the price of admission to NATO security guarantees. There is no reason to believe that threat would correlate with housing prices but, in the data, the two are positively correlated. In light of the negative association between threat and burden-shifting behavior, this correlation should be seen as biasing against my hypotheses. Moreover, because the housing instrument is not available for many of the states most vulnerable to a threat from Russia, the effect on real estate prices should be extremely limited. Nonetheless, a robustness check with threat included in the 2SLS model yields substantively similar results to those in the main model in the paper, however.

Vulnerability to terrorism could also theoretically make burden-shifting less likely. In the fully-specified OLS models, there is a small positive correlation between terrorism deaths and both military burden and equipment spending, lending support to this possibility. There is no reason, however, to believe that terrorism and housing prices would correlate, and no correlation appears in the data.

Veto points could theoretically make burden-shifting more likely, as domestic political figures are the actors who we would expect to seek electoral benefits from doing so. However, veto points are actually associated with less burden-shifting in the OLS model. There is no reason to believe that veto points would be associated with housing price shocks, and no correlation appears in the data.

Military share of the labor force could plausibly affect burden-shifting, but there is no theoretical reason to believe that it would be associated with housing shocks. The data affirm this non-relationship.

I expect Atlanticism to affect burden-shifting, but only in terms of operational spending. There is no reason at all to think that Atlanticism would affect housing prices and, indeed, the two show no association in the data.

I expect years in NATO to affect burden-shifting, with more senior members of NATO shifting the burdens of collective defense more effectively, but there is no reason to believe that years in NATO would affect housing shocks.

*Alternative Samples*

Table E3 displays the countries and years included in each model in Table 2, and the bivariate correlations between the dependent and independent variables in each. For each country that is not included in a particular model, the years available have been replaced with a bivariate correlation between the dependent and independent variables in that model.

For Model 2, the fully specified PCSE model for the share of GDP devoted to defense (milburden), Austria, Cyprus, Finland, Ireland, Malta, and Sweden are missing due to lack of data for control variables. Finland, Ireland, and Malta’s bivariate correlations are all statistically significant and inconsistent with my hypothesis and with the results from the larger sample of states. The results for Austria are statistically significant in the predicted direction, and those for Cyprus and Sweden are insignificant. In sum, the size of the states involved leads me to conclude that their omission from the fully specified model does not bias the results significantly, and those results are consistent with all other models.

For Model 4, the fully specified PCSE model for the share of defense spending allocated to personnel, the results for Ireland are statistically significant in the direction predicted and confirmed in the other models. The results for Austria, Cyprus, Finland, Malta, and Sweden are insignificant.

For Model 6, the same states are excluded. Only Sweden has a statistically significant result, which is large and consistent with my hypothesis and the results of the broader sample.

For Model 8, the 2SLS for personnel, Albania, Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Poland and Romaina are excluded. Latvia, Lithuania, and Poland all behave consistently with the main hypothesis and the results of the models with the larger samples, while the others’ results are statistically insignificant.

For Model 9, the 2SLS for milburden, the same states are excluded. In the bivariate model, Bulgaria, Croatia, Latvia, and Lithuania behave as hypothesized and consistent with the results in the main model. Poland and Malta behave in the opposite fashion, and the results for Albania, Cyprus, and Romania are statistically insignificant.

For Model 10, the 2SLS for equipment, the same states are excluded. The bivariate results for Bulgraria, Lithuania, and Poland are consistent with the main hypothesis and results. The results for Albania, Croatia, Cyprus, Latvia, Malta, and Romania are statistically insignificant.

These results suggest that the results presented in Table 4 are not biased in any meaningful way by the reduction of sample size as controls and instruments are added. However, to more fully ascertain the effect of possible bias, I re-run all models with a series of differing samples, as well as varying the controls. The results are substantively unchanged.

**Table E3: Samples for Each Model in Table 4**



Table E4 reports the results of the main 2SLS analysis using a 5-year moving average for the independent variable in addition to other appropriate variables, and Table E5 reports the results of the main 2SLS analysis using year fixed effect in addition to country fixed effects. The 2SLS model is quite robust to this variation, as it was to OLS and ECM analysis. In Table E5, the coefficient on unemployment is actually quite a bit larger when using a 5-year moving average, which is consistent with the accumulation of effects over time demonstrated in the ECM analysis above. Table E5 demonstrates that the use of year fixed effects has almost no effect on the coefficient of interest – it is slightly higher in the fully specified model here than in Table 2 in the main paper.



**Table E4: Replication of Main 2SLS Analysis with 5-year MA for Unemployment**



**Table E5: Replication of Main 2SLS Analysis with Year Fixed Effects**

Table E6 reports results on a robustness test of the main 2SLS model using the ratio of nonperforming loans to total loans outstanding as an instrument instead of housing price shocks. Doing so allows me to test in some instances with the entire 33 state sample. The results in Table E6 indicate that the nonperforming loans ratio is also a strong instrument for unemployment, and that the results in the main analysis are robust to its use and the inclusion of a larger sample of states – in several models the coefficient on personnel is larger than in the main analysis. Columns 9-14 of Table E6 also replicate the fully specified model for different sub-samples: NATO Allies only, EU Member States only, and Eurozone members only. I repeat this exercise in greater detail in Tables E7-C9, and Table E10 repeats the exercise for each individual country available.



**Table E6: Replication of Main 2SLS Analysis Using Banking Instrument and Varying Samples**

Tables C6-C9 report results on robustness tests for different subsamples, using the fully specified 2SLS model discussed in section 2 in the main paper. These subsamples include NATO Allies, Eurozone members, and EU members. The results are generally robust to these tests.

Taken together, Tables C6-C8 indicate that limiting our analysis to EU members, Eurozone members, and NATO allies has some effect on the results reported in Table 2, but that the conclusions of Table 2 are generally supported. Interestingly, in Table E6, the coefficients on personnel and equipment expenditures are smaller among NATO allies than among the full sample of states in Table 2, while the relevant coefficients for Eurozone members only are significantly higher. This variation among groupings may suggest that organizational efforts to shape allies’ investment priorities (precursors to the Wales Pledge like internal Alliance guidelines and aspects of the NATO Defense Planning Process) have had some effect on allies’ behavior, and that fiscal rules and monetary union may exacerbate tendencies to substitute personnel for other types of expenditures during periods of high unemployment. Moreover, they give lie to claims that NATO itself is at the root of transatlantic burden-sharing issues. The results for EU Member States only are nearly identical to those for NATO allies.



**Table E7: Replication of Main 2SLS Analysis – NATO Only**

 **Table E8: Replication of Main 2SLS Analysis – Eurozone Only**



**Table E9: Replication of Main 2SLS Analysis – EU Only**

Table E9 demonstrates he results are also robust down to the country level. While the number of observations is quite small for most countries, of the seven states with statistically significant relationships between unemployment in year *y-1* personnel spending in year *y* six (all but France) are positive. This is quite meaningful for a collection of relatively short time series, with countries as diverse as the United States, the Netherlands, Slovakia, Slovenia, Sweden, and Norway all exhibiting similar behavior to the sample as a wholF: housing shocks in year *y-2* are associated with unemployment in year *y-1*, and unemployment in year *y-1* is associated with increased personnel expenditures in year *y*. This is an exceptionally diverse group of states that behave in the same way: the United States is a global power that accounts for approximately 75% of NATO’s total defense investment and not subject to the fiscal constraints of the Maastricht Treaty; the Netherlands is a small NATO ally known recently for fiscal probity; Slovenia is a small economy hit hard by housing, fiscal, and economic shocks; Sweden is a neutral state; Norway shares a geostrategic position with Sweden but is a NATO ally; and Slovakia is a former Warsaw Pact member in the heart of Europe with a checkered fiscal record. France’s unique behavior may be explained by France’s significant domestic defense industry and national policies aimed at promoting it – of all the countries considered, France may be the most likely to use equipment expenditures rather than personnel expenditures for the purposes of domestic political patronage.

**Table E10: 2SLS Analysis, by Country**

Table E11, below, replicates the main OLS analysis using Whitten and Williams’s measures of government positions along separate welfare and international policy dimensions, including the interaction terms they propose. In order to maximize sample size, I use welfare generosity data from the Comparative Welfare Entitlements Dataset (Scruggs, Jahn and Kuitto 2014) to capture the welfare dimension, and executive nationalism data from the Database of Political Institutions (Beck, et al. 2001) to capture the hawkishness dimension. The results are substantively similar to those in the main paper.



**Table E11: Replication of Main OLS Analysis Using Whitten & Williams’s Two Dimensions**

Table E12, below, uses Seemingly Unrelated Regressions to ensure that the results in Table 2 in the main paper are not merely artifacts of the compositional nature of disaggregated defense spending data. The main findings are robust to this alternate specification.

 **Table E12: SUR Replication**

Table E13, below, demonstrates the robustness of the analysis in Table 2 of the main paper to the measurement of the DV as the overall share of disaggregated defense spending in GDP. Unemployment is associated with a decline in overall defense spending, an increase in the share of that spending that is devoted to personnel, and a decrease in the share of that spending devoted to equipment. The increase in personnel share is therefore hidden by the decrease in overall spending, and the decrease in equipment is magnified by the decrease in overall spending.



**Table E13: Alternate DV – Share of GDP**

Table E14, below, demonstrates the robustness of the analysis in Table 2 of the main paper to the measurement of the DV as the total number of military personnel. While states do not add to the number of personnel they hire, they do reduce the share of resources they allocate to equipment. This decline in personnel numbers is to be expected during a period of secular decline in the size of armed forces. However, the decline in equipment expenditures is not consistent with the increasing capital intensity of defense production.



**Table E14: Alternate DV – Raw Numbers of Personnel**

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
| VARIABLES | Milex (%GDP) | Personnel (% Milex) | Equipment (% Milex) |
|  |  |  |  |
| L.Independent Variable | 0.847\*\*\* | 0.773\*\*\* | 0.608\*\*\* |
|  | (0.013) | (0.034) | (0.039) |
| Unemployment | -0.012\*\*\* | 0.236\*\*\* | -0.120\*\* |
|  | (0.004) | (0.065) | (0.056) |
| GDP | -0.000\*\*\* | -0.000 | 0.000 |
|  | (0.000) | (0.000) | (0.000) |
| Constant | 0.418\*\*\* | 11.152\*\*\* | 6.797\*\*\* |
|  | (0.051) | (1.946) | (0.819) |
|  |  |  |  |
| Observations | 842 | 531 | 563 |
| Number of ccode | 34 | 33 | 33 |
| rmse | . | . | . |
| Standard errors in parentheses |  |  |  |
| \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 |  |  |  |
| Instruments for differenced equation | |  |  |
| GMM-type: L(2/.).Independent Variable | |  |  |
| Standard: ∆UEM ∆GDP |  |  |  |
|  |  |  |  |
|  |  |  |  |

**Table E15: Arellano-Bond Replication of Main Analysis**

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1. Distinctions between inputs, intermediate outputs, and final outputs are explored in detail in Melese, Richter, & Solomon (2015). Sololsky & Adams (2017) recently highlighted the policy distinction between inputs and outputs. [↑](#footnote-ref-1)
2. While countries without defense industries often receive offsets from the seller, there is no reason to believe that such offsets would have an effect approaching that of other forms of stimulus, including personnel expenditures. Offsets are by their nature a fraction of the purchasing cost of the equipment: *“In 2014, U.S. firms reported entering into nine new offset agreements with members of the EDA valued at $1.68 billion* (U.S. Department of Commerce, Bureau of Industry and Security, 2016, p. 20)*,” approximately 3% of the approximately $50 billion in equipment spending among EDA members that year.* [↑](#footnote-ref-2)
3. Only countries with significant defense industries can even hope to have any stimulus effect with equipment spending. There is no theoretical or practical reason to believe that O&M spending such as training or overseas deployment would have any effect on employment. While governments may believe that infrastructure spending may create jobs in, for example, the construction industry, the data indicate that the relationship between unemployment and infrastructure spending is small, positive, and statistically insignificant. The dependent variable is the extent to which countries engage in this kind of behavior and not whether it has the desired macroeconomic effect. Supplementary File B contains detailed discussion of this phenomenon, along with a summary of data availability by country-year. [↑](#footnote-ref-3)
4. The DPCS and related Metrics Questionnaires used by NATO’s IS also address the question of possible differences across states in, for example how much modernization is done by military personnel and how much is done by external companies: Modernization refers explicitly to the acquisition of new equipment, whether that effort is led by military personnel or external companies. Likewise for O&M expenditures – O&M costs are O&M costs whether they are in the defense budget or elsewhere. Modernization refers to the acquisition of new equipment, which is counted as equipment – the cost of equipment installation in person-hours is not part of personnel expenditures. [↑](#footnote-ref-4)
5. Becker and Malesky (Becker & Malesky, 2017, p. 3) define Atlanticism as a preference “for a transatlantic approach to European security, in which the United States’ role is central.” [↑](#footnote-ref-5)
6. Iceland does not report defense spending. [↑](#footnote-ref-6)