

Šváb, Patrik

**Article**

## Two-country DSGE modelling of the euro area: A systematic literature review

World Economy and Policy (WEP)

**Provided in Cooperation with:**

Prague University of Economics and Business, Faculty of International Relations (FIR)

*Suggested Citation:* Šváb, Patrik (2024) : Two-country DSGE modelling of the euro area: A systematic literature review, World Economy and Policy (WEP), ISSN 2788-0672, Prague University of Economics and Business, Faculty of International Relations, Center for European Studies, Prague, Vol. 3, Iss. 1, pp. 1-9

This Version is available at:

<https://hdl.handle.net/10419/297898>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



<https://creativecommons.org/licenses/by/4.0/>

# TWO-COUNTRY DSGE MODELLING OF THE EURO AREA: A SYSTEMATIC LITERATURE REVIEW

---

**Patrik Šváb**

---

## **Abstract**

This paper reviews the application of two-country Dynamic Stochastic General Equilibrium (DSGE) models in the case of the euro area. By employing a search strategy across Scopus and Web of Science databases, this review identifies “Key Papers” that develop, calibrate, or estimate DSGE models for the euro area and another European country as the second block. There is a particular focus on the gains and losses from the euro adoption to provide a benchmark for a potential future research on the case of the Czech Republic. Out of all the analysed papers, four deal with the welfare consequences of the euro adoption, out of which none concerns the Czech Republic. Thus, developing such model in the future might fill the knowledge gap.

## **Key Words**

Two-Country DSGE, Literature Review, Euro Area, Czech Republic, Welfare

## **Introduction**

Countries that have entered the European Union, including the Czech Republic, should eventually adopt the common currency, the euro. Such a decision needs to be evaluated as an ex-ante policy measure. As the event has not happen yet, no data about the result is available and it is more appropriate to use the macroeconomic modelling approach. Dynamic Stochastic General Equilibrium (DSGE) models have been a macroeconomic modelling workhorse commonly applied by scholars and policy makers.

An important shift in the macroeconomic modelling history was triggered by Lucas (1976), who claimed in his famous critique that it was misleading to predict outcomes of any economic policy changes solely based on historical data. It motivated economists to incorporate microeconomic foundations into macroeconomic models. The 1980s were marked by the influential paper by Kydland and Prescott (1982) who introduced Real Business Cycle (RBC) models. These models emphasized technology shocks as the primary driver of economic fluctuations. They, however, did not include any room for an efficient monetary policy. As a response, New Keynesian models emerged in 1990s and introduced imperfections in form of price stickiness, imperfect competition and other features to extend the work of the neoclassical school. Although the early RBC models already included DSGE properties, models the with New Keynesian features are widely considered to be the modern DSGE models. Important models used as a baseline for DSGE open economy modelling until today were developed by Smets and Wouters (2003) and Galí and Monacelli (2005).

The following text reviews papers that use “two-country DSGE” modeling for the case of the euro area. The syntax “*DSGE*” AND “*Two-country*” AND “*Euro*” was applied to conduct

an extensive research in databases *Scopus* and *Web of Science*. All academic papers in these databases, which either develop and calibrate or estimate a model for the euro area and another European country, were identified as “Key Papers.” They deal with models for countries that already are or potentially can become members of the EMU. These are analysed in broader detail. The aim of the review is to map to which extent has the literature covered the problem of the common currency adoption through DSGE modelling, with a particular focus on the gains and losses from the euro adoption and the example of the Czech Republic. It will be identified if there is a room for developing such model in the future to fill the knowledge gap.

## Literature Review

Papers that are key for reviewing previous empirical investigation in the field of “two-country DSGE” modelling for the euro area are listed in Table 1, including the countries they were applied for and notes about further details. Particular emphasis is given to papers that include welfare calculations of gains and losses from the potential EMU accession. Next, this paper aims to investigate which other topics are tackled by these “two-country DSGE” analyses, which topics became the main focal points over time, and how many of these articles cover the Czech Republic and its neighbouring (similar) economies.

**Pytlarczyk (2005)** reacted to a starting expansion of DSGE models at that time and tried to apply the new approach to a model for the European Monetary Union. Contrary to the vast majority of DSGE models then, he builds one of the first two-region models for the EMU. He assumes a significant structural heterogeneity between Germany and the rest of the EMU, which explains the necessity of building a two-region (two-country) model. This model is modified by **Senaj et al. (2010)**. They created and estimated a two-country model for Slovakia and the rest of the euro area (“MUSE model”) that allows switching between the two monetary regimes (own monetary policy vs. common monetary policy). It incorporates standard features such as external habit formation, investment adjustment costs, sticky prices and wages, and flexible capital utilisation.

Similarly, **Breuss and Rabitsch (2009)** build a two-country DSGE model for Austria. They find out that Austrian variables are significantly more driven by demand shocks, whereas supply shocks prevail in the euro area. This observation particularly holds for output. In addition, they analyse the effect of the monetary regime switch with the EMU’s final stage and confirm the assumption that the transmission of shocks originating in the rest of the euro area is stronger under the monetary union.

**Kolasa (2009)** introduces a two-country model for Poland to assess the degree of structural heterogeneity and the asymmetry of shocks with respect to the euro area. It is considered a step toward estimating the costs of Poland’s entry to the European Monetary Union. On the one hand, this study does not bring any significant conclusions about the differences in parameters describing the behaviour of agents in Poland and the euro area. On the other hand, there is strong evidence for heterogeneity in terms of volatility (significantly higher volatility in Poland) and synchronization of shocks affecting both economies (structural shocks are rather weakly correlated). Regarding the monetary policy rules, interest rate smoothing seems more important in the euro area.

**Table 1: Key Papers**

Name	Authors	Year	Country	Note
An Estimated DSGE Model for the German Economy within the Euro Area	Pytlarczyk	2005	Germany	
An Estimated Two-Country DSGE Model of Austria and the Euro Area	Breuss, Rabitsch	2009	Austria	
BEMOD: a DSGE Model for the Spanish Economy and the Rest of the Euro Area	Andrés et al.	2006	Spain	
Business Cycle Synchronization through the Lens of a DSGE Model	Slanicay	2013	Czech Republic	
Coordinating Macroprudential Policies within the Euro Area: the case of Spain	Carrasco-Gallego, Rubio	2016	Spain	Macroprudential policies coordination
<b>Deciding to Enter a Monetary Union: The role of Trade and Financial Linkages</b>	<b>Lama, Rabanal</b>	<b>2012</b>	<b>United Kingdom</b>	<b>Welfare gains and losses, trade, and financial linkages</b>
FiMod – a DSGE Model for Fiscal Policy Simulations	Stähler, Thomas	2011	Spain	Fiscal policy simulation
German Labor Market and Fiscal Reforms 1999 to 2008: Can They Be Blamed for Intra-Euro Area Imbalances?	Gadatsch et al.	2015	Germany	German labour market and fiscal reform
Inflation – the Harrod-Balassa-Samuelson Effect in a DSGE Model Setting	Lenarčič	2019	Slovenia	Harrod-Balassa-Samuelson effect
Inflation Differentials between Spain and the EMU: A DSGE Perspective	Rabanal	2009	Spain	Inflation differentials
<b>Losses from Membership in EMU: an Estimated Two-Country DSGE Model</b>	<b>Moons</b>	<b>2013</b>	<b>United Kingdom</b>	<b>Welfare gains and losses, trade, and financial linkages</b>
Macroeconomic and Financial Stability in a Monetary Union: The Case of Lithuania	Comunale, Rubio	2017	Lithuania	
MUSE: Monetary Union and Slovak Economy Model	Senaj et al.	2010	Slovakia	
<b>Spain in the Euro: A General Equilibrium Analysis</b>	<b>Andrés et al.</b>	<b>2010</b>	<b>Spain</b>	
Structural Heterogeneity or Asymmetric Shocks? Poland and the Euro Area through the Lens of a Two-Country DSGE Model	Kolasa	2009	Poland	
Tax Reform and Coordination in a Currency Union	Carton	2012	Germany	Labour tax, German labour market reforms
<b>The Business Cycle Implications of the Euro Adoption in Poland</b>	<b>Gradzewicz, Makarski</b>	<b>2013</b>	<b>Poland</b>	<b>Welfare gains and losses</b>

Source: Own adaptation

**Slanicay (2013)** estimates a DSGE model according to Kolasa (2009) to examine the business cycle synchronization of the Czech Republic and the euro area. As a result, he observes that productivity shocks in the tradable sector are the driving forces of different business cycle behaviour. He finds interest rate the most critical variable of the analysis since the impact of shocks on this variable is highly correlated between the CR and the EA. As far as the convergence of business cycles is concerned, we can observe convergence in the case of consumption, investment, and output, as the overall impact of shocks on these variables is getting more and more symmetric over time. On the other hand, there seems to be no evidence for convergence in the case of inflation and interest rates. Finally, among other observations, monetary policy shocks play a much more critical role in explaining the development of the main macroeconomic variables in the euro area than in the Czech economy. This can be explained by the fact that the monetary policy of the ECB is more discretionary.

**Stähler and Thomas (2011)** aim to construct a DSGE model for fiscal policy simulations (“FiMod”) that could be calibrated for any euro area member (being calibrated for Spain in this case). The specific property of this model is the degree of disaggregation level of government expenditures. They distinguish between productivity-enhancing public investment, public purchases, and the public sector wage bill. Different fiscal coordination scenarios are analysed with respect to the damage caused to the economy in terms of output and employment losses. Cuts in public investment are the least desirable way of performing fiscal consolidation. Similarly, cuts in public purchases are relatively harmful in the short run. In contrast, reductions in public sector wages or employment have positive spillover effects on the private sector.

FiMod is extended and calibrated for Germany by **Gadatsch et al. (2015)** to evaluate the impact of structural reforms (mainly the Hartz labour market reforms) on key macroeconomic variables. The model shows that the reforms were successful in terms of the impact on German GDP, consumption, investment, and (un)employment. The impact on the trade balance and current account was only minor. Moreover, the rest of the euro area benefited from positive spillover effects. Therefore, according to the authors, these reforms are not responsible for macroeconomic imbalances within the euro area, which was frequently claimed.

The impact of structural reforms in Germany is similarly analyzed in **Carton (2012)**, focusing on tax reforms in this case. Within the framework of a two-country DSGE model, the author evaluates the short-term and long-term impact of the change in the consumption and labour tax rate (shifting taxation from labour to consumption). As a result, for a constant total amount of taxation, the effect on GDP and welfare is positive in the long run (the welfare is measured by an equivalent variation of consumption during one year). In the short run, the monetary union seems to enhance the short-term positive impact of wage tax cuts and lower the negative impact of consumption tax increases.

**Rabanal (2009)** constructs a two-country DSGE model to study sources of inflation differentials between the euro area and Spain. The paper contrasts the common hypotheses for the inflation differentials explanation. Most importantly, the author finds that tradable and non-tradable sector technology shocks are the most important sources, explaining about 75% of the variability. Demand shocks play a minor role in inflation differences explanation; they explain the output growth variability instead. Furthermore, substantial inflation dynamics heterogeneity exists in Spain and the euro area.

**Lenarčič (2019)** extends the Rabanal (2009) model to build a theoretical concept for the Harrod-Balassa-Samuelson effect. They introduce a quality improvement mechanism that explains why prices grow when productivity increases (the quality improvement mechanism affects marginal costs since it requires the use of more advanced inputs in the production process). Both the calibrated and the estimated model version show the presence of the Harrod-Balassa-Samuelson effect. However, the effect itself is not large enough to pose significant risks to central banks' price stability goals.

As a part of an extensive project to develop and estimate a DSGE model of the Spanish economy for Banco de España, **Andrés et al. (2006)** prepare a theoretical framework for a model consisting of Spain, the rest of the euro area, and the rest of the world. After conducting an asymmetric calibration, they observe differences in the magnitude of the impact of shocks, with a more considerable impact on output in Spain and inflation in the rest of the euro area. This is because Spain is more open than the rest of the euro area and the weight of Spain in the Taylor rule of the euro area is small, which allows for more significant deviations from the target in Spain. Bayesian estimation is a part of a future contribution (**Andrés et al., 2010**). The authors explain in this paper the determinants of Spain's macroeconomic fluctuations after euro adoption by asymmetric country-specific shocks (demand and productivity shocks for growth and cost-push shocks for inflation) and economic structure (lower nominal wage and price rigidities in Spain). In addition, the effects of EMU membership were analysed by conducting a counterfactual analysis, comparing actual inflation and growth differentials between Spain and the rest of EMU with hypothetical differentials (if Spain would have retained the *peseta* and the ability to set its own nominal interest rates). The hypothetical GDP growth differential is defined as follows:

$$y_{diff}^{peseta} = y(P, P^*, BdE; S, S^*) - y^*(P, P^*, BdE; S, S^*)$$

The authors define the function  $y(P, P^*, BdE; S, S^*)$ , which is the set of differentials implied by specific parameter values ( $P, P^*$ ) and certain shocks ( $S, S^*$ ). Then, they compare this differential with the actual one (the same for the CPI inflation differential). They find that inflation differentials would have been lower (except for the period 2006Q3–2007Q4). This decline in inflationary pressures would have produced only small reductions in relative growth (except for 1999Q1–2000Q1). They propose the following explanation: the counterfactual peseta nominal interest rate having been above the observed euro nominal interest rate, the peseta would have appreciated against the euro, which would have reduced the relative price of goods imported from EMU.

**Lama and Rabanal (2012)** estimate a two-country DSGE model for the UK and the euro area to evaluate the welfare impact on the UK of adopting the euro while considering the role of trade and financial channels. On the one hand, joining a currency union reduces transaction costs, while on the other, it adds additional costs for a country since it loses its independent monetary policy. The welfare calculations follow Lucas (1987), who calculates the welfare gains as follows:

$$E \left[ \sum_{t=0}^{\infty} \beta^t u \left( (1 + \gamma) C_t^I, N_t^I \right) \right] = E \left[ \sum_{t=0}^{\infty} \beta^t u \left( C_t^{MU}, N_t^{MU} \right) \right]$$

given a set of allocations of consumption and labour supply  $\{C_t, N_t\}_{t=0}^{\infty}$  where “I” is the allocation under the independent monetary policy and “MU” is the allocation under the monetary union. If  $\gamma > 0$ , there are net gains from entering a monetary union and vice versa.

Summing up steady-state and business-cycle effects, the resulting trade-off is in favour of entering the euro area with a net welfare gain of 0.9 percentage points of lifetime consumption. However, the financial channel can significantly alter the results. During the episodes of financial turbulence (presented by the interest rate spread), the welfare costs of entering the EMU are more than three times higher than the welfare gains from lower trade costs. As a result, belonging to a currency area generates a net welfare loss of 2.9 percent.

**Moons (2013)** evaluates the welfare impact on both the UK and the euro area by calculating a loss function according to Svensson (2003, 2009) and Wollmershäuser (2006), who write the intertemporal loss function as a weighted sum of the variances in inflation and output:

$$L_t = \text{var}[\pi_t] + \beta_y \text{var}[y_t]$$

where  $\beta_y$  stands for a positive weight on output-gap stabilization relative to inflation stabilization. The results show that losses of the UK increase by 44% upon accession, while the euro area benefits by their decrease by 13% if the UK joins the monetary union. Although the welfare of the UK generates overall losses, the output variability drops significantly. The reason is that eliminating the exchange rate decreases the fluctuation of the UK demand for the euro area goods. Therefore, the output variability is reduced in both economies. From the fiscal policy standpoint, increasing the automatic stabilizers and lowering the debt target lowers the losses in the euro area. Moreover, by lessening the rules about automatic stabilizers in the area, the losses are also reduced in the UK. Therefore, the author proposes making the Stability and Growth Pact more flexible.

**Gradzewicz and Makarski (2013)** developed and estimated a two-country model to quantify the effect of the loss of the autonomous monetary policy in the case of Poland’s hypothetical accession to the euro area. Considering the impact on volatilities of macroeconomic variables, most variables are more volatile after accession, especially in the case of the interest rate (the volatility rises from 0.83% to 2.04%) and consumption (1.68% to 2.75%). Moreover, there is a slight increase in the volatility of GDP (2.31% to 2.44%) and employment (1.82% to 1.98%). The only exception is inflation, in which volatility drops (2.44% to 1.54%). It can be explained by the fact that the Taylor rule in the euro area is more inflation-oriented, and fixing the nominal exchange rate stabilizes inflation in the home country. As for the welfare implications calculation, the authors use the Lucas (1987) approach:

$$\int_0^{\omega} \frac{1}{\omega} E_0 \left[ \sum_{t=0}^{\infty} \beta^t u((1-\lambda)c_t^{OUT}(j), l_t^{OUT}(j), \zeta_t) \right] dj = \int_0^{\omega} \frac{1}{\omega} E_0 \left[ \sum_{t=0}^{\infty} \beta^t u(c_t^{IN}(j), l_t^{IN}(j), \zeta_t) \right] dj$$

The equations refer to the utility functions ( $c_t$  and  $l_t$  denote the representative household’s consumption and labour supply, respectively, and  $\zeta_t$  denotes the labour supply shock that follows AR(1) process). “OUT” stands for not being part of the EMU, “IN” for the opposite. After solving the equation, we obtain  $\lambda = 0.124\%$ . It means that losing independent monetary



policy associated with joining the eurozone would have the same effect as decreasing consumption by 0.124% in every period. The authors stress the importance of not limiting the welfare analysis on GDP and inflation volatility since changes in consumption, labour, and the interest rate might have greater importance.

Similarly, a welfare analysis is conducted by **Rubio and Carrasco-Gallego (2016)**. In this case, the authors calculate the welfare difference for Spain and the euro area between the cases of adopting and not adopting macroprudential policies in Spain. The motivation behind this analysis stems from the fact that at the time of writing the paper, Spain was the only country within the EU that had not established a macroprudential regulator. The paper focuses on a particular macroprudential policy, a loan-to-value ratio rule that responds countercyclically to credit booms. Following Mendicino and Pescatori (2007), the welfare is first calculated for savers and borrowers separately and second together as a weighted sum. As a result, even if Spain does not coordinate and only the rest of the euro area coordinates, welfare improves for the whole union (approximately 7.3 units of consumption), including Spain itself. Still, the gain is even more significant if Spain also implements the macroprudential policies (approximately eight units of consumption (methodology according to Ascari and Ropele (2012))). Savers are slightly worse off, but borrowers outweigh the effect significantly.

Analogically, this type of analysis with the same welfare calculation approach is replicated by **Rubio and Comunale (2018)** for Lithuania. A two-country DSGE model is developed to analyse the implications of macroprudential policies for macroeconomic and financial stability. First, it is confirmed that without macroprudential policies, the financial stability in Lithuania is lower than in the rest of the euro area. The next scenario considered is the Taylor rule extended with credit variables. Central banks taking care of both objectives reduces financial volatility; however, it comes at the expense of increasing macroeconomic instability, especially concerning inflation. The welfare calculation confirms that having the two authorities take care of different objectives (financial and macroeconomic stability) is more beneficial for the whole economy. Equally to the previous case, savers are worse off, while borrowers are better off.

## Conclusion

Out of all the analysed papers, four deal with the welfare consequences of the euro adoption: Andrés et al. (2010) for Spain; Lama and Rabanal (2012) and Moons (2013) for the United Kingdom, and Gradzewicz and Makarski (2013) for Poland. Two approaches are generally adopted: to observe the variance in key macroeconomic variables or calculate a loss function according to Lucas. Welfare analyses are conducted in different fields too. Lately, the analyses have focused on the welfare effects of macroprudential policies (Rubio and Carrasco-Gallego (2016) for Spain or Rubio and Comunale (2018) for Lithuania).

The evolution of the literature suggests that the authors first aimed at building “two-country DSGE” models for general analyses, followed by more specific investigations (monitoring the impact of structural reforms, euro adoption, macroprudential policies etc.). Moreover, just one “key paper” deals with the Czech Republic. This implies that building a “two-country DSGE” model for the Czech Republic that would tackle the welfare consequences of the euro adoption could fill in a certain knowledge gap in this field.



## References

- Andrés, J., Burriel, P., and Estrada, A. (2006). BEMOD: a DSGE model for the Spanish economy and the rest of the Euro area. Technical Report 0631, *Banco de España Working Papers*.
- Andrés, J., Hurtado, S., Ortega, E., and Thomas, C. (2010). Spain in the euro: A general equilibrium analysis. *Journal of the Spanish Economic Association*, 1(1/2):67–95.
- Breuss, F. and Rabitsch, K. (2009). An estimated two-country DSGE model of Austria and the Euro Area. *Empirica*, 36(1):123–158.
- Carton, B. (2012). Tax Reform and Coordination in a Currency Union. *Economie internationale*, 132(4):141–158.
- Gadatsch, N., Stahler, N., and Weigert, B. (2015). German Labor Market and Fiscal Reforms 1999 to 2008: Can They Be Blamed for Intra-Euro Area Imbalances? *SSRN Scholarly Papers*.
- Galí, J. and Monacelli, T. (2005). Monetary Policy and Exchange Rate Volatility in a Small Open Economy. *The Review of Economic Studies*, 72(3):707–734.
- Graszewicz, M. and Makarski, K. (2013). The Business Cycle Implications of the Euro Adoption in Poland. *Applied Economics*, 45(17):2443–2455.
- Kolasa, M. (2009). Structural Heterogeneity or Asymmetric Shocks? Poland and the Euro Area through the Lens of a Two-Country DSGE Model. *Economic modelling*, 26(6):1245–1269.
- Kydland, F. E. and Prescott, E. C. (1982). Time to Build and Aggregate Fluctuations. *Econometrica*, 50(6):1345–1370.
- Lama, R. and Rabanal, P. (2012). Deciding to enter a monetary union: The role of trade and financial linkages. *European Economic Review*, 72:138–165.
- Lenarčič, (2019). Inflation – the Harrod-Balassa-Samuelson Effect in a DSGE Model Setting. *Economic and Business Review for Central and South-Eastern Europe*, 21(2):275–307,342.
- Lucas, R. (1976). Econometric policy evaluation: A critique. *Carnegie-Rochester Conference Series on Public Policy*, 1:19–46.
- Lucas, R. (1987). *Models of Business Cycles*. Basil Blackwell, New York.
- Moons, C. (2013). Losses from Membership in EMU: an Estimated Two-Country DSGE Model. *Applied Economics Quarterly*, 59(1):27–61.
- Pytlarczyk, E. (2005). An estimated DSGE model for the German economy within the euro area. Working Paper 2005, 33, *Discussion Paper Series 1*.
- Rabanal, P. (2009). Inflation Differentials between Spain and the EMU: A DSGE Perspective. *Journal of Money, Credit and Banking*, 41(6):1141–1166.
- Rubio, M. and Carrasco-Gallego, J. (2016). Coordinating macroprudential policies within the Euro Area: the case of Spain. *Economic Modelling*, 59.
- Rubio, M. and Comunale, M. (2018). Macroeconomic and financial stability in a monetary union: The case of Lithuania. *Economic Systems*, 42(1):75–90.
- Senaj, M., Vyskrabka, M., and Zeman, J. (2010). MUSE: Monetary Union and Slovak Economy Model. *SSRN Scholarly Papers*.
- Slanicay, M. (2013). Business Cycle Synchronization through the Lens of a DSGE Model. *Finance a Úvěr*, 63(2):180–196.
- Smets, F. and Wouters, R. (2003). An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area. *Journal of the European Economic Association*, 1(5):1123–1175.
- Stähler, N. and Thomas, C. (2011). FiMod - a DSGE model for fiscal policy simulations. *Bank of Spain Working Papers*, (1110):1–53.

**Ing. Patrik Šváb** is a Ph.D. candidate at the Department of International Economic Relations, Faculty of International Relations, Prague University of Economics and Business. In his research, he focuses mainly on macroeconomic modelling of currency areas. He also gained experience in international trade at the Kiel Institute for the World Economy, both participating in the Institute's Advanced Studies Program and working in the Trade Policy group, which focuses on economic sanctions and gravity models, among other topics.