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Spillover effects of Germany's final demand on Southern Europe

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1 | INTRODUCTION

The euro area witnessed the emergence of large internal current account imbalances in the period leading up to the Great Recession. Euro member states such as Greece, Ireland and Spain recorded relatively high growth rates, high inflation rates and external deficits, while other countries, most prominently Germany, recorded low growth, low inflation and external surpluses. Largely as a result of the expenditure collapse during the crisis, many of the former deficit countries today record small current account surpluses, but whether these can be maintained if and when growth picks up remains an open question (Tressel et al., 2014). A sustainable rebalancing process, it is frequently argued, requires the surplus countries to stimulate domestic expenditure and inflate wages and prices, and the deficit countries to moderate expenditure and deflate. There is no consensus about what is a just or economically sensible distribution of the burden of adjustment between surplus and deficit countries. In practice, deficit countries are stifled by debt; they often face financing constraints and are forced to adjust, whereas surplus countries hesitate to do so. Adjustment is "compulsory for the debtor and voluntary for the creditor" (Keynes in Joshi & Skidelsky, 2010, p. 174). In this paper, we take as given that surplus countries should contribute to the rebalancing process, and we ask how much they can help to ease the burden of adjustment of deficit countries. We predict the size of *spillover effects* of Germany's final demand on GDP, employment and the trade balance in deficit countries.

Reports by international institutions routinely emphasise the positive spillover effects of Germany's final demand on its trading partners in the euro area (EC, 2015; IMF, 2015a). The Bundesbank however argues that Germany can contribute little to the stimulation of economic activity in Southern Europe (Bundesbank, 2010). Since Germany trades with a large number of countries, each bilateral trade flow is fairly small. A German expenditure boom, according to this argument, will diffuse in many directions, and consequently, the final effect on income and employment in individual countries in Southern Europe will be small.

To illustrate, the ratio of bilateral imports of goods and services by Germany from Spain (M_{ESP}^{DEU}) to German final demand (A^{DEU}) varied between 0.7% and 1.3% over 1991–2014. For the purpose of a preliminary guess, we treat this ratio as a parameter $m = M_{ESP}^{DEU}/A^{DEU}$ and we assume that it is higher than historically observed: $m = 0.02$, that is, one euro spent by Germany on final goods and services will call forth two cents worth of imports of Spanish goods and services. Given this parameter, if Germany's final demand were to increase by 1% over the level in 2014 (by 27 billion euro), Spain's exports to Germany would rise by 549 million euro, which amounts to 0.05% of Spain's GDP in 2014.[1]

This guess ignores obvious repercussions. On the one hand, Spain's GDP would rise by less than 0.05% because the additional production of Spanish exports would require imported intermediate goods, and the factor income generated by additional production would induce an increase in Spanish imports for consumption purposes. On the other hand, Spain's GDP would rise by more than 0.05% because the German expenditure boom would generate income and expenditure in third countries that trade with Spain and import products from Spain, and a Keynesian multiplier process would increase consumption expenditure in Spain, Germany and third countries. In short, the prediction of spillover effects calls for the use of an economic model that, at the very least, captures multiplier effects and global value chains.

The input–output model is well suited to this task. The model, which represents a country's industrial structure in a matrix of interindustry flows of intermediate goods, can be used to predict the effects of an exogenous change in final demand on income and employment (Leontief, 1986; Miller & Blair, 2009). A multiregional input–output model takes into account not only the structural relations between domestic industries but also the structural relations between industries in different countries. With sufficient information on the interindustry flows of intermediate and final goods within and across countries, it can be used to predict spillover effects, that is, the response of economic variables in one country triggered by an exogenous increase in final demand in another country.

EC (2012) uses the input–output model to predict spillover effects of Germany's final demand on the trade balances of individual countries in the euro area. Ederer and Reschenhofer (2016) use it to analyse the historical evolution of trade balances in the euro area from 1995 to 2011, and to predict the spillover effects of hypothetical final demand shocks in Germany on certain country groups (e.g., Western and Southern Europe). These studies are based on the *open* input–output model that treats final demand as entirely exogenous. In this paper, we use the *closed* input–output model that endogenises consumption and investment. The endogenous increase in consumption and investment expenditure in response to higher income represents an *induced effect* that is missing from the open model and that strengthens the effects of final demand shocks. We go beyond those earlier studies and explore the temporal stability of the Leontief inverse and Germany's final demand composition in order to assess the extent to which the results derived from historical data generalise to today.

Our estimates complement existing ones derived from dynamic stochastic general equilibrium (DSGE) models (BMWi, 2015a; Bundesbank, 2016; Elekdag & Muir, 2014; IMF, 2015b; in't Veld, 2013, 2017). DSGE models are grounded in theory; they incorporate a wide range of behavioural details and emphasise forward-looking decision making by rational agents. The typical DSGE model relates aggregate quantities to one another (e.g., aggregate consumption) and has to be content with taking broad country groups as the unit of analysis (e.g., six regions of the world economy). The input–output model is capable of using granular data; its main advantage is the use of country-specific information on a low level of aggregation. While the ultimate goal of this paper is the prediction of *aggregate* spillover effects by country, the unit of analysis is the industry and the structural relations are fitted using dis-aggregated data. The World Input-Output Database (Timmer, Dietzenbacher, Los, Stehrer, & de Vries, 2015), the main data source of this

[1] Appendix C lists the data sources.

paper, is capable of operationalising input–output models with 41 countries and 35 industries per country.[2]

We are concerned with problems of external adjustment in the euro area, and we report results for the EA10.[3] Nonetheless, the predicted spillover effects depend on the entire structure of the world economy. The spillover effect of Germany's final demand on Spain's GDP, for instance, includes the direct, indirect, and induced demand for Spanish goods and services by producers and end-users in Spain, Germany and the rest of the world.

Our central estimate suggests that if Germany's final demand were to exogenously increase by 1% of GDP, France, Italy, Spain and Portugal's GDP would grow by 0.11%–0.13%, the unemployment rate would be reduced by 0.09 to 0.14 percentage points, and the trade balance would improve by ~0.04 percentage points. The spillover effects on Greece are significantly smaller. The real beneficiaries would be countries that are integrated into Germany's supply chains (e.g., GDP would increase by ~0.3% in Austria and 0.5% in the Czech Republic). We argue that a modest expansion in Germany alone will hardly make a significant contribution to the external adjustment process in the south. The governments in the south should not rest their hopes in foreign demand stimuli but rather focus their attention on the stimulation domestic demand.

This paper is structured as follows. Section 2 explains input–output analysis to the reader who is not familiar with the method (Appendix A states the input–output model using matrix algebra). Section 3 describes the main data sources. Section 4 presents the results and compares them to previous studies. Section 5 assesses the absolute magnitude of the spillover effects and evaluates Germany's capacity to help the south. Brief policy conclusions are outlined in section 6. Appendix B assesses the robustness of the results.

2 | METHOD: A CLOSED MULTICOUNTRY INPUT–OUTPUT MODEL

The input–output model can be used to investigate the extent to which changes in final demand, given the structural relations between industries, generate changes in other economic variables such as income and employment. This approach is known as *impact analysis*.[4] This section describes the assumptions and the intuition behind the input–output model; see the Appendix for the mathematical representation.

The input–output model treats final demand as exogenous. It assumes that industries use inputs in *fixed proportions in the double sense*. The industries are assumed to use all inputs in fixed proportion to output (constant returns to scale), and they use all inputs in fixed proportion to each other (no factor substitution). In other words, the *technical coefficients*, which determine the quantities of inputs that are necessary to produce one unit of output, are fixed. The input–output model furthermore assumes that additional supply is always able to meet an exogenous increase in final demand—the economy operates below full capacity.

If the final demand for cars were to increase by 100 euro, how much would gross output/income/employment in all industries increase in order to meet the new demand? If the car industry did not use any inputs (if the technical coefficients of this industry were zero), 100 euro worth of

[2]The WIOD covers 40 countries and includes a model for the rest of the world, so there are no black holes and the database fully accounts for global production.

[3]The EA10 is made up of the early euro member states minus tiny and exceptional Luxembourg: Austria, Belgium, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal and Spain.

[4]Miller and Blair (2009) describe the use of input–output models for impact analysis in greater detail.

additional production in the car industry would be sufficient to satisfy the increase in final demand for cars. There would be no repercussions beyond the *initial effect* of increased car production. But the car industry does use inputs from itself and from other industries, and the technical coefficients are not zero. The *direct effect* includes the initial effect as well as changes in output/income/employment in industries that directly supply intermediate inputs to the car industry. These repercussions in the rubber and plastics industry resulting from higher production in the car industry represent a direct effect of the change in the final demand for cars. In addition, the production of intermediate inputs supplied to the car industry in turn depends on the supply of intermediate inputs, which in turn depends on the supply of intermediate inputs, and so forth. The *indirect* effect captures these additional rounds of intermediate input demand.

The *open* input–output model includes only direct and indirect effects. The *closed* input–output model recognises that final demand is not entirely exogenous. Basic consumption theory predicts that higher household income causes higher consumption spending. A final demand shock will initiate additional production; additional production will require more labour input; the higher demand for labour services will increase labour income; and this will increase the amounts spent by households on consumption. In input–output economics, the endogenisation of household consumption is known as closing the model with respect to households. This step can be likened to the addition of industry-specific Keynesian consumption functions to the input–output model. The *total effect* of an exogenous increase in final demand is composed of the direct effect, the indirect effect and the *induced consumption effect*. The induced consumption effect represents the change in output/income/employment that arises from households spending the increased labour income earned in the car industry and in supporting industries.

The input–output model closed with respect to households treats the household sector as if it was an industry. The labour input requirements, which are given by wages and salaries in proportion to industry output, are treated as technical coefficients. The more labour-intensive is production, the higher is the fraction of income that turns into additional consumption spending, and the larger will be the induced effect. The consumption coefficients, which are given by household consumption spending on industry output in proportion to total household income, are treated as technical coefficients. The input–output model "freezes" household consumption behaviour and regards it as part of the economy's structure. The Keynesian consumption functions are industry-specific in the sense that the labour input requirements and consumption coefficients are industry-specific.

One can go one step further and postulate that higher income not only generates additional consumption spending but also additional investment spending. The higher profits earned in the car industry and in supporting industries might induce firms to increase their investment expenditure. In a theoretical ideal, investment expenditure would depend only on the availability of profitable investment opportunities and would be independent of current income. In the presence of capital market imperfections, many firms will be liquidity-constrained and they will tend to raise their investment expenditure when higher current income relaxes this constraint. With adaptive expectations, higher current income will raise the prospective yield of investment and the expectation of increased profits in future periods will induce investment in the current period. In an input–output model that is closed with respect to (households and) firms, the *total effect* of an exogenous increase in final demand is composed of the direct effect, the indirect effect, the induced consumption effect and the *induced investment effect*. The induced investment effect represents the change in output/income/employment that arises from firms investing a fraction of the additional profits earned in the car industry and in supporting industries. The fraction of current-period profits that turns into current-period investment is industry-specific and given by the ratio of industry-level investment expenditure to total economy-wide profits.

The multiregional input–output model represents an extension of the single-region model that does not alter the basic ideas in any way. A multiregional model that has two countries and two industries per country can be thought of as a single-region model that has four industries. Germany's final demand falls in part on the output of domestic industries, and in part on the output of foreign industries. If Germany's final demand increases, there are direct effects on output/income/employment in domestic and foreign industries. There are also indirect and induced effects in Germany and abroad as a result of increased intermediate goods demand by producers, induced consumption demand by households and induced investment demand by producers. The *spillover effect* of Germany's final demand on Spain measures the increase in Spanish output/income/employment that arises as a result of direct, indirect, and induced effects in the world as a whole. In other words, Germany's final demand shock triggers demand for Spanish intermediate goods by producers in Germany, Spain, and the rest of the world as well as demand for Spanish final goods by end-users in Germany, Spain and the rest of the world.

3 | DATA: THE WORLD INPUT-OUTPUT DATABASE

The data requirement of a closed multiregional input–output model is vast. The WIOD makes available World Input-Output-Tables (WIOTs) for $n = 35$ industries and $m = 41$ regions (40 countries and a model for the rest of the world) from 1995 to 2011 (Timmer et al., 2015). These tables report the flows of goods and services from industries to intermediate and final users, broken down by country of origin and by country of destination. The flows are measured in basic prices in current US dollars. The tables assign values to all elements of the gross output vector $\mathbf{x}$ and the interindustry flow matrix $\mathbf{Z}$. Given the data, the technical coefficient matrix $\mathbf{A}$ and the Leontief inverse $\mathbf{L}$ can be computed.

The final demand columns of the WIOT are composed of final consumption expenditure, gross fixed capital formation and changes in inventories. We disregard inventories. Final consumption expenditure is the sum of expenditure by households, non-profit organisations serving households (NPISH) and government. We aggregate households and NPISH and obtain $m = 41$ private consumption vectors $\mathbf{c}^r$. The final demand vector of country r is defined as the sum over the demand categories $\mathbf{f}^r = \mathbf{c}^r + \mathbf{g}^r + \mathbf{k}^r$, where $\mathbf{g}^r$ is the public consumption vector of country r, and $\mathbf{k}^r$ is the investment vector.

The WIOD provides auxiliary variables in the Socio-Economic Accounts (SEA). We use employment by industry, measured in persons engaged in production, for the employment vector; value added by industry, measured in basic prices in current national currency units, for the value added vector; and labour compensation by industry, measured in current national currency units, for the labour input vectors. We convert domestic-currency values into dollars using the WIOD-provided market exchange rates. Given the data, the technical coefficients matrix of the closed model $\bar{\mathbf{A}}$ and the truncated Leontief inverse of the closed model $\bar{\mathbf{L}}$ can be computed.[5]

[5]Observations on labour compensation by industry in the rest of the world (ROW) are missing in the SEA. To close the model, we have to impute the missing values: we assume that labour compensation per euro of output in each industry in the ROW is equal to the mean of emerging economies outside the European Union (Brazil, China, India, Indonesia, Mexico and Turkey). The imputation is good insofar as the mean economic structure in these countries approximates the economic structure in the ROW. Regardless of whether we impute the minimum, the maximum or the mean, the results for EA10 countries hardly change. The 40 countries that are included in the database make up 85% of world GDP in 2008 (at market exchange rates), so the WIOD accounts for the vast majority of global value added and labour income, and the ROW is relatively small. Moreover, the trade ties between the euro area and the ROW are relatively weak.

The predicted spillover effects are based on the latest available data, which is from 2009. The WIOTs contain observations through 2011, but some of the auxiliary variables in the SEA that are needed to close the model are only available until 2009. We use values from 1995 to 2009 to explore the temporal stability of the results as a way of gauging the extent to which the results generalise to today's situation (it turns out the estimated spillover effects are fairly stable over time).

4 | RESULTS

4.1 | Spillover effects on GDP by model type, all countries

Figure 1 shows the spillover effects on GDP stemming from a proportional increase in all components of Germany's final demand. The exogenous increase in Germany's final demand is scaled to 1% of Germany's GDP. Note that Germany's economy ultimately expands by less than the exogenous final demand shock in the open model, as a result of import leakage, and by more than the exogenous final demand shock in the closed models, as a result of multiplier effects. The "own effect" on Germany's GDP, that is, the percentage change in Germany's GDP in response to a 1%-of-GDP exogenous stimulus of Germany's final demand, is 0.8% in the open model, 1.3% in the endogenous-consumption model and 1.8% in the endogenous-consumption-and-investment model.

To get a sense of relative magnitudes across the world, Figure 1 shows the spillover effects on all countries that are included in the WIOD (other than Germany itself and the rest of the world). The induced effects from the closed models are stacked upon the direct and indirect effects from the open model. For instance, the open model predicts a spillover effect on the Czech Republic of 0.09% of GDP (direct and indirect effects). The endogenous-consumption model predicts a spillover effect on the Czech Republic of 0.09 + 0.14 = 0.23% of GDP (direct, indirect and induced consumption effects). The endogenous-consumption-and-investment model predicts a spillover effect on the Czech Republic of 0.09 + 0.14 + 0.26 = 0.49% of GDP (direct, indirect, and induced consumption and investment effects). The induced investment effect accounts for more than half of the total spillover effect on the Czech Republic. This is a general pattern: closing the model matters a lot, and in particular, the induced investment effect is tremendously important.

The total spillover effect on the Czech Republic is the largest in the sample. In general, the countries that would benefit the most from a German demand boom are Germany's neighbours and emerging economies in Eastern Europe that are well integrated into German supply chains. The countries that would benefit the least from a German demand boom are the United States, Japan and Canada—these are large economies for which Germany is just one trading partner among many others.

In general, the size of spillover effects depends on three factors. First, *relative size* matters. A spillover effect is large, ceteris paribus, when Germany's economy is large relative to the country in question. Germany can more easily provide a demand stimulus to Luxembourg than to France. Second, a spillover effect is large, ceteris paribus, when *Germany's final demand composition* is favourable to the country in question. The higher the share of French final products that directly satisfy Germany's final demand, the larger will be the spillover effect on France. Third, a spillover effect is large, ceteris paribus, when the world economy's *production structure* is favourable to the country in question. The bigger the role of French intermediate goods suppliers in those production chains that ultimately satisfy German final demand, and in those production chains that ultimately satisfy final demand induced in France and third countries, the larger will be the spillover effect on France.

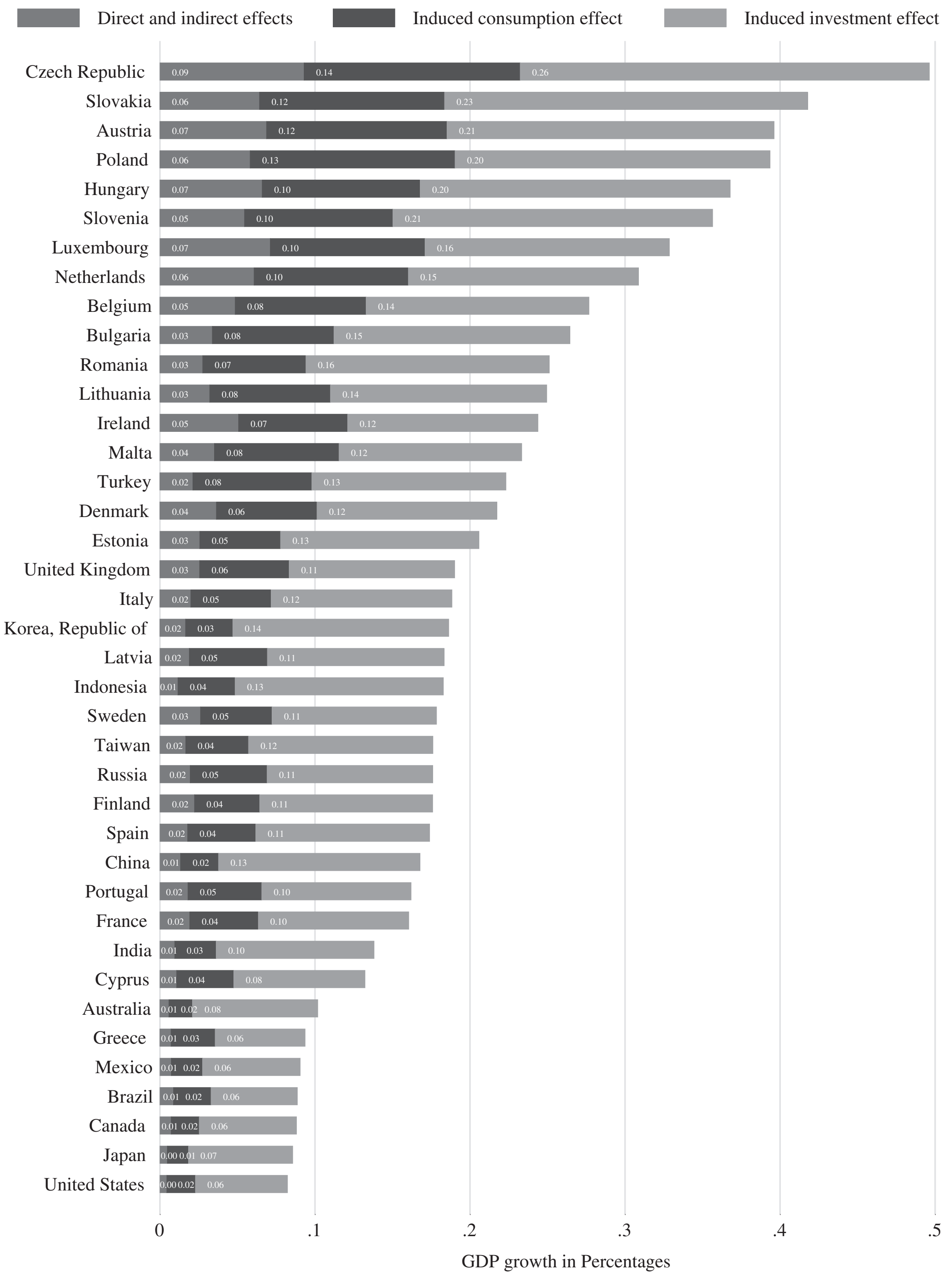

FIGURE 1 Spillover effects on GDP of Germany's final demand, full sample

Note: The demand shock is scaled to 1% of Germany's GDP. [Colour figure can be viewed at wileyonlinelibrary.com]

4.2 | Spillover effects by impact variable, EA10

From now on, we focus on the countries that make up the EA10. Figure 2 shows the spillover effects of a shock to Germany's final demand on GDP, employment and the trade balance in the EA10. To avoid clutter and a plethora of numbers, a model selection was made. Figure 2 and the rest of the paper presents the simple average of the predictions of the endogenous-consumption model and the endogenous-consumption-and-investment model. Recall that the only difference between the two models is that the induced investment effect is missing in the former model and present in the latter. Taking the simple average of the two models therefore effectively halves the induced investment effect.[6] In terms of Figure 1, the total spillover effects reported in the remainder of this paper amount to the sum of the dark gray bar, near-black bar, and half of the light gray bar. This choice reflects our view that the theoretical and empirical case for induced consumption effects is strong. Investment

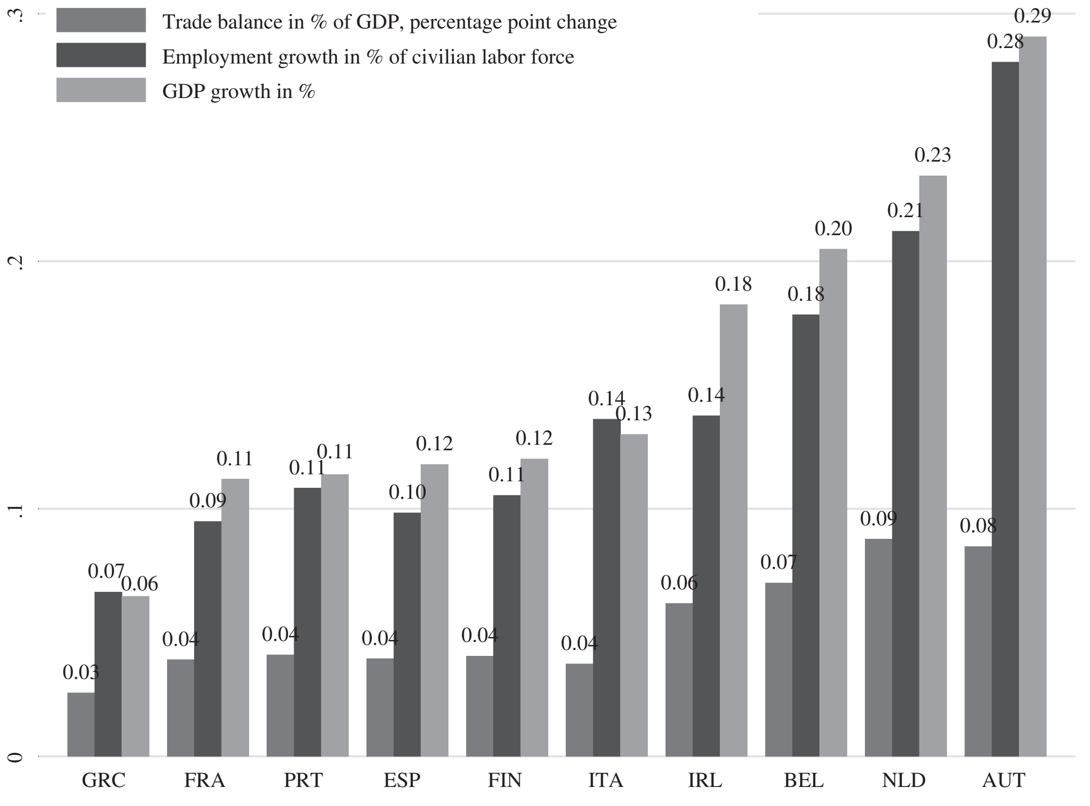

FIGURE 2 Spillover effects of Germany's final demand, EA10

Notes: The demand shock is scaled to 1% of Germany's GDP. The trade balance effect is the first difference of the trade balance measured in percentage of GDP. The employment effect is expressed in percentage of the civilian labour force; under the assumption that the labour force remains constant, it represents a percentage point reduction in the unemployment rate. The GDP effect is expressed as a percentage growth rate. [Colour figure can be viewed at wileyonlinelibrary.com]

[6]With respect to the spillover effect on the trade balance, "halving the induced investment effect" is not exactly correct because the denominator varies across models (since we report the first difference of the trade balance).

decisions, however, are more difficult to predict and they cannot be presumed to follow mechanically from increases in final demand, in particular in times of spare capacity and overstretched balance sheets. The charge of ad hocery cannot entirely be dismissed, yet a benchmark for incorporating investment behaviour into input–output models does not exist.

It can be observed that the correlation across the types of spillover effects is high: Greece records the smallest effect on GDP and employment and the smallest effect on the trade balance; Austria records the largest effects on GDP and employment. The correlation is not perfect; for example, the effect on Ireland's GDP is dis-proportionally larger than the effect on Ireland's unemployment rate.

Figure 2 sorts the countries by the size of the spillover effect on GDP. The EA10 countries that would benefit the most from a German demand boom are Austria, the Netherlands and Belgium—three neighbours. If Germany's final demand were to exogenously increase by 1% of GDP, Austria's GDP would grow by 0.29%, the unemployment rate would be reduced by 0.28 percentage points, and the trade balance would improve by 0.08 percentage points. The country that would benefit the least from a German demand boom is Greece. If Germany's final demand were to exogenously increase by 1% of GDP, the Greek GDP would grow by 0.06%, the unemployment rate would be reduced by 0.07 percentage points, and the trade balance would improve by 0.03 percentage points. The spillover effects on other countries in the Southern Europe—France, Portugal, Spain and Italy—are larger than in Greece. Their GDP would grow by more than 0.1%, and their unemployment rate would fall by about 0.1 percentage points. The relatively small spillover effect on France is surprising in the light of the strong trade ties between the neighbours Germany and France. It can be explained by the fact that France is a relatively large economy (French GDP amounts to more than two thirds of German GDP). The relative size of the economies limits the capacity of Germany to play the locomotive role for France.

How do these predictions compare to others in the literature? Ederer and Reschenhofer (2016) use the WIOD to fit an open input–output model to execute an impact analysis. The model predicts that a 50% exogenous increase in final demand in Germany would eliminate the German trade surplus; the spillover effects of this hypothetical German demand expansion on GDP in Western and Southern Europe would amount to no more than 1% or 2% (Western and Southern Europe are understood as Belgium, Finland, France, Luxembourg, Cyprus, Greece, Spain, Ireland, Italy and Portugal). Recall that the input–output model assumes constant returns to scale in production. Since the effects increase in proportion to the shocks, predictions can be compared simply by scaling up or down the hypothetical final demand shocks. The closed model (simple average of endogenous-consumption model and endogenous-consumption-and-investment model) predicts that a 50% exogenous increase in Germany's final demand would lead to 5.9% higher GDP in Spain, 5.6% higher GDP in France and 6.5% higher GDP in Italy. Our predictions are more than three times larger than Ederer and Reschenhofer's. The induced response of consumption and investment explains the difference.

EC (2012) use the open input–output model to predict the effects of a 1% increase in Germany's final demand on the trade balances in other euro area countries. The study finds the trade balance of Spain, Italy and Portugal would improve by about 0.02 percentage points (the corresponding value for Greece is smaller). We find that the same shock would improve the trade balance of these countries by approximately 0.04 percentage points. While the spillover effects on GDP and employment are necessarily larger in the closed model, the spillover effects on the trade balance could in principle go either way. The induced response of consumption and investment demand in trading partner economies increases the revenue side of the trade balance through additional exports, while the induced response of domestic consumption and investment demand increases imports. The net effect is theoretically ambiguous; the data reveal that it is positive.

4.3 | Spillover effects on GDP by final demand category

Figure 3 shows the spillover effects on GDP of equal-size final demand shocks broken down by final demand category. Since the shocks are scaled to 1% of Germany's GDP, the size of the spillover effects varies only because the composition of final demand varies across final demand categories. An exogenous increase in Germany's investment expenditure, for instance, activates different industries than an exogenous increase in consumption expenditure.

If Germany's total investment expenditure were to exogenously increase by 1% of GDP, the GDP of Portugal, Spain, France and Italy would grow by 0.13%–0.16%. Greece, once again, cannot be placed in the same group of countries, because the spillover effect is about half that size. An exogenous increase in Germany's total investment expenditure tends to generate the largest spillover effects, and an exogenous increase in public consumption expenditure the smallest (Ireland, Netherlands, Greece represent exceptions to this rule). This finding mirrors a robust pattern that stretches across time and space: in general, the import propensity is highest for investment

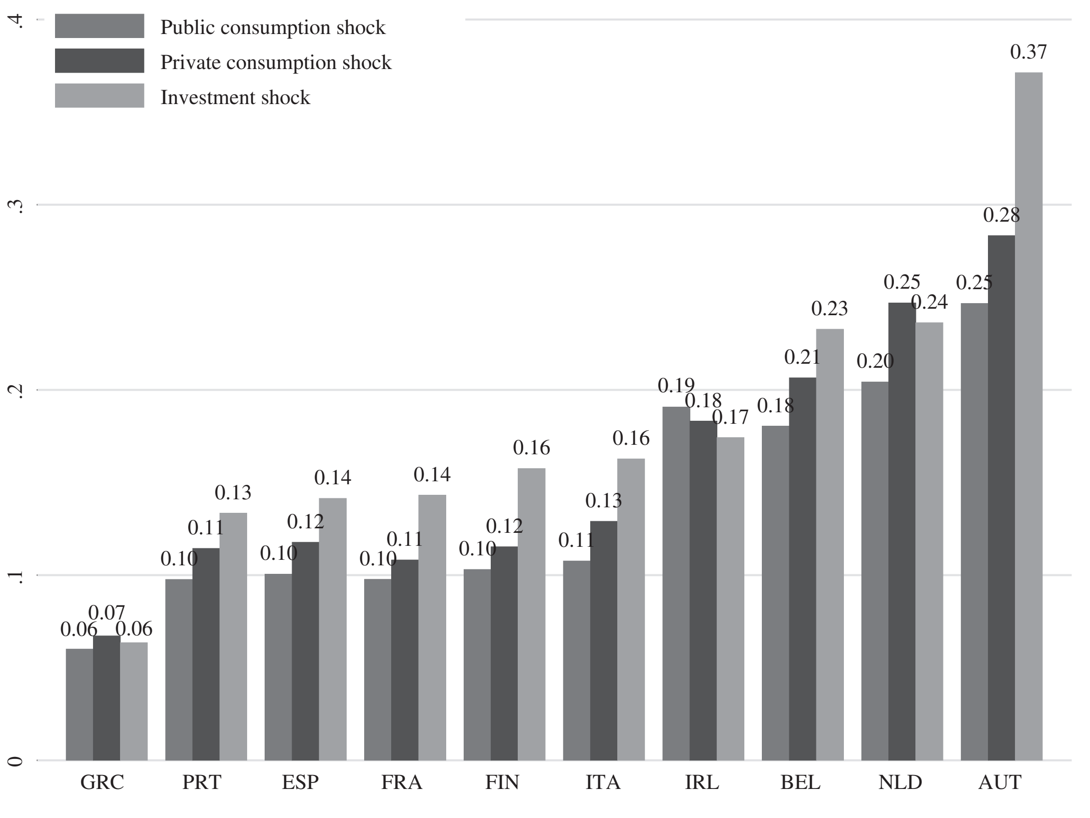

FIGURE 3 Spillover effects on GDP by final demand category, EA10

Notes: The chart shows the spillover effects on GDP of equal-size German demand shocks. The shocks are scaled to 1% of Germany's GDP. The spillover effects are expressed in percentage of GDP. [Colour figure can be viewed at wileyonlinelibrary.com] expenditure, lowest for government expenditure, and consumption expenditure falls in between (Bussiere, Callegari, Ghironi, Sestieri, & Yamano, 2013; Kennedy & Thirlwall, 1979). It is therefore no surprise that the demand category which tends to induce the largest quantity of imports generates the greatest spillover effects.

How do these predictions compare to others in the literature? Table 1 in the Appendix gives an overview of existing studies. A comparison with predictions derived from DSGE models is not straightforward, because input–output models are static (the shocks are permanent) and DSGE models are dynamic (the shocks can be temporary or permanent, and the effects typically stretch over multiple periods). DSGE models tend to be based on country groups (e.g., Greece, Ireland, Italy, Portugal, Spain = EA5) which complicates a comparison with the country-specific results derived in this study.

IMF (2015b) uses the IMF's Global Integrated Monetary and Fiscal Model (GIMF) to predict the spillover effects of an increase in German consumption demand. The GIMF model is set up to represent six regions of the world economy, one of which comprises Greece, Ireland, Italy, Portugal and Spain (EA5). As consumption demand is an endogenous variable in the model, the study predicts the implications of shocks to: (i) the German wage markup and (ii) a German consumer preference parameter. The wage markup shock leads to lower aggregate demand in Germany and lower GDP in the EA5. The preference parameter shock, scaled so as to generate a 2% temporary increase in German consumption demand, leads at its peak to about 0.1% higher GDP in the EA5, but only if monetary policy is accommodative (i.e., if the nominal policy rate is constant). This result should be compared to the near-black bars in Figure 3, because 2% of Germany's private consumption amounts to 1.07% of Germany's GDP, which means that the size of the shocks is comparable (although precision would dictate a division of the numbers in the figure by 1.07). It can be observed that the GIMF and the closed input–output model predict more or less the same private-consumption spillover effects for France, Italy, Portugal and Spain. The GIMF model does not capture the differences across countries and cannot reveal that Greece is an outlier.

Elekdag and Muir (2014) use the same six-region GIMF model to investigate the spillover effects of shocks to Germany's public investment. If monetary policy is accommodative, a 2-year debt-financed public investment shock, scaled to 1% of GDP per year, raises the EA5's GDP by 0.2% relative to the baseline scenario. For lack of data on the composition of investment, the input–output model cannot simulate a public investment shock. The results summarised in Figure 3 are based on an exogenous increase in total investment expenditure (both public and private). Ignoring Greece, if we allow the total investment shock in the input–output model to represent a public investment shock and otherwise ignore the incommensurabilities, the GIMF model's estimate of public-investment spillover effects is roughly one third higher than our estimate.

The import intensity of Germany's public investment is lower than the import intensity of Germany's total final demand (BMWi, 2015a). The typical DSGE model, however, is highly aggregated and does not take into account this heterogeneity across final demand categories. It will therefore overstate the spillover effects of shocks to Germany's public investment. Our multiregional input–output model relies on data provided by the WIOD, and the WIOD aggregates public and private investment into total investment. The import intensity of Germany's total investment is higher than the import intensity of Germany's public investment. If an exogenous increase in total investment is supposed to mimic a public investment programme, the input–output model, too, will overstate the spillover effects of shocks to Germany's public investment.

in't Veld (2013) uses the QUEST model, the macroeconomic model of the European Commission's Directorate-General for Economic and Financial Affairs, to predict the spillover effects of fiscal consolidation and fiscal expansion under crisis conditions (liquidity-constrained households

TABLE 1 Overview of spillover effects in the literature

Study	Model, regions	Shock type, size, and duration	Shock where?	Own effects	Spillover effects
in't Veld, (2013)	QUEST, Germany, France, Italy, Spain, Ireland, Portugal, Greece, ROEA, ROEU, and ROW	Public investment, 1% of GDP, 2 years	Germany and ROEA	Less than 1% GDP growth and 0.3–0.4 pps current account deterioration	0.2%–0.3% GDP growth and less than 0.1pps current account improvement in France, Italy, Spain, Ireland, Portugal, and Greece
Elekdag and Muir (2014)	GIMF, Germany, EA5, ROEA, US, emerging Asia, and ROW	(a) Public consumption, 1% of GDP, 2 years; (b) public investment, 0.5% of GDP, 4 years	Germany	(a) 0.6% GDP growth and 0.5pps current account deterioration; b) 1% GDP growth and 0.5 pps current account deterioration	(a) Less than 0.1% GDP growth and less than 0.05 pps current account improvement in EA5; (b) 0.2% GDP growth and 0.05 pps current account improvement in EA5
IMF (2015)	GIMF, Germany, EA5, ROEA, US, emerging Asia, and ROW	Private consumption (preference parameter shock), 2% of GDP, 2 years	Germany	0.6% GDP growth and 0.5 pps current account deterioration	0.1% GDP growth and negligible current account improvement in EA5
BMWi (2015)	GEM, 80 countries plus some regions	Public investment, 1% of 2014 GDP, 4 years	Germany	0.75% GDP growth in scenario 4 (peak 1%); 0.5 pps current account deterioration	0.1% GDP growth in Greece, France, Spain, and Portugal (less if efficiency of public investment is high), slightly more in ROEA; 0.1pps current account improvement in ROEA

(Continues)

TABLE 1 (Continued)

Study	Model, regions	Shock type, size, and duration	Shock where?	Own effects	Spillover effects
Bundesbank (2016)	NiGEM, 44 countries plus 6 regions	Public investment, 1% of GDP, 2 years	Germany	0.5% GDP growth; 0.7 pps current account deterioration	0.2% GDP growth in France, Italy, and Spain, 0.1% in Greece and Portugal (0.26% in ROEA on average); <0.1 pps current account improvement in ROEA
in't Veld (2017)	QUEST, Germany, Netherlands, France, Italy, Spain, ROEA, and ROW	Public investment, 1% of GDP, 10 years	Germany and Netherlands	If efficiency of public investment is high: 2.4% GDP growth after 10 years; 0.2 pps current account deterioration	If efficiency of public investment is high: 0.5% GDP growth but almost no current account improvement in France, Italy, Spain, and ROEA

Notes: ROEA, rest of euro area; EA5, Greece, Ireland, Italy, Spain, Portugal; ROEU, rest of European Union; ROW, rest of world. The table reports the results of scenarios that assume monetary accommodation.

and zero lower bound). The model considers seven countries separately (Germany, France, Italy, Spain, Ireland, Portugal and Greece) and treats the rest of the euro area as one aggregate block. If Germany in concert with a few small euro area countries would increase public investment expenditure by 1% of GDP per year for 2 years, France, Italy, Spain, Ireland, Portugal and Greece's GDP would grow by 0.2% to 0.3%. Comparing this range to the total-investment spillover effects on France, Italy, Spain, Portugal in Figure 3, it can be observed that the QUEST model's spillover effects are almost twice as large.

To our knowledge, the most recent incarnation of the QUEST model generates the largest spillover effects (in't Veld, 2017). The model used in that study is based on a slightly different country grouping, sets the output elasticity of public capital to a higher value and simulates a joint expansion of public investment in Germany and the Netherlands. Furthermore, the shock duration is much longer: public investment in Germany and the Netherlands is exogenously increased by 1% of GDP for 10 years. This configuration of the QUEST model generates large spillover effects: GDP in France, Italy and Spain is 0.5% higher than in the baseline scenario.

If we cast a wide net and allow the spillover effects produced by the closed input–output model to vary by a factor of two (half or twice the estimated size), all studies listed in Table 1 would fall within these bounds except in't Veld (2017). The earlier version of the QUEST model (in't Veld, 2013) already produced relatively high spillover effects; the combination of long shock duration and high output elasticity of public capital in the more recent version of the model appears to account for this result.

A few words on the underlying mechanisms. DSGE models incorporate a number of mechanisms that are absent from input–output models. One might expect that a robust expansion of the German economy exercises upward pressure on domestic wages and prices; as Germany loses price competitiveness and Southern Europe gains price competitiveness, exports from Southern Europe should increase to some extent and imports by Southern Europe should decrease to some extent. The predicted spillover effects on GDP, employment and the trade balance should be greater in models that do incorporate such realignment of competitive positions. The actual strength of this *price competitiveness channel* remains elusive; in DSGE models, it is regulated by the choice of the elasticity of substitution, a parameter. We are not aware of DSGE studies that present, as a sensitivity test, the results of variations in the elasticity of substitution. BMWi (2015a) use the GEM, a large macroeconometric model, to assess the importance of the competitiveness channel. By comparing the results of a simulation which holds unit labour costs in the euro area constant, to an otherwise identical simulation which allows unit labour cost to move freely, one can conclude that the competitiveness channel accounts for about 20% of the total spillover effect.

The simulations by researchers at the IMF and the European Commission assume that monetary policy is accommodative: the tightening that would follow an increase in demand and inflation in normal times does not occur at the zero lower bound; therefore, the nominal policy rate remains constant, and the real rate declines. In the model economy, the lower real rate tends to stimulate domestic demand all across the euro area, and moreover, it induces a depreciation of the euro that stimulates foreign demand for euro area products. While the actual strength of this *monetary policy channel* is difficult to ascertain, it is the major driver of spillover effects in the model economy; without it, the spillovers are negligible, or even negative in the short run.

The price competitiveness channel and the monetary policy channel would be reflected in the input–output model as both changes in the technical coefficients and changes in the final demand composition. Propagation in the constant-coefficient input–output model is predicated on multipliers that reflect endogenous intermediate input demand by producers and endogenous final goods demand by households at constant prices and below full capacity. In DSGE models, the labour supply function acts as a (flexible) supply constraint; the spillover effects do not result from multipliers in the manner of Leontief and Keynes, but from behavioural change in the form of relative price-induced expenditure switching and, most importantly, from the interest elasticity of domestic expenditure.

4.4 | Temporal stability

This section studies robustness. If historically observed changes in the data underlying the input–output model generated wild fluctuations in the predicted spillover effects, there would be little justification for applying results that are based on historical data to today's situation. If the predicted spillover effects were robust with respect to historically observed changes in the data, the predictions would carry weight under present circumstances.

A spillover effect is determined by relative size, Germany's final demand composition and the world economy's economic structure. All three variables vary by country and over time. We compute 15 estimates per country, one for each year between 1995 and 2009. Table 2 reports simple summary statistics. It can be observed that Austria records the smallest standard deviation; Austria's mean, minimum and maximum are fairly close to the 2009 value. In this sense, the spillover effect on Austria is the most robust. Belgium records the largest standard deviation, and the maximum is almost twice as large as the minimum. The spillover effect on Belgium is the least robust. Although the volatility in the predictions is non-negligible, it is reassuring that the spillover effects do not change by an order of magnitude even over a 15-year time horizon. The spillover effects computed on the basis of 2009 data, we argue, represent an approximation to the spillover effects in 2017, where data are unavailable.[7]

Appendix B analyses the contribution of changes in relative size, composition and structure on the temporal variation in spillover effects. To foreshadow the results, most of the temporal variation can be explained by changes in relative size.

TABLE 2 Spillover effects 1995–2009

	AUT	BEL	ESP	FIN	FRA	GRC	IRL	ITA	NLD	PRT
2009	0.185	0.133	0.062	0.064	0.064	0.035	0.121	0.072	0.161	0.066
Mean	0.189	0.169	0.081	0.090	0.083	0.052	0.152	0.095	0.184	0.093
StdDev	0.008	0.033	0.017	0.011	0.013	0.011	0.032	0.018	0.021	0.030
Min	0.176	0.123	0.056	0.064	0.064	0.035	0.112	0.072	0.154	0.062
Max	0.203	0.227	0.098	0.108	0.103	0.074	0.221	0.131	0.228	0.149

Notes: The first row shows the percentage spillover effects on GDP, predicted on the basis of the endogenous-consumption model and 2009 data (the values represent the sum of the green and red bars in Figure 1). The predictions vary as the underlying source data vary over $t = 1995, \ldots, 2009$. The last four rows show the mean, standard deviation, minimum and maximum of the 15 predicted values per country.

[7]One might surmise that economic integration with Eastern Europe leads to a sharp increase in Germany's spillover effects on Eastern Europe. Yet the spillover effects on Eastern Europe are surprisingly stable as well. This stability is the aggregate outcome of conflicting trends that neutralise each other. The Eastern European economies have increased their participation in Germany's supply chains (in contrast to Southern Europe, the structural effect is positive), but the high growth rates have worked in the opposite direction (the relative size effect is negative, and strongly so).

5 | DISCUSSION

The spillover effects on Southern Europe are small in *relative* terms; that is, they are small in comparison with the spillover effects on Germany's small neighbours and countries in Eastern Europe. The question whether the spillover effects on Southern Europe are small or large in *absolute* terms—whether Germany is able to play a locomotive role and contribute to external adjustment in the south—depends on the size of the presumed final demand changes. By how much can the German economy realistically expand? And how much is politically feasible?

First of all, it can be argued that the German economy operates below full capacity and there is considerable scope for an expansion. Private and public investment in Germany is weak, and it has been weak for a long time (BMWi, 2015b; EC, 2015). The German economy is healthy in comparison with crisis-ridden countries in Southern Europe, but economic growth is low by own historical standards. As of February 2017, 6.3% of the labour force is unemployed (2.76 million persons), and 8.4% is underemployed (3.76 million persons) according to the national employment agency's definition of underemployment.[8] These numbers do not include persons in subsidised short-time work nor discouraged persons who left the labour force. If large parts of the German economy were supply-constrained and unable to keep up with rising demand, inflation pressure would mount. In fact inflation is low. Measured by the OECD consumer price index, inflation stood at 0.5% in 2016 and is projected to be 1.4% in 2017. The fact that German officials and their advisers make reference to a "tight labour market and closed output gap" (IMF, 2015a, p. 13) merely shows that definitions of full employment and potential output are fairly elastic and change over time. Recall that in the 1960s and early 1970s, the unemployment rate routinely fell below 1%. One or two generations of Germans have not seen anything that resembles full employment as it was known then.

Imagine the following scenario. A joint effort by German labour unions, employer associations and government aimed at a coordination of wage policy and fiscal policy would bring about a truly ambitious macroeconomic policy stance, such that over the course of 5 years the exogenous stimulus to final demand would amount to 10% of GDP, which is slightly less than 2% in annual terms.[9] The closed input–output model predicts that the increase in Germany's GDP from this programme alone, considering import leakage and multiplier effects, would be 15.8% (this is the "own effect" of the exogenous increase in Germany's final demand).[10] The numbers in Figure 2, times 10, represent a prediction of the spillover effects on Southern Europe. GDP would grow by 1.1% to 1.3% in France, Portugal, Spain and Italy, and by 0.6% in Greece. The trade balance would improve by 0.4 percentage points in France, Portugal, Spain and Italy, and by 0.3 percentage points in Greece. Clearly, these are large spillover effects. At the same time, it would take 5 years to reach numbers in this ballpark, and even a German growth spurt of this extraordinary duration and magnitude would not close the output gaps in Southern Europe.[11]

[8]The data sources are listed in Appendix C.

[9]In 2016, Germany's share of public investment in GDP was merely 2.2%. A public investment programme = 1% of GDP implies that public investment increases by almost 50%. A truly ambitious macroeconomic policy stance that aims at annual growth rates upwards of say 3% in real terms for a sustained period cannot rely on public investment alone to stimulate final demand. Wage policy and a willingness to expand the provision of public services, that is, an increase public consumption, would have to be part of the policy mix.

[10]The last time the 5-year average annual growth rate of Germany's GDP stood above 3% was at the end of the unification boom, when East Germans entered the labour force, and during periods in the 1970s and 1960s, when the working-age population was growing faster than it does today. A growth spurt of this magnitude would be possible only by immigration and the rapid integration of refugees in the labour market.

[11]2016 IMF estimates of output gaps in percentage of potential GDP: −2.0% in France, −2.3% in Spain, −2.4% in Italy, −2.7% in Portugal and −4.8% in Greece.

The larger is the assumed exogenous increase in final demand, the more dynamic will be the model economy and the less credible will be the assumption of a fixed economic structure and fixed final demand composition. Economies of scale, relative price changes, domestic production bottlenecks that require foreign sourcing—the list of factors that could change the model's parameters is long. A massive final demand shock concentrated in 1 or 2 years would likely pose a greater challenge to the parameter stability than modest increases over multiple years, since over time the production capacity can adjust to the new, higher level of demand. Over longer time periods, the parameters change as a result of technological, social and political developments that are independent of the final demand shock. That being said, the predicted spillover effects were relatively stable over the period 1995–2009 even as producers changed their sourcing pattern and end-users changed their consumption pattern (see section 4.4 and Appendix B). In spite of sharp differences in the macroeconomic performance across euro member states, which was reflected in the observed divergence in domestic demand and the divergence in unit labour costs; in spite of the process of Eastern enlargement and the associated foreign direct investment flows and the re-organisation of supply chains; in spite of the rise of China as the world's assembly line; the spillover effects of Germany's final demand on Southern Europe remained remarkably stable over a 15-year time period. When the presumed shock size is relatively small, the prospect of behavioural and structural change, which is ignored by the input–output model, poses less of a challenge to parameter stability.

We return to the domain of political feasibility. If we limit ourselves to the consideration of final demand stimuli that are within political reach in terms of size, then the spillover effects are bound to be small. The European Commission gauges Germany's annual infrastructure investment backlog with one-half to 1% of GDP (EC, 2015). Let the 1%-of-GDP total investment shock in Figure 3 represent this public investment programme. The spillover effects on the south range from 0.06% to 0.16% of GDP. In our view, these are small effects which certainly do not justify a swing towards growth optimism in the south. Why do so many experts expect large spillover effects to come from rather modest fiscal stimuli?

It is relatively easy to overestimate the importance of foreign demand for a country's growth performance. To this end, one only needs to relate a country's exports of goods and services, a *gross* flow, to GDP, a *value added* flow; then it might appear as if export growth could make a considerable contribution to GDP growth. As soon as intermediate goods demand and supply-chain trade are taken into account, as is done by the input–output method, the said overestimation becomes significantly harder to sustain. In the EA10, the foreign value added content of gross exports ranges from 24% in Greece to 45% in Ireland (Stehrer, 2013).

The next fact to appreciate is that in spite of the increased interdependence of economies and the presence of global value chains, a country's final demand first and foremost generates income in the domestic economy. A country's GDP can be split into the share that is activated by domestic final demand and the share that is activated by foreign final demand. In 2011, domestic sources of demand still account for 82% of domestic income in France, 82% in Spain, 80% in Italy and 68% in Germany.[12] In other words, less than a fifth of the GDP in Southern Europe depends on foreign sources of demand. The lesson that we draw from these numbers is

[12]These numbers are reported in Foster, Stehrer, and Timmer (2013), Garbellini, Marelli, and Wirkierman (2014), and Ederer and Reschenhofer (2016). Note also that the share of imported intermediates in global manufacturing output is only 16%; the share of imported intermediates in global production of goods and services is 8% (Baldwin & Lopez-Gonzalez, 2014). In this sense, "global manufacturing is not very internationalised" and "world production is not very globalised" (Baldwin & Lopez-Gonzalez, 2014, pp. 10–11).

that any export-led growth strategy is forced to rely on rapid growth in what remains a small fraction of domestic income. Since all trading partners jointly account for this foreign demand-generated income, the contribution of any single trading partner is bound to be smaller still.

Matters will be somewhat different in small countries that trade a lot with a large neighbouring economy, for example, Austria/Germany, Ireland/UK. Suppose the dominant trading partner were to experience final demand growth rates comparable to those recorded in Ireland, Greece and Spain before the crisis (upwards of 5% annually in real terms). The spillovers from this strong boom in the dominant trading partner could be expected to exert a significant influence on the evolution of the domestic economy. If *all* trading partners *simultaneously* were to go through *rapid* expansions, the spillover effects would no doubt be considerable. It is however rarely the case, absent macroeconomic policy coordination, that all trading partners are growing fast; in reality, some trading partners are expanding while others are stagnating, and final demand in the *average* trading partner is growing at some *average* rate but not at the precrisis rates observed in Ireland, Greece and Spain. Without a coordinated expansion, it is unlikely that foreign demand will make a significant contribution to economic activity in Southern Europe.

A rather closed economy like Greece can hardly benefit from foreign demand spillovers. Exporting industries are larger in Italy, France, Spain and Portugal, but even a relatively open economy like Germany can experience a combination of strong export growth and weak macroeconomic performance—it did so from the mid-1990s until the mid-2000s. Germany's unemployment rate peaked at 11.2% in 2005, after the large trade surplus had emerged. The export growth rates were higher than in comparable high-income countries, but Germany, then called the "sick man of Europe," recorded relatively low growth and high unemployment. The lesson is that it is difficult to overestimate the importance of domestic sources of demand for a country's growth and employment performance. Germany's performance was poor then because domestic demand was weak. Growth will resume in Southern Europe if and when domestic demand picks up.

The results of DSGE models effectively confirm the importance of domestic sources of demand. The same QUEST model that generates a 0.5% spillover effect on GDP yields a negligible spillover effect on the current account; that is, the simulated expansion in Germany has no effect on the current account balances in the south. This is not surprising in the light of the underlying mechanisms, because in DSGE models, the GDP increase in Southern Europe ultimately rests on behavioural change in the south that leads to an expansion of domestic demand—the representative agent reacts to the lower real interest rate. The domestic demand expansion induces imports that exhaust the external space created by the German expansion.

A revival of domestic sources of demand would certainly worsen the region's external balances, although the relative closedness of the Southern economies would work in their favour. It is evident that *expenditure-switching polices* are in principle desirable, for they would relax the external constraint and make room for an expansion of domestic demand. Consider, though, the arsenal of expenditure-switching policies discussed by Harry Johnson (1958): currency devaluation, internal devaluation, trade subsidies, tariffs and quantitative restrictions on imports. The Treaty of Rome rules out tariffs and quantitative import restrictions as well as any measures that have equivalent effects. Europe's common competition policy largely rules out state subsidies, and euro membership eliminates the option of currency devaluation. The only instrument that remains at the disposal of national governments in the euro area is internal devaluation. Whether and to what extent internal devaluation might raise export competitiveness is an open question, which cannot be discussed here.[13] The elected governments in Southern Europe face a trade-off between the objective of promoting domestic employment and objective of improving the external balance, and the restrictions placed upon the macroeconomic policy toolkit certainly do not alleviate this trade-off.

A coordinated expansion in the euro area would contribute to both policy objectives. The relatively strong trade ties between the Southern European countries would help to contain adverse trade balance effects—to a non-negligible extent the southern economies could invigorate one another. If the constraint was accepted that the trade balances in the south must not deteriorate, the stimulus in the north would have to be considerably larger than in the south. Given the dispersion of trade flows (the euro area countries have significant trade ties with countries outside the currency area), the coalition that agrees to pursue expansionary policies would have to include as many countries as possible.

Any policy that could help spur innovation and encourage the development of new industries in Southern Europe would support the rebalancing process. A revival of industrial policy may have the capacity to raise economic growth and promote exports in the long run (Aghion, Boulanger, & Cohen, 2011; Aiginger, 2013; Mazzucato et al., 2015; Rodrik, 2014). The design and implementation of industrial policy raises a set of issues that is largely independent of the short-run external adjustment problems discussed here. In general any country, whether in surplus or deficit, strives to support innovative firms and develop new industries.

6 | CONCLUSION

We find that the spillover effects of Germany's final demand on countries in Southern Europe are small in relative terms. If a German demand boom were to materialise, France, Greece, Italy, Spain and Portugal would hardly benefit in terms of growth and external adjustment. The real beneficiaries would be small neighbours (e.g., Austria and Luxembourg) and emerging economies in Eastern Europe that are well integrated into German supply chains (e.g., Czech Republic and Poland). The spillover effects of a modest expansion in Germany are small in absolute terms as well. The results lend support to the notion that Germany, in the absence of a growth spurt of historical duration and magnitude, is unable to stimulate economic activity in Southern Europe (Bundesbank, 2010). Although international institutions routinely emphasise the positive spillovers from modest fiscal action in Germany (EC, 2015; IMF, 2015a), these spillovers hardly constitute a remedy to the external adjustment problems in Southern Europe.

Gross export statistics give a misleading picture of the importance of foreign demand. Even at the current stage of European integration and in spite of the presence of global value chains, the contribution of foreign demand to domestic income and employment in Southern Europe remains

[13]To assess the prospect of internal devaluation, O'Rourke and Taylor (2013) turn to the examination of the historical record of the gold standard, and they conclude that there was less need for external adjustment in the first place, and when it was required, adjustment was achieved through other channels, including the devaluation of the exchange rate in peripheral countries. Shambaugh (2012) turns to more recent history and finds only three episodes that qualify as internal devaluation in a low-inflation environment, all associated with a severe contraction and high unemployment. It remains unclear to what degree these current account reversals can be attributed to relative price adjustment or simply to a compression of import demand. The internal devaluation strategy has few successful precursors, if any. Schröder (2016) shows that there is no correlation between unit labour cost growth and expenditure switching in the euro area in the period 1999–2007; he argues that reforms that aim at a reversal of the unit labour cost divergence should not be regarded as expenditure-switching policies.

rather small. The contribution of Germany's final demand is smaller still, for Germany is merely one trading partner among many.

Rebalancing in accordance with the European Commission's Macroeconomic Imbalance Procedure relies on relatively modest fiscal action in Germany and other surplus countries aimed at stimulating domestic investment, while growth in Southern Europe is supposed to come from the positive spillover effects thereof, and from the implementation of market-conforming structural reforms in labour and product markets (EC, 2015). Since the presumed benefits of market-conforming structural reforms certainly do not include a short-run expansion of domestic demand, it is clear that this strategy depends heavily on the real-interest-rate elasticity of the representative agent to generate domestic demand in the south. It may be worthwhile to complement the strategy with reforms of the European fiscal policy straight-jacket, which would open up more direct avenues towards the stimulation of domestic demand in the south. The introduction of a "Golden Rule of Public Investment" (Musgrave, 1939, 1959), which would exclude net public investment expenditure from balanced-budget rules, represents one possible escape route from the complex web of national and European procedures that constrain fiscal policy (Feigl & Truger, 2015; Truger, 2015). The spillovers from a simultaneous expansion in the north and the strong trade ties among the Southern European economies would at least help to contain the adverse trade balance effects.

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REFERENCES

Aghion, P., Boulanger, J., & Cohen, E. (2011). *Rethinking industrial policy*. Bruegel: Policy Brief 566. http://bruegel.org/2011/06/rethinking-industrial-policy/

Aiginger, K. (2013). A Southern Europe strategy based on vision and industrial policy. *EKONOMIAZ*, *82*(01), 127–168.

Baldwin, R., & Lopez-Gonzalez, J. (2014). Supply-chain trade: A portrait of global patterns and several testable hypotheses. *The World Economy*, *38*(11), 1–40.

BMWi (2015a). Auswirkungen höherer öffentlicher Investitionen in Deutschland auf die Wirtschaft des Euroraums - Ergebnisse modellgestützter Simulationen. Schlaglichter der Wirtschaftspolitik 7-2015, Bundesministerium für Wirtschaft und Energie. https://www.bmwi.de/Redaktion/DE/Downloads/Monatsbericht/07-2015-auwirkungen-oeffentlicher-investitionen.html

BMWi (2015b). Staerkung von Investitionen in Deutschland. Expert Commission's Report on Increasing Investment in Germany, Federal Ministry for Economic Affairs and Energy. http://www.bmwi.de/DE/Mediathek/publikationen,did=702188.html

Bundesbank (2010). On the problems of macroeconomic imbalances in the euro area. Monthly Report 62(7). Deutsche Bundesbank. https://www.bundesbank.de/Redaktion/EN/Downloads/Publications/Monthly_Report_Articles/2010/2010_07_macroeconomic_imbalances.pdf

Bundesbank (2016). The international spillover effects of an expansion of public investment in Germany. Monthly Report Vol. 68 No. 8, Deutsche Bundesbank. https://www.bundesbank.de/Redaktion/EN/Downloads/Publications/Monthly_Report/2016/2016_08_monthly_report.pdf

Bussiere, M., Callegari, G., Ghironi, F., Sestieri, G., & Yamano, N. (2013). Estimating trade elasticities: demand composition and the trade collapse of 2008–2009. *American Economic Journal: Macroeconomics*, *5*(3), 118–151.

EC (2012). Current account surpluses in the EU. European Economy 9/2012. European Commission, Directorate-General for Economic and Financial Affairs. http://ec.europa.eu/economy_finance/publications/european_economy/2012/pdf/ee-2012-9_en.pdf

EC (2015). *Macroeconomic imbalances. Main findings of the in-depth reviews 2015*. European Economy - Occasional Paper 228, European Commission, Directorate General Economic and Financial Affairs. http://ec.europa.eu/economy_finance/publications/occasional_paper/2015/op228_en.htm

Ederer, S., & Reschenhofer, P. (2016). *Growth patterns and trade imbalances in the EMU. A global value chain analysis* (Working Paper 509). Vienna, Austria: Austrian Institute of Economic Research (WIFO). Retrieved from http://www.foreurope.eu/fileadmin/documents/pdf/Workingpapers/WWWforEurope_WPS_no067_MS221.pdf

Elekdag, S., & Muir, D. (2014). *Das public Kapital: How much would higher German public investment help Germany and the euro area?* (Working Paper WP/14/227). Washington, DC, USA: International Monetary Fund. https://www.imf.org/external/pubs/cat/longres.aspx?sk=42533.0

Feigl, G., & Truger, A. (2015). *The golden rule of public investment: Protecting fiscal leeway and public infrastructure in the EU*. Policy Brief 12, European Trade Union Institute ETUI. http://www.etui.org/Publications2/Policy-Briefs/European-Economic-Employment-and-Social-Policy/The-Golden-Rule-of-Public-Investment-protecting-fiscal-leeway-and-public-infrastructure-in-the-EU

Foster, N., Stehrer, R., & Timmer, M. (2013). *International fragmentation of production, trade and growth: Impacts and prospects for EU member states*. European Economy - Economic Paper 484, European Commission, Directorate-General for Economic and Financial Affairs. http://ec.europa.eu/economy_finance/publications/economic_paper/2013/ecp484_en.htm

Garbellini, N., Marelli, E., & Wirkierman, A. L. (2014). Domestic demand and global production in the Eurozone: a multi-regional input-output assessment of the global crisis. *International Review of Applied Economics*, *28*(3), 335–363.

IMF (2015a). Germany: 2015 Article IV Consultation. Country Report 15/187, International Monetary Fund. https://www.imf.org/external/pubs/ft/scr/2015/cr15187.pdf

IMF (2015b). Germany: 2015 selected issues. Country Report 15/188, International Monetary Fund. https://www.imf.org/external/pubs/ft/scr/2015/cr15188.pdf

Johnson, H. G. (1958). Towards a General Theory of the Balance of Payments. In H. G. Johnson (Ed.), *International trade and economic growth* (pp. 153–168). Sydney, Australia: Unwin Books.

Joshi, V., & Skidelsky, R. (2010). Keynes, Global Imbalances, and International Monetary Reform, Today. In S. Claessens, S. Evenett, & B. M. Hoekman (Eds.), *Rebalancing the global economy: A primer for policymaking* (pp. 173–180). London, UK: Centre for Economic Policy Research..

Kennedy, C., & Thirlwall, A. P. (1979). The input–output formulation of the foreign trade multiplier. *Australian Economic Papers*, *18*(32), 173. https://doi.org/10.1111/j.1467-8454.1979.tb00654.x

Leontief, W. (1986). *Input-output economics*. New York, NY: Oxford University Press.

Mazzucato, M., Cimoli, M., Dosi, G., Stiglitz, J. E., Landesmann, M. A., Pianta, M., … Page, T. (2015). Which industrial policy does Europe need? *Intereconomics*, *50*(3), 120–155. https://doi.org/10.1007/s10272-015-0535-1

Miller, R. E., & Blair, P. D. (2009). *Input-output analysis: Foundations and extensions*. Cambridge, UK: Cambridge University Press. https://doi.org/10.1017/CBO9780511626982

Musgrave, R. A. (1939). The nature of budgetary balance and the case for the capital budget. *The American Economic Review*, *29*(2), 260–271.

Musgrave, R. A. (1959). *The theory of public finance: A study in public economy*. New York, NY: McGraw-Hill.

O'Rourke, K. H., & Taylor, A. M. (2013). Cross of Euros. *Journal of Economic Perspectives*, *27*(3), 167–192. https://doi.org/10.1257/jep.27.3.167

Rodrik, D. (2014). Green industrial policy. *Oxford Review of Economic Policy*, *30*(3), 469–491. https://doi.org/10.1093/oxrep/gru025

Schröder, E. (2016). *Euro area imbalances: Measuring the contribution of expenditure growth and expenditure switching* (Working Paper 1604). New York, NY: New School for Social Research, Department of Economics. Retrieved from http://www.economicpolicyresearch.org/econ/2016/NSSR_WP_042016.pdf

Shambaugh, J. C. (2012). The Euro's three crises. *Brookings Papers on Economic Activity*, *2012*, 157–231. https://doi.org/10.1353/eca.2012.0006

Stehrer, R. (2013). *Accounting relations in bilateral value added trade* (wiiw Working Paper 101). Vienna, Austria: The Vienna Institute for International Economic Studies, wwi. https://wiiw.ac.at/accounting-relations-in-bilateral-value-added-trade-dlp-3021.pdf

Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R., & de Vries, G. J. (2015). An illustrated user guide to the World Input-Output Database: The case of global automotive production. *Review of International Economics*, *23*(3), 575–605. https://doi.org/10.1111/roie.12178

Tressel, T., Wang, S., Kang, J. S., Shambaugh, J. C., Decressin, J., & Brooks, P. K. (2014). *Adjustment in euro area deficit countries: Progress, challenges, and policies* (IMF Staff Discussion Notes 14/7). International Monetary Fund. https://www.imf.org/external/pubs/ft/sdn/2014/sdn1407.pdf

Truger, A. (2015). *Implementing the golden rule for public investment in Europe: Safeguarding public investment and supporting the recovery* (WWWforEurope Policy Paper 22). WWWforEurope. Retrieved from http://www.foreurope.eu/fileadmin/documents/pdf/PolicyPapers/WWWforEurope_Policy_Paper_022.pdf

in't Veld, J. (2013). Fiscal consolidations and spillovers in the euro area periphery and core. European Economy - Economic Paper 506, European Commission, Directorate General Economic and Financial Affairs. http://ec.europa.eu/economy_finance/publications/economic_paper/2013/pdf/ecp506_en.pdf

in't Veld, J. (2017). A public investment stimulus in surplus countries and its spillovers in the EA. *National Institute Economic Review*, *239*(1), R53–R62. https://doi.org/10.1177/002795011723900113

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APPENDIX A

THE CLOSED MULTICOUNTRY INPUT–OUTPUT MODEL

This section introduces our notation for the multiregional input–output model and describes how the model translates exogenous increases in final demand in country r into effects on GDP, employment and the trade balance in country s.[14] The accounting equation $\mathbf{x} = \mathbf{Z}\,\mathbf{i} + \mathbf{f}$ summarises the relation between the gross output vector $\mathbf{x}$, the multiregional interindustry flow matrix $\mathbf{Z}$ and the world final demand vector $\mathbf{f}$. All vectors are column vectors. $i = 1, 2, \ldots, n$ indexes industries and $r = 1, 2, \ldots, m$ indexes countries. The gross output vector $\mathbf{x}$ and the world final demand vector $\mathbf{f}$ have length $n \times m$. The interindustry flow matrix $\mathbf{Z}$ has the dimension $(n \times m) \times (n \times m)$. In the WIOD $n = 35$ and $m = 41$, so that $n \times m = 1{,}435$. $\mathbf{i}$ denotes a column vector of ones with the appropriate length.

The multiregional input coefficient matrix is defined as $\mathbf{A} = \mathbf{Z}\,\hat{\mathbf{x}}^{-1}$. The hat denotes a diagonal matrix, and the superscript -1 denotes the inverse of a matrix. Hence, $\hat{\mathbf{x}}^{-1}$ is a diagonal matrix with the inverted elements of the gross output vector on the main diagonal and zeros elsewhere. The input coefficient matrix $\mathbf{A}$, the Leontief inverse $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$ and the identity matrix $\mathbf{I}$ have the dimension $(n \times m) \times (n \times m)$. The Leontief inverse converts final demands into gross output requirements: $\mathbf{x} = \mathbf{L}\,\mathbf{f}$.

The world final demand vector $\mathbf{f}$ is the sum over the country final demand vectors, that is, $\mathbf{f} = \sum_{r=1}^{m} \mathbf{f}^r$. The column sum of $\mathbf{f}^r$ gives the demand by end-users in country r for output from all industries in all countries, that is, country r's total final demand: $f^r = \mathbf{i}'\,\mathbf{f}^r$. A country final demand vector can be decomposed into the *size* and the *composition* of final demand. Dividing each element of $\mathbf{f}^r$ by the country's total final demand f^r gives the final demand composition of country r:

$$\mathbf{sf}^r = \mathbf{f}^r \div f^r. \tag{A1}$$

The elements of $\mathbf{sf}^r$ represent the share (in country r's total final demand) of final demand by end-users in country r for the output of industry i in country s. In practice, the lion's share of a country's

[14]The MATLAB code, which documents every step from reading the source data to computing the results, is available from the authors upon request.

total final demand represents purchases of output from producers in the n domestic industries, and a smaller share represents purchases from producers in the $n \times (m-1)$ foreign industries.

A country final demand vector is the sum of private consumption, public consumption and investment vectors: $\mathbf{f}^r = \mathbf{c}^r + \mathbf{g}^r + \mathbf{k}^r$. The demand composition obviously varies across these demand categories. $\mathbf{sc}^r = \mathbf{c}^r \div c^r$ gives the composition of private consumption in country r, where $c^r = \mathbf{i}' \mathbf{c}^r$ is total private consumption in country r. The composition of public consumption $\mathbf{sg}^r$ and the composition of investment $\mathbf{sk}^r$ can be computed in analogous fashion.

Predicted Spillover Effects

The predicted spillover effect of country r's final demand on the GDP of country s is:

$$\Delta v^{sr}/v^s \times 100 = (\mathbf{v}^{s0})' \,\bar{\mathbf{L}}\,\mathbf{sf}^r \times v^r/v^s, \tag{A2}$$

where $\bar{\mathbf{L}}$ is the truncated Leontief inverse of the closed model, $\mathbf{sf}^r$ is the final demand composition of country r, v^r is total value added of country r, and v^s is total value added of country s.
$\mathbf{v}^{s0}$ is a vector of length $n \times m$; the elements that correspond to country s represent the value-added coefficients of country s (industry value added divided by industry gross output), and all other elements are zero. This vector essentially counts the value added generated in s and ignores the value added in all other countries. Equation (A2) gives the predicted percentage change in value added in country s generated by an exogenous increase in final demand in country r, where the exogenous increase is scaled to one percent of country r's value added.

To aid interpretation, observe that:

$$VAX^s = (\mathbf{v}^{s0})' \,\mathbf{L}\,\mathbf{f}, \tag{A3}$$

are the *value-added exports* of country s as defined in Stehrer (2013). A country's value-added exports represent the income generated in the country by final demand in the rest of the world. We are however interested in the income generated in the country by the final demand of a single trading partner. Hence on the right-hand side of Equation (A2) there appears the country final demand vector $\mathbf{f}^r$, as opposed to the world final demand vector $\mathbf{f}$. The final demand vector is then decomposed into composition and scale; we use value-added v^r as scale variable and not final demand f^r in order to facilitate the comparison of results with other studies. WE are interested in percentage changes and not absolute changes, therefore the division by v^s. Furthermore, we count not only the direct and indirect effects of final demand on income but also the induced effects that arise as a result of the endogenisation of private consumption and investment. Hence, the truncated Leontief inverse of the closed model $\bar{\mathbf{L}}$ replaces the Leontief inverse of the open model $\mathbf{L}$.

The predicted spillover effect of country r's final demand on employment in country s is:

$$\Delta e^{sr}/CLF^s \times 100 = (\mathbf{e}^{s0})' \,\bar{\mathbf{L}}\,\mathbf{sf}^r \times v^r/CLF^s, \tag{A4}$$

where CLF^s is the civilian labour force of country s. $\mathbf{e}^{s0}$ is a vector of length $n \times m$; the elements that correspond to country s represent the employment coefficients of country s (industry employment divided by industry gross output), and all other elements are zero. This vector essentially counts the employment generated in s and ignores the employment in all other countries. Equation (A4) gives the predicted change in employment in country s generated by an exogenous increase in final demand in country r, where the exogenous increase is scaled to one percent of country r's value added. The employment effect is expressed in percent of the civilian labour force; under the assumption that the labour force remains constant, it represents a percentage point reduction in the unemployment rate.

The Closed Model

Basic consumption theory predicts that higher household income causes higher consumption spending. A final demand shock will initiate additional production; additional production will require more labour input; the higher demand for labour services will increase labour income; and this will increase the amounts spent by households on consumption. In input–output economics, the endogenisation of household consumption is known as closing the model with respect to households.

The model is closed by expanding the interindustry flow matrix of the open model.[15] The input–output model closed with respect to households regards the household sector as an additional industry; it effectively treats wages and salaries as the "output" of the household sector, and household consumption as the "input" to the household sector. In a multiregional model, there is one additional "industry" per country, so the expanded interindustry flow matrix $\tilde{\mathbf{A}}$ has the dimension $(n+1)\cdot m \times (n+1)\cdot m$, and the expanded gross output vector $\tilde{\mathbf{x}}$ has length $(n+1)\times m$.

The input–output model closed with respect to (households and) firms regards the corporate sector as an additional industry; it effectively treats profits as the "output" of the corporate sector, and corporate investment as the "input" to the corporate sector. In a multiregional model, there are two additional "industries" per country (household and corporate sector), so the expanded interindustry flow matrix $\tilde{\mathbf{A}}$ has the dimension $(n+2)\cdot m \times (n+2)\cdot m$, and the expanded gross output vector $\tilde{\mathbf{x}}$ has length $(n+2)\times m$.

The Leontief inverse of the closed model(s) is $\tilde{\mathbf{L}} = (\mathbf{I} - \tilde{\mathbf{A}})^{-1}$. The *truncated* Leontief inverse $\bar{\mathbf{L}}$ is a submatrix of $\tilde{\mathbf{L}}$. The additional input columns and output rows are removed from $\tilde{\mathbf{L}}$; the truncated Leontief inverse has dimension $(n \times m) \times (n \times m)$ and contains only the elements that correspond to the original industries.

Trade Balance

We compute the trade balance of country 1 as the difference between a country's value added and final demand divided by value added: $(v^1 - f^1)/v^1 \times 100$. The trade balance computed from the WIOTs however does not coincide with the trade balance reported in the national accounts. The difference is non-negligible, and it exists for two reasons. First, the WIOTs report all flows in basic prices, whereas the national accounts report flows in purchaser's prices. Second, the WIOTs report flows on the basis of the "territory principle": final consumption by industry captures consumption expenditures within the domestic market. The trade balance that is of interest to us and that is reported in balance of payments statistics follows the "residency principle": it is supposed to measure transactions between residents and non-residents. Tourism implies that residents purchase goods and services abroad and nonresidents purchase goods and services on domestic territory.

The WIOTs report "taxes less subsidies on products" and "international transport margins" on the industry-level (giving the wedge between basic and purchaser's prices) and "direct purchases abroad by residents" and "purchases on the domestic territory by non-residents" by country (giving the wedge between territory and residency principle). Using this information, it is straightforward to compute the *actual* trade balance in any given year in purchaser's prices according to the

[15] Miller and Blair (2009) describe the procedure of closing input–output models in greater detail.

residency principle. To compute the *hypothetical* trade balance after the exogenous final demand shock, it is necessary to predict the changes in taxes less subsidies, transport margins and tourism expenditures. In all cases, we impose proportional changes. For instance, direct purchases abroad by Germany's residents increase in proportion to Germany's final demand, and purchases on the domestic territory by non-residents increase in proportion to world final demand excluding Germany's final demand.[16]

APPENDIX B

TEMPORAL STABILITY

Recall that the spillover effect of an increase in final demand in country $r = 2$ (e.g., Germany) on value added in country $s = 1$ (e.g., Spain) is calculated as:

$$\Delta v_t^{12}/v_t^1 \times 100 = \underbrace{(\mathbf{v}_t^{s0})' \bar{\mathbf{L}}_t}_{\text{Economic structure}} \overbrace{\mathbf{sf}_t^2}^{\text{Final demand composition}} \times \underbrace{v_t^2/v_t^1}_{\text{Relative size}} . \tag{A5}$$

The equation gives the percentage change in value added in country $s = 1$ generated by an exogenous increase in final demand in country $r = 2$. Δv^{12} is the predicted change in value added in country 1, v^1 and v^2 the level of value added in country 1 and country 2, $\bar{\mathbf{L}}$ the truncated Leontief inverse of the endogenous-consumption model, and $\mathbf{sf}^2$ the final demand composition of country 2. $\mathbf{v}^{s0}$ is a vector of length $n \times m$; the elements that correspond to country s represent the value-added coefficients of country s (industry value added divided by industry gross output), and all other elements are zero. The results reported in the body of the paper are based on the latest available data from 2009; here, the elements that make up the predicted spillover effect carry a time index $t = 1995, \ldots, 2009$. The first two elements on the right-hand side of the equation, $(\mathbf{v}_t^{s0})' \bar{\mathbf{L}}_t$, jointly represent what we term *economic structure*. The last two elements on the right-hand side, v^2/v^1, represent what we term *relative size* (the ratio of value added in country 2 to value added in country 1).

We can isolate the effect of the temporal variation in the economic structure by letting the economic structure vary over time $t = 1995, \ldots, 2009$, while holding the other elements constant at $t = 2009$. Analogously, we can isolate the effect of the temporal variation in the final demand composition by letting the final demand composition vary over time, while holding the other elements constant. Finally, we can isolate the effect of the temporal variation in the relative size of the economies by letting the relative size vary over time, while holding the other elements constant. Figure A1 shows the outcome of this exercise. The black-solid line visualises the predictions summarised in Table 2: economic structure, final demand composition and relative size jointly take on time-varying values. The grey-solid line represents the spillover effects that result from time-varying relative size while holding constant the world economy's economic structure and Germany's final demand composition. The dashed lines are defined analogously and should be self-explanatory.

It can be observed that spillover effects do change over time, but change is fairly gradual, and sharp jumps from one year to the next are the exception. Spillover effects decline everywhere except in Austria, where the black-solid line shows no downward trend. Germany's ability to play

[16]Details can be found in the MATLAB code, which is available upon request.

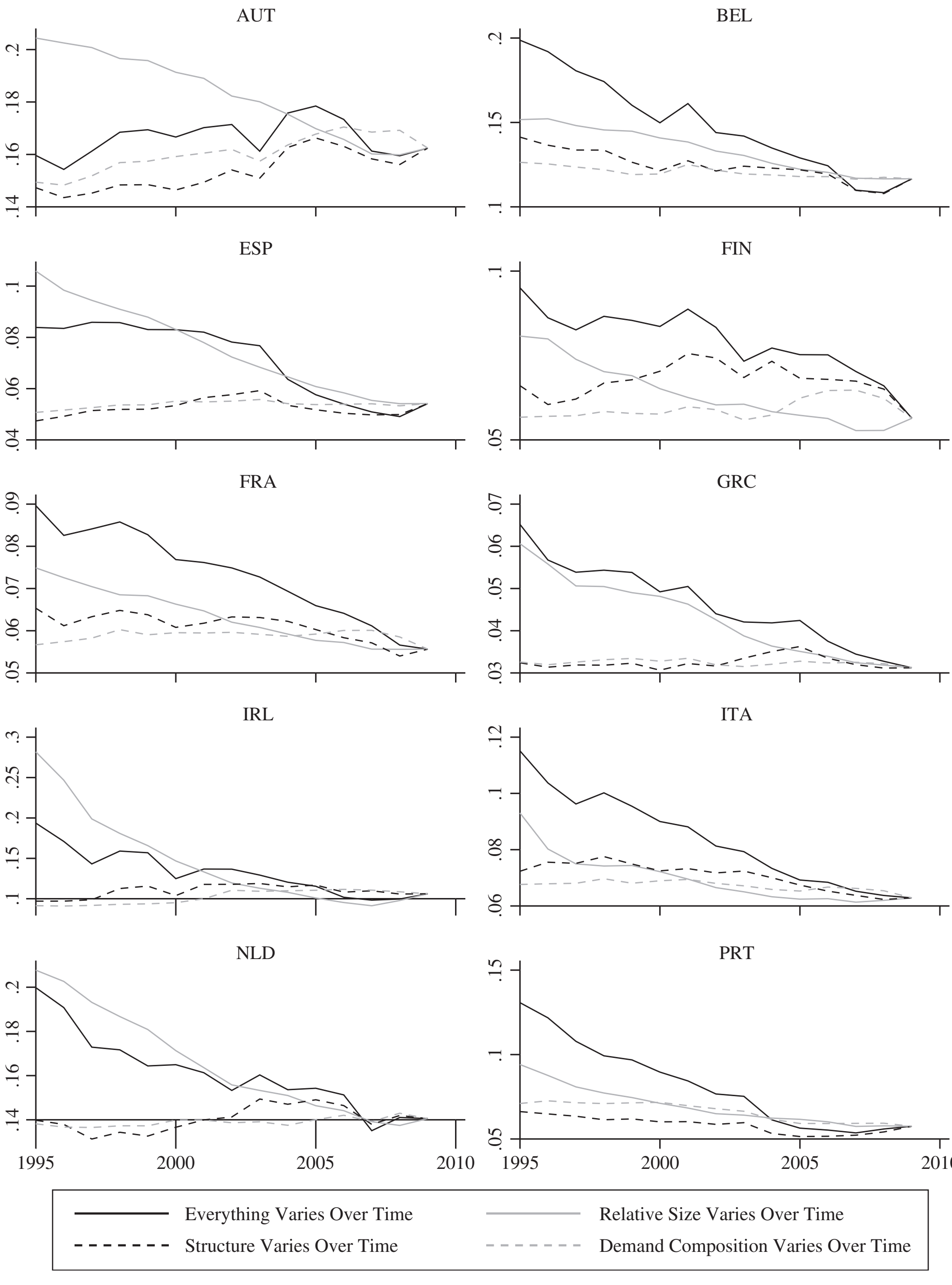

FIGURE A1 Temporal stability of spillover effects.

Notes: The black-solid line represents the spillover effects computed with economic structure, final demand composition and relative size from $t = 1995, \ldots, 2009$. The grey-solid line represents the spillover effects computed with time-varying relative size while all other elements take on 2009 values. The black-dashed line represents the spillover effects computed with time-varying economic structure while all other elements take on 2009 values. The grey-dashed line represents the spillover effects computed with time-varying final demand composition while all other elements take on 2009 values. The *y*-axis scales are country-specific. Details in Appendix B.

a locomotive role for the euro area was greater in 1995 than it was in 2009 and probably is today. The main point that we wish to emphasise is this one: change in the world economy's structure and Germany's final demand composition does not account for the decline of spillover effects in most countries—relative size does. In most cases, the dashed lines (reflecting change in structure and composition) are relatively flat in comparison with the grey-solid line (reflecting change in relative size). The proximity of the solid lines to each other indicates that spillover effects declined over time largely because the size of Germany's economy declined relative to the size of other euro area economies. Germany is less able to play the locomotive role today simply because the German economy has shrunk in relative terms.

The global crisis and the associated collapse of demand in Southern Europe partly reversed the change in relative size that occurred during Germany's "sick-man period" (1995–2005). From 2009 to 2014, Germany's final demand increased from 2,366 to 2,741 billion euros while for instance Spain's GDP decreased from 1,079 to 1,041 billion euros. The ratio of Germany's final demand to Spain's GDP increased by 20%. This fact suggests that the 2014 spillover effect of Germany's final demand on Spain's GDP can be expected to be about 20% higher than reported in our tables and figures, which are based on 2009 values.

To repeat, the spillover effects are stable in spite of the observed changes in the world economy's structure and Germany's final demand composition from 1995 to 2009 (a 15-year period). We can state with reasonable confidence that the unobserved behavioural and structural change that certainly did occur since 2009 does not substantially challenge our results.

APPENDIX C

AUXILIARY DATA SOURCES

Bundesbank: Germany's trade in goods and services in euros from the section "Current account by country and group of countries."[17]
AMECO: Civilian labour force (variable code NLCN), GDP at current market prices (UVGD), and final domestic demand excluding inventories at current prices (UUNF).[18]
Bundesagentur für Arbeit: Unemployment rate and underemployment rate from the section "Arbeitsmarkt im Überblick - Die aktuellen Entwicklungen in Kürze."[19]
OECD: Inflation (CPI) and inflation forecast.[20]

[17] http://www.bundesbank.de/Navigation/EN/Statistics/statistics.html (accessed on 15 August 2015).

[18] http://ec.europa.eu/economy_finance/db_indicators/ameco/index_en.htm (accessed on August 15, 2015).

[19] http://statistik.arbeitsagentur.de/Navigation/Statistik/Statistik-nach-Themen/Arbeitsmarkt-im-Ueberblick/Arbeitsmarkt-im-Ueberblick-Nav.html (accessed on March 17, 2017).

[20] https://data.oecd.org/price/inflation-cpi.htm and https://data.oecd.org/price/inflation-forecast.htm (accessed on March 17, 2017).