

Bekkers, Eddy; Francois, Joseph F.

**Working Paper**

## Bilateral Exchange Rates and Jobs

wiiw Working Paper, No. 83

**Provided in Cooperation with:**

The Vienna Institute for International Economic Studies (wiiw) - Wiener Institut für Internationale Wirtschaftsvergleiche (wiiw)

*Suggested Citation:* Bekkers, Eddy; Francois, Joseph F. (2012) : Bilateral Exchange Rates and Jobs, wiiw Working Paper, No. 83, The Vienna Institute for International Economic Studies (wiiw), Vienna

This Version is available at:

<https://hdl.handle.net/10419/203948>

**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.*

# Working Papers | 83 |

June  
2012

*Eddy Bekkers and Joseph Francois*

## **Bilateral Exchange Rates and Jobs**



## **wiiw Working Papers published since 2009:**

- No. 83 E. Bekkers and J. Francois: Bilateral Exchange Rates and Jobs. June 2012
- No. 82 E. Bekkers, J. Francois and M. Manchin: Import Prices, Income, and Inequality. June 2012
- No. 81 R. Stehrer: Trade in Value Added and the Valued Added in Trade. June 2012
- No. 80 R. Stehrer, N. Foster and G. de Vries: International spillovers in a world of technology clubs. June 2012
- No. 79 R. Stöckinger: International spillovers in a world of technology clubs. May 2012
- No. 78 S. Leitner and R. Stehrer: Access to Finance and Composition of Funding during the Crisis: A firm-level analysis for Latin American countries. February 2012
- No. 77 E. Bekkers and R. Stehrer: Reallocation Gains in a Specific Factors Model with Firm Heterogeneity. December 2011
- No. 76 M. Holzner and F. Peci: The Impact of Customs Procedures on Business Performance: Evidence from Kosovo. August 2011
- No. 75 C. Hornok: Need for Speed: Is Faster Trade in the EU Trade-Creating? April 2011
- No. 74 S. Leitner and R. Stehrer: Subgroup and Shapley Value Decompositions of Multidimensional Inequality – An Application to Southeast European Countries. March 2011
- No. 73 S. M. Leitner and R. Stehrer: Do Exporters Share Part of their Rents with their Employees? Evidence from Austrian Manufacturing Firms. February 2011
- No. 72 S. M. Leitner, J. Pöschl and R. Stehrer: Change begets change: Employment effects of technological and non-technological innovations – A comparison across countries. January 2011
- No. 71 M. Holzner: Inequality, Growth and Public Spending in Central, East and Southeast Europe. October 2010
- No. 70 N. Foster, J. Pöschl and R. Stehrer: The Impact of Preferential Trade Agreements on the Margins of International Trade. September 2010
- No. 69 L. Podkaminer: Discrepancies between Purchasing Power Parities and Exchange Rates under the Law of One Price: A Puzzle (partly) Explained? September 2010
- No. 68 K. Hauzenberger and R. Stehrer: An Empirical Characterization of Redistribution Shocks and Output Dynamics. August 2010
- No. 67 R. Stöckinger, R. Stehrer and J. Pöschl: Austrian Exporters: A Firm-Level Analysis. July 2010
- No. 66 M. Holzner: Tourism and Economic Development: the Beach Disease? June 2010
- No. 65 A. Bhaduri: A Contribution to the Theory of Financial Fragility and Crisis. May 2010
- No. 64 L. Podkaminer: Why Are Goods Cheaper in Rich Countries? Beyond the Balassa-Samuelson Effect. April 2010
- No. 63 K. Laski, J. Osiatynski and J. Zieba: The Government Expenditure Multiplier and its Estimates for Poland in 2006-2009. March 2010
- No. 62 A. Bhaduri: The Implications of Financial Asset and Housing Markets on Profit- and Wage-led Growth: Some Results in Comparative Statics. February 2010
- No. 61 N. Foster and R. Stehrer: Preferential Trade Agreements and the Structure of International Trade. January 2010
- No. 60 J. Francois and B. Hoekman: Services Trade and Policy. December 2009
- No. 59 C. Lennon: Trade in Services: Cross-Border Trade vs. Commercial Presence. Evidence of Complementarity. November 2009
- No. 58 N. Foster and J. Pöschl: The Importance of Labour Mobility for Spillovers across Industries. October 2009
- No. 57 J. Crespo-Cuaresma, G. Doppelhofer and M. Feldkircher: The Determinants of Economic Growth in European Regions. September 2009
- No. 56 W. Koller and R. Stehrer: Trade Integration, Outsourcing and Employment in Austria: A Decomposition Approach. July 2009
- No. 55 U. Schneider and M. Wagner: Catching Growth Determinants with the Adaptive Lasso. June 2009
- No. 54 J. Crespo-Cuaresma, N. Foster and R. Stehrer: The Determinants of Regional Economic Growth by Quantile. May 2009
- No. 53 C. Lennon: Trade in Services and Trade in Goods: Differences and Complementarities. April 2009
- No. 52 J. F. Francois and C. R. Shiells: Dynamic Factor Price Equalization and International Convergence. March 2009

Eddy Bekkers is Assistant Professor at Johannes Kepler University, Linz, Austria. Joseph Francois is Professor of Economics at Johannes Kepler University, Research Fellow of the Centre for Economic Policy Research (CEPR) (London) and Senior Research Associate at the Vienna Institute for International Economic Studies (wiiw).

*Eddy Bekkers and  
Joseph Francois*

**Bilateral Exchange Rates  
and Jobs**



# Contents

Abstract .....	i
1 Introduction .....	1
2. Basic Model .....	4
3 Properties of Basic Model .....	8
3.1. Balanced Trade.....	8
3.2. Changing Trade Balance .....	12
3.3 Incomplete Pass Through .....	14
4 Numerics.....	15
5. Summary and Closing Remarks .....	21
References .....	23
Appendix A Derivations Basic Model.....	25
Appendix B The Numerical Model .....	27



## **Abstract\***

*We study the labour market effects of bilateral exchange rate realignment. We place emphasis on the composition of trade, the role of intermediates, and the underlying conditions of the labour market. Employment effects hinge on the fraction exported to and imported from the trading partner. A larger fraction exported to and a smaller fraction imported from the trading partner make it more likely that appreciation has beneficial effects. Furthermore, more sticky price expectations in wage formation, a smaller fraction of intermediates in the production process, and a lower rate of importer pass through make it more likely that appreciation of the exchange rate of the trade partner has positive employment effects. At a more technical level, the scope for substitution away from higher priced inputs, either towards other sources of supply, or towards value-added, is also important to the direction and magnitude of changes in employment.*

**Keywords:** *bilateral exchange rates, devaluation, exchange rates and trade, trade and employment*

**JEL classification:** *F32, F41*

---

\* We would like to thank Richard Baldwin, Peter Egger, Doug Nelson, Clint Shiells, and participants at CEPR workshops and ETSG sessions for helpful comments and suggestions. Address for correspondence: Eddy Bekkers, Johannes Kepler University of Linz, Dept. of Economics, Altenbergerstr 69, 4040 Linz, Austria. email: eddy.bekkers@jku.at.





# Bilateral Exchange Rates and Jobs

**ABSTRACT:** We study the labor market effects of bilateral exchange rate realignment. We place emphasis on the composition of trade, the role of intermediates, and the underlying conditions of the labor market. Employment effects hinge on the fraction exported to and imported from the trading partner. A larger fraction exported to and a smaller fraction imported from the trading partner make it more likely that appreciation has beneficial effects. Furthermore, more sticky price expectations in wage formation, a smaller fraction of intermediates in the production process, and a lower rate of importer pass through make it more likely that appreciation of the exchange rate of the trade partner has positive employment effects. At a more technical level, the scope for substitution away from higher priced inputs, either toward other sources of supply, or toward value added, is also important to the direction and magnitude of changes in employment.

*keywords:* bilateral exchange rates, devaluation, exchange rates and trade, trade and employment

*JEL codes:* F32, F41.

## 1 Introduction

Conventional reasoning suggests that a country's output and employment will rise when its currency falls. The chain of logic is relatively straightforward – improved export competitiveness stimulates demand and so drives up output. However, there are also well known countervailing factors to consider. For example, it has been shown that that the increased price of imports as a result of depreciation may also reduce output through adverse supply effects (Edwards , 1986; van Wijnbergen , 1986). Broadly speaking, the literature focuses on generic exchange rate changes (i.e. vis-a-vis the world as a whole). This paper's contribution is a better understanding of bilateral exchange rate changes (or revaluation against a sub-set of partners). At a practical level, our focus on the issue of bilateral revaluation has immediate relevance given the current exchange rate dispute between China and

the US, the earlier exchange rate dispute between Japan and the US, and ongoing calls for inclusion of exchange rate issues within the WTO.

To examine the employment effects of bilateral revaluation, we extend the model of de Melo and Robinson (1986) to include variable labor supply conditions as well as intermediate inputs in production. We explore this framework both analytically and numerically. The analytics allow us to highlight detailed mechanics linked to particular aspects of technology and the composition of trade. We then use numerics to examine and illustrate more complex issues related to interaction between key elements of the model. The numeric version of the model is calibrated to global macroeconomic data for 2007.

The import and export shares of trade of the exchange rate realigning trade partner are shown to be crucial determinants of the employment effects. In particular, an appreciation of the currency of a trading partner can have negative employment effects when a country's import share from that trading partner is larger than its share of exports going to that trading partner. An appreciation of a trading partner's currency helps a country, because its export sales generate more revenues. It hurts a country, because the price of its inputs go up. This adversely affects employment for two reasons. Imported intermediates become more expensive, reducing the marginal product of labor. And a higher price of imported final goods leads to higher wage demands. In a baseline model with flexible labor markets and balanced trade, a trading partner's currency depreciation is harmful when the import share from that country exceeds the export share to that country.

Further analytical results include proof that a slower wage adjustment and a smaller share of intermediates in the gross production function make it more likely that a trading partner's currency appreciation is beneficial. A

lower rate of pass through on the importer side also increases the probability that a country benefits from the trading partner’s appreciation, as it does not suffer so much from increased import prices. Also, it is shown that an improvement in the trade balance as a result of a trading partner’s currency appreciation contributes negatively to the change in employment, whereas a deterioration of the trade balance makes a positive contribution. From the numerics, we are able to highlight the importance of underlying labor conditions, and in particular the scope for magnification of employment effects. We also show that parameterization (the structure of technology in allowing substitution) is critical to both the direction and magnitude of effects.

To place this paper in context, there is an early literature arguing that broad-based devaluations can be contractionary. Hirschman (1949), Diaz-Alejandro (1963) and Krugman and Taylor (1978). Edwards (1986) and van Wijnbergen (1986) all emphasize the supply side effects driving in the possible contraction. In the more recent literature, open economy DSGE models are used to study the effect of exchange rate realignments,<sup>1</sup> including Erceg et al. (2006) and Bodenstein et al. (2009). Throughout, the emphasis is on broad-based rather than bilateral realignment. An exception is Fair (2010), who uses a macroeconometric model to estimate the effects of a realignment of the exchange rate of one of the trading partners of the US, China and finds modest effects of a Chinese revaluation. He does not identify trade shares, but focuses instead on inflation effects.

The rest of this paper is organized as follows. We develop the basic model in 2. The basic properties of the model are explored analytically in Section 3, including changes in the trade balance, and the role of variations in passthrough rates. This is followed by numerical analysis, based on Chinese

---

<sup>1</sup>With exchange rates typically endogenous in these models, shocks to monetary policy can be used to mimic these effects

revaluation vis-a-vis the US in Section 4. From the numerics, we demonstrate that there is not an unambiguous pairing between improved trade balance and increased employment. Rather, this depends on technology and parameter sets, on top of the trade composition effects stressed in Section 3. Finally, we summarize and conclude in Section 5.

## 2 Basic Model

Consider the '123 model' of de Melo and Robinson (1986).<sup>23</sup> A small country produces goods for the domestic market and the exporting market, equation (1) and consumes imports and domestic goods, equation (2):

$$X = G(E, D_s) = \left( \beta_E E^{\frac{\theta+1}{\theta}} + \beta_{D_s} D_s^{\frac{\theta+1}{\theta}} \right)^{\frac{\theta}{\theta+1}} \quad (1)$$

$$Q = F(M, D_d) = \left( \alpha_M M^{\frac{\sigma-1}{\sigma}} + \alpha_{D_d} D_d^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad (2)$$

The price indexes corresponding to equations (1) and (2) are given by:

$$p_x = \left( \beta_E^{-\theta} p_e^{\theta+1} + \beta_{D_s}^{-\theta} p_d^{\theta+1} \right)^{\frac{1}{\theta+1}} \quad (3)$$

$$p_q = \left( \alpha_M^{\sigma} p_m^{1-\sigma} + \alpha_{D_d}^{\sigma} p_d^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \quad (4)$$

Optimality along transformation curve and indifference curve imply the following conditions:

$$\frac{E}{D_s} = \left( \frac{\beta_{D_s} p_e}{\beta_E p_d} \right)^{\theta} \quad (5)$$

$$\frac{M}{D_d} = \left( \frac{\alpha_M p_d}{\alpha_{D_d} p_m} \right)^{\sigma} \quad (6)$$

---

<sup>2</sup>See de Melo and Robinson (1986) and Devarajan, et al. (1998) for a detailed description of the model.

<sup>3</sup>Table 1 contains a description of the variables and parameters of the model.

Table 1: List of Variables and Parameters

Variable	Description
$X$	gross output
$Q$	gross demand
$M, E$	imports and exports
$p_q, p_x$	price of demand and output
$p_m, p_e$	price of imports and exports
$p_{m,i}, p_{e,i}$	home price of imports and exports of country $i$
$R_i$	nominal exchange rate between home and country $i$
$\pi_{m,i}, \pi_{e,i}$	country $i$ price of imports and exports
$B$	net capital inflow into home, measured in domestic prices
$D_d, D_s$	demand and supply of non tradable
$I$	intermediates
$L, K$	employment and capital
$w$	(nominal) wage
Parameters	Description
$\theta$	elasticity of transformation between domestic goods and exports
$\sigma$	elasticity of substitution between domestic goods and imports
$\eta$	elasticity of substitution between imports from different countries
$\omega$	elasticity of transformation between exports to different countries
$\rho$	elasticity of substitution between inputs in production function
$\varphi$	labor supply elasticity
$\beta_E, \beta_{D_s}$	shift parameters in supply of exports and domestic goods
$\alpha_M, \alpha_{D_d}$	shift parameters in demand for imports and domestic goods
$\gamma_i, \delta_i$	shift parameters in imports from and exports to different trade partners
$\phi_I, \phi_L, \phi_K$	shift parameters in production function
$\xi_q$	degree of stickyness of price expectations
$\xi_{p_{m,i}}$	rate of importer pass through

Domestic equilibrium requires equality of supply of and demand for non tradables:

$$D_d - D_s = 0 \quad (7)$$

There are  $N$  trade partners. The price index of imports in equation (8) and the price index of exports in equation (9) follow from the Armington assumption:

$$p_m = \left( \sum_{i=1}^N \gamma_i^\eta p_{m,i}^{1-\eta} \right)^{\frac{1}{1-\eta}} \quad (8)$$

$$p_e = \left( \sum_{i=1}^N \delta_i^{-\omega} p_{e,i}^{\omega+1} \right)^{\frac{1}{\omega+1}} \quad (9)$$

Foreign prices  $\pi_{m,i}$  and  $\pi_{e,i}$  are given reflecting the small country assumption. The foreign prices are related with the domestic trading prices  $p_{m,i}$  and  $p_{e,i}$  by a bilateral exchange rate  $R_i$  with trading partner  $i$ :

$$p_{m,i} = R_i \pi_{m,i} \quad (10)$$

$$p_{e,i} = R_i \pi_{e,i} \quad (11)$$

An increase in  $R_i$  corresponds with an appreciation of the exchange rate of trading partner  $i$ . Capital inflows  $B$  are positive when the country's imports exceed its exports:

$$B = p_m M - p_e E \quad (12)$$

To address the effect of exchange rate realignments including both demand and supply side effects, we add a production structure. The country uses intermediates, labor and capital in production giving rise to the following

CES production function:

$$X = \left( \phi_I I^{\frac{\rho-1}{\rho}} + \phi_L L^{\frac{\rho-1}{\rho}} + \phi_K K^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} \quad (13)$$

The amount of capital is fixed. Firms use the same aggregate good  $Q$  with corresponding price  $p_q$  as intermediate inputs as consumers for final goods consumption implying the following demand for intermediates:

$$I = \left( \phi_I \frac{p_x}{p_q} \right)^{\rho} X \quad (14)$$

The labor market is characterized by a constant elasticity supply curve, equation (15). Labor demand in equation (16) follows from the production function in equation (13):

$$w = p_q^e L^{\frac{1}{\varphi}} \quad (15)$$

$$L = \left( \phi_L \frac{p_x}{w} \right)^{\rho} X \quad (16)$$

To model labor market rigidities, the expected price level  $p_q^e$  responds less than proportional to the true price level  $p_q$ :

$$\widehat{p}_q^e = \xi_{p_q} \widehat{p}_q$$

Variables with a hat indicate relative changes. Working with (partially) sticky wages as in much of the recent business cycle literature (see Smets and Wouters (2003)) would generate equivalent results. Partial adjustment of the expected price level fits in the macro literature on imperfect information (see Mankiw and Reis (2010)).<sup>4</sup>

---

<sup>4</sup>Also, we could model unemployment using efficiency wages or search frictions, but the results would be equivalent to our specification, though we do not account explicitly for unemployment.



### 3 Properties of Basic Model

In this section we derive analytical results on the effects of exchange rate realignments of one of the trading partners, working with the small country assumption. The first subsection addresses the effects under balanced trade, then we come to the effects under a changing trade balance and finally we address the impact of imperfect pass through. In the next section we explore with simulations the impact of working with a large country starting from unbalanced trade.

#### 3.1 Balanced Trade

We can log linearize the model to derive the effect of a change in the exchange rate of country  $i$ ,  $R_i$ . To derive analytical results, we start from trade balance, i.e.  $B = 0$ . The relative change in the consumption price  $p_q$  and output price  $p_x$  follow easily from log differentiating equations (3) and (4) and (8)-(11):

$$\widehat{p}_q = \kappa_{TR} s_{m,i} \widehat{R}_i + (1 - \kappa_{TR}) \widehat{p}_d \quad (17)$$

$$\widehat{p}_x = \kappa_{TR} s_{e,i} \widehat{R}_i + (1 - \kappa_{TR}) \widehat{p}_d \quad (18)$$

$\kappa_{TR}$  is the trade share of output,  $\kappa_{TR} = \frac{p_e E}{p_e E + p_d D}$  and  $s_{m,i}$  and  $s_{e,i}$  are the import and export share of country  $i$ ,  $s_{m,i} = \frac{p_{m,i} M_i}{\sum_{i=1}^N p_{m,i} M_i}$  and  $s_{e,i} = \frac{p_{e,i} E_i}{\sum_{i=1}^N p_{e,i} E_i}$ .

To find the change in employment, the production side is log differenti-

ated, i.e. equations (13)-(15), leading to:<sup>5</sup>

$$\widehat{L} = \frac{\rho}{1 - \lambda_I - \lambda_L} (\widehat{p}_x - (1 - \lambda_I) \widehat{w} - \lambda_I \widehat{p}_q) \quad (19)$$

$$\widehat{w} = \xi_{p_q} \widehat{p}_q + \frac{1}{\varphi} \widehat{L} \quad (20)$$

Substituting equation (20) into (19) and rearranging, one arrives at:

$$\widehat{L} = A_0 \left( \widehat{p}_x - \left( \lambda_I + (1 - \lambda_I) \xi_{p_q} \right) \widehat{p}_q \right); \quad (21)$$

$$A_0 = \frac{\rho \varphi}{\varphi (1 - \lambda_I - \lambda_L) + \rho (1 - \lambda_I)} \quad (22)$$

Log differentiating the production and consumption optimality equations (6), (5) and the balance of trade equation (12), assuming that we start from balanced trade, leads to an expression for the relative change in domestic price as a function of the relative exchange rate change (derivation in Appendix A):

$$\widehat{p}_d = A_1 \widehat{R}_i + \frac{1}{\theta + \sigma} dB; \quad (23)$$

$$A_1 = \frac{(\theta + 1) s_{e,i} + (\sigma - 1) s_{m,i}}{\theta + \sigma} \quad (24)$$

Substituting equations (17)-(23) into equation (21), we find the relative change in employment as a function of the relative exchange rate change:

$$\begin{aligned} \widehat{L} = & A_0 \kappa_{TR} \left( s_{e,i} - \left( \lambda_I + (1 - \lambda_I) \xi_{p_q} \right) s_{m,i} \right) \widehat{R}_i \\ & + A_0 (1 - \kappa_{TR}) \left( 1 - \left( \lambda_I + (1 - \lambda_I) \xi_{p_q} \right) \right) \left( A_1 \widehat{R}_i + \frac{1}{\theta + \sigma} dB \right) \end{aligned} \quad (25)$$

We can state the following result based on this equation:

**Proposition 1** *In a small economy with balanced trade and fully adjusting*

---

<sup>5</sup>derivation in Appendix A

*wages, employment expands in response to an appreciation of the currency of one of its trading partners if and only if the share of its exports to the trading partner is larger than the share of imports from the trading partner.*

Proposition 1 follows directly from equation (25) setting  $\xi_{p_q}$  equal to 1, implying that the expected price level of workers is equal to the actual price level, so fully adjusting wages. A substitution elasticity between domestic and imported goods larger than 1 implies that substitution towards nontradables when import prices rise lead to an increase in the price of nontradables. This condition is likely to be satisfied in rich countries.

The three channels at work can be found in equations (19). First, an increase in the sales price  $p_x$  as a result of appreciation of the currency of a trading partner raises value marginal product of labor fostering labor demand. Second, an increase in  $p_q$  raises the cost of intermediates used in production. This decreases the marginal product of labor, reflected in the term  $-\lambda_I \hat{p}_q$  in equation (19). Third, the rise in  $p_q$  drives up wages in equation (20), which leads to less labor demand, the term  $-(1 - \lambda_I) \hat{w}$  in equation (19). With fully adjusting wages, the overall effect depends on the trading partners import and export shares, which determine by how much output prices  $p_x$  and consumption/input price  $p_q$  change.

In proposition 1 we work with fully adjusting wages, representing the effects in the long run. With sticky wages there is a fourth channel present, represented by the second line in equation (25). An appreciation of the exchange rate of the trading partner drives up the import price and decreases the export price. If the substitution elasticity between domestic and imported goods is larger than 1, the domestic price  $p_d$  goes up. Therefore, both consumers and producers switch to domestic goods. This leads to increased demand for labor, unless wages are fully flexible. With fully flexible

wages the beneficial demand side effect on employment of the higher price of domestic goods would exactly cancel out against the adverse supply side effect through a higher price of intermediates and higher wage demands, as is clear from equation (25). With rigid wages (sticky price expectations in wage formation) instead the demand side effect of higher domestic price dominates the supply side effect.

Sticky price expectations reflect a soft labor market with high unemployment, where workers do not demand compensation for higher prices. Using equation (25) one can show that for reasonable parameter values the employment effects of appreciation of a trading partner are negative, also under sticky price expectations, when the import share of the trading partner is much larger than the export share. If we take for example  $\theta = \frac{5}{3}$ ,  $\sigma = 3$  as in Devarajan, et al. (1998), intermediates share  $\lambda_I = 0.7$  and a tradables share of 0.3 we get a negative employment effect from a country's trading partner's appreciation when its import share  $s_m = 0.2$  and its export share  $s_e = 0.05$ . Hence, also when wage demands are modest due to for example high unemployment, employment may still decline when a country's trading partner appreciates. Higher prices of imported intermediates have a direct negative impact on labor demand and this effect may dominate the beneficial effect of higher export prices and the beneficial substitution towards the use of domestic goods.

The effect of wage rigidity following from equation (25) can be summarized as follows:

**Proposition 2** *In a small economy with balanced trade and a substitution elasticity between domestic and imported goods larger than 1, a higher degree of wage flexibility makes it more likely that an appreciation of the currency of one of its trading partners has a negative effect on employment.*

Larger wage flexibility raises the impact of higher import prices on wages the workers demand, leading to a more negative employment effect. There are two channels, a direct effect through higher import prices and an indirect effect through higher prices of domestic goods when the substitution elasticity between domestic and imported varieties,  $\sigma$ , is larger than 1. Hence, the employment effect is more likely to be negative in the long run, when wages can fully adjust. If we interpret the parameter  $\xi_{p_q}$  as following from conditions on the labor market, this proposition points out that it is less likely that an appreciation of the currency of one of the trading partners has a negative impact on employment when the labor market is softer with workers asking less compensation for increased prices.

We can also draw some conclusions on the influence of the intermediates share in output:

**Proposition 3** *In a small economy with balanced trade, a substitution elasticity between domestic and imported goods larger than 1 and imperfect wage flexibility, an increase in the share of intermediates in output makes it more likely that an appreciation of the currency of one of its trading partners has a negative effect on employment.*

This proposition follows from the fact that a larger import price reduces employment through two channels: it depresses the marginal product of labor and raises wage demands. When wage flexibility is imperfect, the impact through the first channel is stronger. Hence, the larger the intermediates share, the larger the detrimental effect on employment.

### 3.2 Changing Trade Balance

Until now we have assumed that the country under consideration retains trade balance. Starting from balanced trade, i.e.  $B = 0$ , we can explore

the implications of a change in the trade balance analytically. In principle we need to extend the model with demand and supply for capital to determine the change in the capital balance. This would require a dynamic model making the model too complicated for the point we want to make. To show the effect of changes in the trade balance on the outcomes of exchange rate realignment, we address two scenarios: one where the Marshall-Lerner condition is not satisfied and one where it is satisfied. These correspond empirically with the short run and long run, respectively. When the Marshall-Lerner condition is not satisfied,  $dB/dR_i > 0$ , i.e. the trade balance deteriorates. From equation (23) and (25), we see that the employment effect of the deteriorating trade balance is positive. If more capital flows into the country, i.e.  $dB > 0$ , the demand for labor will increase through an increase in the price of nontradables (cf. equation (23)). When the Marshall-Lerner condition is satisfied, the trade balance improves. This has a negative employment effect, because the demand for labor declines as a result of the declining price of non-tradables, see equations (23) and (25). The effects are only present when wages are not fully adjusting, i.e.  $\xi_{p_q} < 1$ , as the effect runs through changes in the price of non-tradables and a change in the price of non-tradables only affects employment under inflexible wages.

We can summarize the discussion as follows:

**Proposition 4** *In a small economy starting from balanced trade and a substitution elasticity between domestic and imported goods larger than 1, a deterioration of the trade balance as a result of an appreciation of the currency of one of its trading partners contributes positively to the change in employment. An improvement of the trade balance generates a negative contribution to the change in employment.*

So, an improving trade balance impinges negatively on employment,

which is a surprising result. The reason is that an improving trade balance goes along with capital outflows, leading to a lower price of nontradables and therefore less demand for labor. Observe that dynamic effects of an improving trade balance like capital outflows leading to less demand for labor are not taken into account.

### 3.3 Incomplete Pass Through

In the short run, changes in exchange rates might not fully work through into domestic prices. Working with a small country, there can be imperfect pass through on the importer side. The domestic import price  $p_{m,i}$  changes less than proportional with the exchange rate  $R_i$ ,  $\widehat{p_{m,i}} = \xi_{p_{m,i}} \widehat{R_i}$ . Working through the model, the new expression for the change in employment is now:

$$\begin{aligned} \widehat{L} &= A_0 \kappa_{TR} \left( s_{e,i} - \left( \lambda_I + (1 - \lambda_I) \xi_{p_q} \right) \xi_{p_{m,i}} s_{m,i} \right) \widehat{R_i} \\ &\quad + A_0 (1 - \kappa_{TR}) \left( 1 - \left( \lambda_I + (1 - \lambda_I) \xi_{p_q} \right) \right) A_2 \widehat{R_i} \\ A_2 &= \frac{(\theta + 1) s_{e,i} + (\sigma - 1) s_{m,i} \xi_{p_{m,i}}}{\theta + \sigma} \end{aligned} \quad (26)$$

Equation (26) makes clear that the export share and import share of a trading partner, the degree wage of rigidity and the degree of pass through together determine the employment effect of a trading partner's depreciation. More specific we can state the following:

**Proposition 5** *In a small economy with balanced trade and a substitution elasticity between domestic and imported goods larger than 1, employment expands in response to an appreciation of the currency of one of its trading partners if and only if wages are fully flexible and the share of its exports to the trading partner is larger than the share of imports from the trading partner times the rate of pass through.*

**Proposition 6** *In a small economy with balanced trade and a substitution elasticity between domestic and imported goods larger than 1, an increase in the rate of pass through of imports makes it more likely that an appreciation of the currency of one of its trading partners has a negative effect on employment.*

As we are considering a small country, the rate of pass through onto sales prices in the export market is by definition zero: firms have no market power in the foreign market and are thus not able to pass part of the lower exchange rate onto their buyers. In the simulations we address the large country case and also come to the possibility of incomplete pass through on the exporter side. Proposition 5 makes clear that the employment effects of an appreciation of a country's trading partner can be positive, irrespective of this trading partner's importance in exports and imports when the rate of pass through on the importer side goes to zero.

Incomplete pass through goes together with markup adjustments and market power. With appreciation of the currency of a trading partner incomplete pass through means that importers with market power lower their markups. Proposition 6 points out that a lower degree of pass through dampens the negative employment effects of appreciation of the currency of a trading partner, because import prices do not rise so much. The importers with market power pay the price for this dampened employment effect, because of the lower markups they charge.

## 4 Numerics

So far we have worked with a small country, focusing on general equilibrium mechanics within the economy. In this section, we work with a numerical



version of the model, implemented as a multi-country extension of the basic theory and calibrated to macroeconomic data for 2007. We use the model to illustrate numerically the role that parameters play, as outlined above, when we open up the underlying framework to allow for size and third country effects.

Before discussion numerics in detail, we will briefly discuss expected changes in the effect of exchange rate realignment. The first is that, when the country under consideration is large, foreign prices  $\pi_{m,i}$  and  $\pi_{e,i}$  vary with the volume of the country's imports and exports. The effect of the policy experiment explored in the basic model, an appreciation of the currency of one of the trading partners, can be expected to change as follows. The appreciation raises both the domestic export and import price. This implies more exports and less imports. More exports implies more imports for the trading partner and a move along its import demand function, such that the export price of our country will increase less as a result of the appreciation and the gains on the export side will be smaller. The decrease in imports means a shift along the export supply curve of the trading partner towards lower prices. Our import price will go up less and the losses on the import side will be smaller. So, we can expect that working with a large instead of small country attenuates the effects of an exchange rate realignment.

Additionally, in the basic model we were able to focus strictly on price changes of the realigning trading partner. If the realigning country also appreciates relative to third countries, export and import prices vis-vis other countries will change as well. An appreciation of the realigning trading partner vis-a-vis other countries implies on the export side that our country becomes cheaper in third markets and will pick up market share. Exports and the export price will increase implying larger gains on the export side.

On the import side effects also become larger. Third countries will have to pay more for imports from the appreciating country. This drives up their price of exports through increased prices of intermediates and a shift in demand towards non-tradables. The higher export price of third countries makes imports for our country more expensive with adverse employment effects. [Appendix B](#) lists the set of equations for the multicountry model, the underlying data, and the baseline parameter values. All equations are as in the basic model, but we explicitly model all countries, implying that foreign prices are not given.<sup>6</sup> Running simulations requires an explicit expression for how the capital balance changes. We focus on the case where the Marshall-Lerner condition is met (so trade balances improve with a depreciated exchange rate.) These conditions are discussed formally in [Appendix B](#).

We numerically estimate the effects of an appreciation by China on employment in the US, starting from our basic data for 2007. We actually implement both a 20% appreciation against the US (a bilateral revaluation), and 20% appreciation against the world (a multilateral revaluation). This is done while ranging parameters to examine their role, as represented above in the analytical discussion.

We start with [Figure 1](#), where we present employment effects for both the bilateral and multilateral experiments over a range of values for the trade substitution elasticity. Recall that the numeric examples in [Figure 1](#) reflect the assumption that the Marshall-Lerner conditions are met. On the basis of the simulations, we make the following observation.

**Observation 1** *In a multi-country setting with large countries, an appreciation of the currency of one of the trading partners can lead to either a decline*

---

<sup>6</sup>GAMS-based model code is available on request.

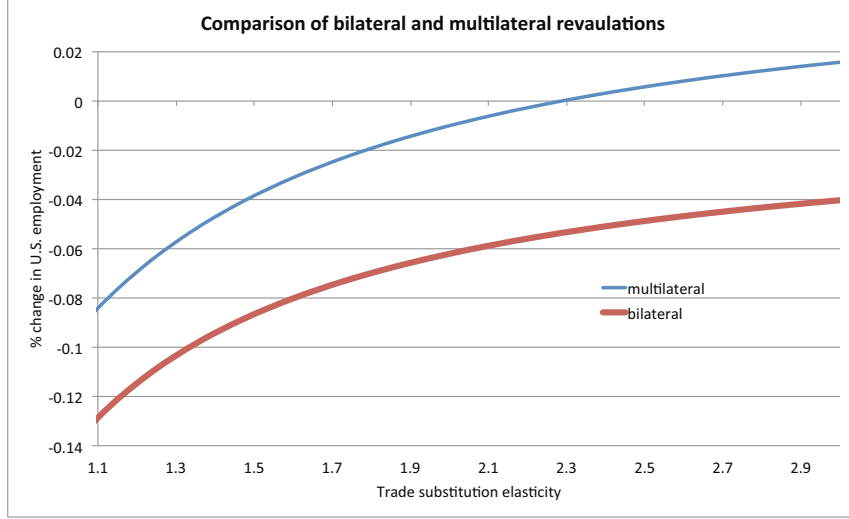


Figure 1: trade substitution and employment effects

or gain in employment, even with an improvement in the trade balance. This depends, in part, on the underlying elasticity of substitution for imports.

What we stress in Observation 1 is that there is not an unambiguous pairing between trade balance improvement and employment gains. Indeed, we can have gains or losses in employment, and this will hinge on the properties of technology, the underlying trade relationship, and preferences. It also depends on labor market conditions. In Figure 2 we present estimated employment effects of revaluation under alternative labor market conditions, leading to the following observation:

**Observation 2** *In a multi-country setting with large countries, higher wage flexibility (higher labor supply elasticity) can lead to larger employment effects. However, this can be a magnification of losses or gains.*

The ambiguity stressed in Observation 2 is linked to Observation 1. Given ambiguity in the change in employment levels, this ambiguity can itself be magnified by labor market conditions. Indeed, it is the case that, in an

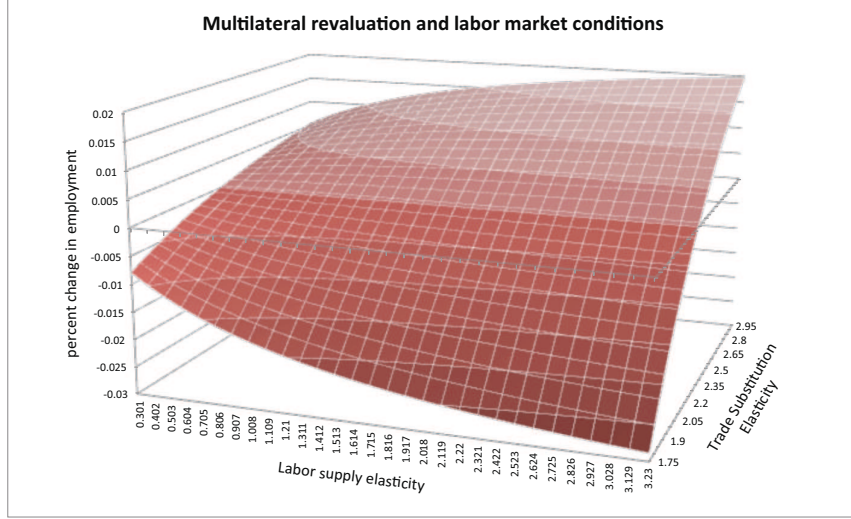


Figure 2: wage flexibility and employment

equilibrium characterized by revaluation generating employment, situations of relatively flat labor supply can yield even greater job gains. They can also yield even greater jobs losses. Note also the importance of trade substitution (the extent to which China's goods can be substituted following revaluation), as stated in the Proposition 3.

**Observation 3** *In the numerical model, the easier it is to substitute away from more expensive (revalued) inputs toward other inputs, the greater the job gains or smaller the job losses.*

The relationship stressed in Observation 3 can be seen in Figures 1 and 2 above and Figure 3, which is discussed below.

Finally, both panels of Figure 3 map a range of results for variation in the ease to substitute between value added and inputs. The focus on substitutability in production highlights the extent to which domestic value added can be used in lieu of higher priced imports. Following from Observation 1, Figure 3 again highlights ambiguity, in particular depending on the trade

substitution elasticity. In addition, the numerical results also illustrate that there is ambiguity with respect to the degree of substitution between inputs and value added in equation (13). When we have jobs losses, these are magnified in our numerical examples as we increase this value. However when we have job gains, these are also magnified as we increase the degree of substitution between inputs and value added  $\rho$ . On the basis of the simulations,

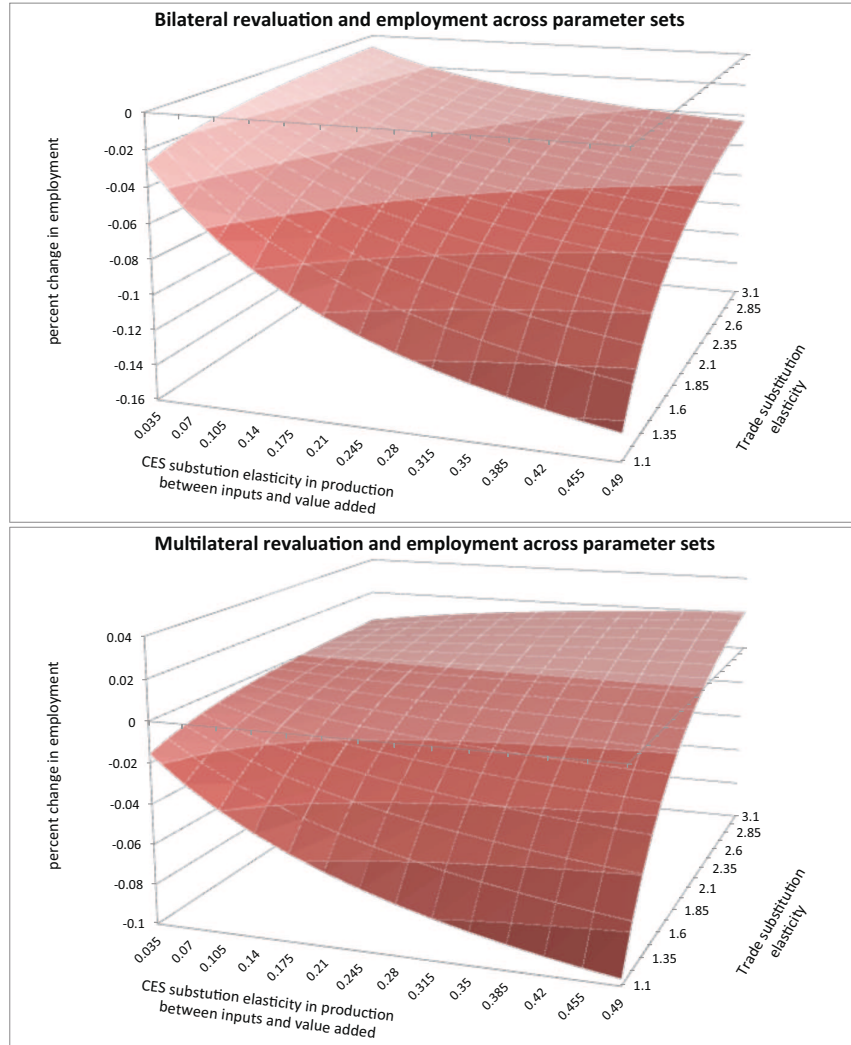


Figure 3: substitution between inputs and value added

we make the following observation.

**Observation 4** *In a multi-country setting with large countries, the impact on employment depends on the combination of the degree of substitution in production between inputs and value added, and between sources of inputs (the trade substitution elasticity).*

The mechanics driving this last observation are those drawn out in the analytical discussion above. Increased prices of intermediates can reduce demand for labor in a setting with imperfect substitutability between intermediates and labor (a volume effect), though this is weakened by greater degrees of substitution (an input price effect). On top of this, increased prices of imported consumer goods drive up wage demands, which also reduces demand for labor (a consumer price). From Figure 3, how these work out on net can involve gains or losses in jobs following revaluation by a trading partner.

## 5 Summary and Closing Remarks

In this paper we have extended the de Melo and Robinson (1986) model of production and trade to include intermediate linkages and variable labor market conditions. We have used this to study the employment effects of bilateral revaluation on employment. A basic contribution to the literature is the focus on bilateral rather than general revaluation, and the emphasis on the composition of imports in this context.

Analytically, we focus individually on factors like technology, the bilateral balance of trade, and the composition of imports. This is complemented by numerical analysis with a calibrated numerical model, used to highlight the interaction of factors examined individually in the analytics. With fully flexible labor markets and full pass-through, employment increases with ap-

preciation of one of the trading partners when the fraction exported to the trading partner is larger than the fraction imported. With sticky wages, a larger fraction of intermediate inputs in production makes it more likely that the negative supply side effects dominate positive demand effects. A smaller degree of stickyness of price expectations in wage formation and a smaller importer pass through make the negative supply side effects smaller. In the numerics, the ability to substitute for higher cost inputs following a trading partner revaluation proves critical to the direction of employment changes. General labor market conditions, in terms of wage sensitivity to increased labor demand, also prove critical to the magnitude of employment effects. Indeed, depending on technology, weaker labor markets may imply magnified job gains or losses following revaluation.

Our focus here has been on direct employment effects of exchange rate realignment linked to relative price changes, rather than the issue of sustainability of current account imbalances. In the current context of both China (vis-a-vis the US) and Germany (vis-a-vis the euro zone), these provide additional channels to argue about macroeconomic effects of real exchange rate misalignment outside the scope of this paper. With respect to the framework explored here, extensions that combine real misalignment with a sub-set of countries (like within the euro) might be particularly fruitful.

## References

- BODENSTEIN, M., C.J. ERCEG AND L. GUERRIERI (2009). 'The Effects of Foreign Shocks when Interest Rates are at Zero.' International Finance Discussion Papers Federal Reserve, No. 983.
- DEVARAJAN, S., D.S. GO, J.D. LEWIS, S. ROBINSON, P. SINKO (1998). 'Simple General Equilibrium Modeling.' In: FRANCOIS, J.F. AND K. REINERT (1998). *Applied Methods for Trade Policy Analysis*. Cambridge University Press.
- DIAZ-ALEJANDRO (1963). 'A Note on The Impact of Devaluation and Distributive Effects.' *Journal of Political Economy* 71: 577-580.
- EDWARDS, S. (1986). 'Are Devaluations Contractionary?' *Review of Economics and Statistics* 68: 501-508.
- ERCEG, C.J., L. GUERRIERI AND C. GUST (2006). 'SIGMA: A New Open Economy Model for Policy Analysis.' *International Journal of Central Banking*: 1-50.
- FAIR, R.C. (2010). 'Estimated Macroeconomic Effects of a Chinese Yuan Appreciation.' Cowles Foundation Discussion Paper, No. 1755.
- HIRSCHMAN, A.O. (1949). 'Devaluation and The Trade Balance: A Note.' *Review of Economics and Statistics* 16: 50-53.
- KRUGMAN, P. AND TAYLOR, L. (1978). 'Contractionary Effects of Devaluation.' *Journal of Development Economics* 8: 445-456.
- MAGEE, C.S.P. AND S.P. MAGEE (2008). 'The United States Is a Small Country in World Trade.' *Review of International Economics* 16(5): 990-1004.



- MANKIW, N. GREGORY AND RICARDO REIS (2010). 'Imperfect Information and Aggregate Supply.' NBER Working Paper No. 15773.
- DE MELO, JAIME AND SHERMAN ROBINSON (1989). 'Product Differentiation and the Treatment of Foreign Trade in Computable General Equilibrium Models of Small Economies.' *Journal of International Economics* 27: 47-67.
- SMETS, FRANK AND RAF WOUTERS (2003). 'An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area.' *Journal of the European Economic Association* 1(5): 1123-1175.
- VAN WIJNBERGEN, SWEDER V. (1986). 'Exchange Rate Management and Stabilization Policies in Developing Countries.' *Journal of Development Economics* 23: 227-247.

## Appendix A Derivations Basic Model

Equation (23)

Start by log differentiating equations (10) and (11) substituting into the log differentiation of equations (8) and (9) to get:

$$\widehat{p}_m = s_{m,i} \widehat{R}_i \quad (\text{A.1})$$

$$\widehat{p}_e = s_{e,i} \widehat{R}_i \quad (\text{A.2})$$

Next, log differentiate equations (6) and (5), using (A.1) and (A.2):

$$s_{m,i} \widehat{M}_i - \widehat{D} = \sigma (\widehat{p}_d - s_{m,i} \widehat{R}_i) \quad (\text{A.3})$$

$$s_{e,i} \widehat{E}_i - \widehat{D} = \theta (s_{e,i} \widehat{R}_i - \widehat{p}_d) \quad (\text{A.4})$$

Combining equations (A.3) and (A.4) leads to:

$$\begin{aligned} s_{m,i} \widehat{M}_i - \sigma (\widehat{p}_d - s_{m,i} \widehat{R}_i) &= s_{e,i} \widehat{E}_i - \theta (s_{e,i} \widehat{R}_i - \widehat{p}_d) \\ s_{e,i} \widehat{E}_i - s_{m,i} \widehat{M}_i &= \theta (s_{e,i} \widehat{R}_i - \widehat{p}_d) - \sigma (\widehat{p}_d - s_{m,i} \widehat{R}_i) \\ s_{e,i} \widehat{E}_i - s_{m,i} \widehat{M}_i &= (\theta s_{e,i} + \sigma s_{m,i}) \widehat{R}_i - (\theta + \sigma) \widehat{p}_d \end{aligned} \quad (\text{A.5})$$

Log differentiating the BoP condition, equation (12), assuming that we start from balanced trade, gives:

$$dB = s_{m,i} (\widehat{M}_i + \widehat{R}_i) - s_{e,i} (\widehat{E}_i + \widehat{R}_i) \quad (\text{A.6})$$

Substituting equation (A.5) into equation (A.6) implies the equation for the relative change of  $p_d$  in the main text, equation (23)

Equation (19)

Log differentiating equations (13)-(15) gives:

$$\widehat{X} = \lambda_L \widehat{L} + \lambda_I \widehat{I} \quad (\text{A.7})$$

$$\widehat{I} = \rho (\widehat{p}_x - \widehat{p}_q) + \widehat{X} \quad (\text{A.8})$$

$$\widehat{L} = \rho (\widehat{p}_x - \widehat{w}) + \widehat{X} \quad (\text{A.9})$$

$$\widehat{w} = \xi_{p_q} \widehat{p}_q + \frac{1}{\varphi} \widehat{L} \quad (\text{A.10})$$

Substituting equation (A.7) into equations (A.8) and (A.9) and solving for  $\widehat{L}$  generates:

$$\widehat{L} = \rho \frac{1}{1 - \lambda_I - \lambda_L} \widehat{p}_x - \rho \frac{1 - \lambda_I}{1 - \lambda_I - \lambda_L} \widehat{w} - \rho \frac{\lambda_I}{1 - \lambda_I - \lambda_L} \widehat{p}_q \quad (\text{A.11})$$

## Appendix B The Numerical Model

The numerical model is described by the following set of equations. Variables with a subscript  $ij$  indicate flows from country  $i$  to country  $j$ .

$$X_i = G_i(E_i, D_{s,i}) = \left( \beta_{E_i} E_i^{\frac{\theta+1}{\theta}} + \beta_{D_{s,i}} D_{s,i}^{\frac{\theta+1}{\theta}} \right)^{\frac{\theta}{\theta+1}} \quad (\text{B.1})$$

$$Q_i = F_i(M_i, D_{d,i}) = \left( \alpha_{M_i} M_i^{\frac{\sigma-1}{\sigma}} + \alpha_{D_{d,i}} D_{d,i}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad (\text{B.2})$$

$$M_{ji} = \left( \frac{p_{m_{ji}}}{\gamma_{ji} p_{m_i}} \right)^{-\eta} M_i \quad (\text{B.3})$$

$$E_{ij} = \left( \frac{p_{e_{ij}}}{\delta_{ij} p_{e_i}} \right)^{\omega} E_i \quad (\text{B.4})$$

$$p_{q_i} = \left( \alpha_{M_i}^{\sigma} p_{m_i}^{1-\sigma} + \alpha_{D_{d,i}}^{\sigma} p_{d_i}^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \quad (\text{B.5})$$

$$p_{x_i} = \left( \beta_{E_i}^{-\theta} p_{e_i}^{\theta+1} + \beta_{D_{s,i}}^{-\theta} p_{d_i}^{\theta+1} \right)^{\frac{1}{\theta+1}} \quad (\text{B.6})$$

$$p_{m_i} = \left( \sum_{j \neq i}^N \gamma_{ji}^{\eta} p_{m_{ji}}^{1-\eta} \right)^{\frac{1}{1-\eta}} \quad (\text{B.7})$$

$$p_{e_i} = \left( \sum_{j \neq i}^N \delta_{ij}^{-\omega} p_{e_{ij}}^{\omega+1} \right)^{\frac{1}{\omega+1}} \quad (\text{B.8})$$

$$R_{ij} p_{e_{ij}} = p_{m_{ij}} \quad (\text{B.9})$$

$$E_{ij} = M_{ij} \quad (\text{B.10})$$

$$\frac{M_i}{D_{d,i}} = \left( \frac{\alpha_{M_i} p_{d_i}}{\alpha_{D_{d,i}} p_{m_i}} \right)^{\sigma} \quad (\text{B.11})$$

$$\frac{E_i}{D_{s,i}} = \left( \frac{\beta_{D_{s,i}} p_{e_i}}{\beta_{E_i} p_{d_i}} \right)^{\theta} \quad (\text{B.12})$$

$$B_i = p_{m_i} M_i - p_{e_i} E_i \quad (\text{B.13})$$

$$B_i = \bar{B} \quad (\text{B.14})$$

$$D_{d_i} - D_{s_i} = 0 \quad (\text{B.15})$$

$$X_i = \left( \phi_{I_i} I_i^{\frac{\rho-1}{\rho}} + \phi_{L_i} L_i^{\frac{\rho-1}{\rho}} + \phi_{K_i} K_i^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} \quad (\text{B.16})$$

$$I_i = \left( \phi_{I_i} \frac{p_{x_i}}{p_{q_i}} \right)^{\rho} X_i \quad (\text{B.17})$$

$$L_i = \left( \phi_{L_i} \frac{p_{x_i}}{w_i} \right)^{\rho} X_i \quad (\text{B.18})$$

$$w_i = p_{q_i}^e L_i^{\frac{1}{\varphi_i}} \quad (\text{B.19})$$

$R_{ij}$  is the exchange rate between country  $i$  and  $j$  or more specifically the price of the currency of country  $i$  expressed in terms of the currency of country  $j$ . So, an increase in  $R_{ij}$  reflects an appreciation of the currency of country  $i$  relative to the currency of country  $j$ .

All the equations are as in the small economy model, we added equations for import demand and export supply per country (B.3) and (B.4) and an equation imposing that the exports of country  $i$  to country  $j$  are equal to the imports of country  $j$  from country  $i$ .

We get  $15N + 4(N - 1)N$  equations in the same number of unknowns, the following 15 variables per country:

$$X_i, Q_i, M_i, E_i, D_{d_i}, D_{s_i}, p_{x_i}, p_{q_i}, p_{d_i}, p_{e_i}, p_{m_i}, B_i, I_i, L_i, w_i$$

and the  $N - 1$  variables  $M_{ij}, E_{ij}, p_{m_{ij}}, p_{e_{ij}}$  per country.

The model is calibrated to macroeconomic data for 2007, based on data from the IMF's World Economic Outlook database and the GTAPv8 database from the GTAP Project.

Running experiments, we add two sets of equations for sticky prices and wages. Incomplete adjustment of the price expectations in wage formation implies:

$$\widehat{p_{q_i}^e} = \xi_{p_{q_i}} \widehat{p_{q_i}} \quad (\text{B.20})$$

Incomplete pass through implies:

$$\widehat{p_{m_{ij}}} = \xi_{p_{m_{ij}}} \left( \widehat{R_{ij}} + \widehat{p_{e_{ij}}} \right) \quad (\text{B.21})$$

To model changes in the trade balance, we distinguish between the cases where the Marshall Lerner condition is and is not satisfied. We work with the following equation for the changing trade balance:

$$\widehat{B_{ij}} = \mu \text{sign}(B_{ij}) \widehat{R_{ij}} \quad (\text{B.22})$$

$\mu > 0$  and  $\mu < 0$  reflect respectively the situations where the Marshall Lerner is and is not satisfied. If the initial capital balance is positive ( $B_{ij} > 0$ ) and  $\mu > 0$ , an appreciation of the currency of country  $i$  relative to country  $j$  raises  $B_{ij}$ , so increases capital inflows into the country. If the initial capital balance is negative and  $\mu > 0$ , an appreciation of the currency of country  $i$  relative to country  $j$  should raise  $B_{ij}$  as well and so should decrease  $B_{ij}$  in absolute terms. Therefore, we have to add the  $\text{sign}(B_{ij})$  term.

The change in the total trade balance is a function of the sum of the bilateral trade balance changes:

$$\begin{aligned} \widehat{B_i} &= \sum_{j \neq i} \frac{B_{ij}}{B_i} \widehat{B_{ij}} \\ &= \sum_{j \neq i} \frac{B_{ij}}{B_i} \mu \text{sign}(B_{ij}) \widehat{R_{ij}} \end{aligned} \quad (\text{B.23})$$

We need to set values for the following parameters,  $\theta, \sigma, \eta, \omega, \rho, \varphi_i$  and the taste parameters  $\beta_{E_i}, \alpha_{M_i}, \gamma_{ij}, \delta_{ij}, \phi_I, \phi_L, \phi_K$  and the scale parameters  $\overline{A_i}$ . The chosen values of the parameters are displayed in [2](#). To get expressions for the taste parameters we can set all prices at 1 in the baseline scenario and express the taste parameters and scale parameters as a function of the

Table 2: Values of Parameters

parameters in benchmark
$\theta = 10$
$\sigma = 1.25$
$\eta = 1.25$
$\omega = 30$
$\rho = 0.35$
$\varphi = 1.5$
$\mu = 0.05$
$\xi_{p_q} = 1$
$\xi_{p_m} = 0.9$

value shares:<sup>7</sup>

$$\begin{aligned}
\delta_{ij} &= \left( \frac{E_{ij}p_{e_{ij}}}{E_i p_{e_i}} \right)^{-\frac{1}{\omega}} \left( \frac{p_{e_{ij}}}{p_{e_i}} \right)^{\frac{\omega+1}{\omega}} = \left( \frac{E_{ij}p_{e_{ij}}}{E_i p_{e_i}} \right)^{-\frac{1}{\omega}} \\
\gamma_{ji} &= \left( \frac{M_{ji}p_{m_{ji}}}{M_i p_{m_i}} \right)^{\frac{1}{\eta}} \left( \frac{p_{e_{ij}}}{p_{e_i}} \right)^{\frac{\eta-1}{\eta}} = \left( \frac{M_{ji}p_{m_{ji}}}{M_i p_{m_i}} \right)^{\frac{1}{\eta}} \\
\alpha_{M_i} &= \left( \frac{M_i p_{m_i}}{Q_i p_{q_i}} \right)^{\frac{1}{\sigma}} \\
\alpha_{D_i} &= \left( 1 - \frac{M_i p_{m_i}}{Q_i p_{q_i}} \right)^{\frac{1}{\sigma}} \\
\beta_{E_i} &= \left( \frac{E_i p_{e_i}}{X_i p_{x_i}} \right)^{-\frac{1}{\theta}} \\
\beta_{D_i} &= \left( 1 - \frac{E_i p_{e_i}}{X_i p_{x_i}} \right)^{-\frac{1}{\theta}} \\
\phi_{I_i} &= \left( \frac{I_i p_{q_i}}{X_i p_{x_i}} \right)^{\frac{1}{\rho}} \\
\phi_{L_i} &= \left( \frac{L_i w_i}{X_i p_{x_i}} \right)^{\frac{1}{\rho}} \\
\phi_{K_i} &= \left( \frac{K_i r_i}{X_i p_{x_i}} \right)^{\frac{1}{\rho}} \\
\overline{A_i} &= \left( \frac{L_i}{\overline{X_i}} \right)^{-\frac{1}{\varphi_i}}
\end{aligned}$$

---

<sup>7</sup>If in the baseline prices are not equal to 1, this just means that volumes of the different variables are measured in different units.

## **Short list of the most recent wiiw publications** (as of June 2012)

For current updates and summaries see also  
wiiw's website at [www.wiiw.ac.at](http://www.wiiw.ac.at)

### **Bilateral Exchange Rates and Jobs**

by **Eddy Bekkers and Joseph Francois**

wiiw Working Papers, No. 83, June 2012  
31 pages including 2 Tables and 3 Figures  
hardcopy: EUR 8.00 (PDF: free download from wiiw's website)

---

### **Import Prices, Income, and Inequality**

by **Eddy Bekkers, Joseph Francois and Miriam Manchin**

wiiw Working Papers, No. 82, June 2012  
44 pages including 4 Tables  
hardcopy: EUR 8.00 (PDF: free download from wiiw's website)

---

### **Trade in Value Added and the Valued Added in Trade**

by **Robert Stehrer**

wiiw Working Papers, No. 81, June 2012  
20 pages including 7 Tables and 1 Figure  
hardcopy: EUR 8.00 (PDF: free download from wiiw's website)

---

### **Wirtschaftsentwicklung divergiert in den kommenden Jahren auch in Mitteleuropa, Ost- und Südosteuropa zwischen Norden und Süden**

by **Vasily Astrov, Doris Hanzl-Weiss, Mario Holzner and Sebastian Leitner**

wiiw Research Papers in German language, June 2012  
(reprinted from: WIFO-Monatsberichte, Vol. 85, No. 5, May 2012)  
10 pages including 5 Tables and 4 Figures  
hardcopy: EUR 8.00 (PDF: free download from wiiw's website)

---

### **Value Added and Factors in Trade: A Comprehensive Approach**

by **Robert Stehrer, Neil Foster and Gaaitzen de Vries**

wiiw Working Papers, No. 80, June 2012  
23 pages including 9 Tables  
hardcopy: EUR 8.00 (PDF: free download from wiiw's website)

---

### **wiiw Monthly Report 6/12**

edited by **Leon Podkaminer**

- The transformation of international financial markets and the future of the eurozone
  - The harmonisation of banking supervision: a chokehold
  - The impact of offshoring on the skill structure of labour demand
  - Statistical Annex: Selected monthly data on the economic situation in Central, East and Southeast Europe
- wiiw, June 2012  
30 pages including 15 Tables and 4 Figures  
(exclusively for subscribers to the wiiw Service Package)



## **International spillovers in a world of technology clubs**

by Roman Stöllinger

wiiw Working Papers, No. 79, May 2012  
25 pages including 8 Tables and 3 Figures  
hardcopy: EUR 8.00 (PDF: free download from wiiw's website)

### **wiiw Monthly Report 5/12**

edited by **Leon Podkaminer**

- Interim Romanian government sworn in: any room for manoeuvring?
- Croatia's EU membership: lessons from earlier accessions
- The cold civil war in Poland
- Statistical Annex: Selected monthly data on the economic situation in Central, East and Southeast Europe

wiiw, May 2012  
22 pages including 8 Tables  
(exclusively for subscribers to the wiiw Service Package)

---

## **Convergence of Knowledge-intensive Sectors and the EU's External Competitiveness**

by Robert Stehrer et al.

wiiw Research Reports, No. 377, April 2012  
123 pages including 30 Tables and 60 Figures  
hardcopy: EUR 8.00 (PDF: free download from wiiw's website)

---

### **wiiw Monthly Report 4/12**

edited by **Leon Podkaminer**

- Slovakia after the elections
- Labour market issues in Europe's Eastern and Western Balkan neighbours
- Net private savings in relation to the government's financial balance
- Statistical Annex: Selected monthly data on the economic situation in Central, East and Southeast Europe

wiiw, April 2012  
28 pages including 10 Tables and 4 Figures  
(exclusively for subscribers to the wiiw Service Package)

---

## **New Divide(s) in Europe?**

by Vladimir Gligorov, Mario Holzner, Michael Landesmann, Sebastian Leitner, Olga Pindyuk, Hermine Vidovic et al.

wiiw Current Analyses and Forecasts. Economic Prospects for Central, East and Southeast Europe, No. 9, March 2012  
161 pages including 34 Tables and 23 Figures  
hardcopy: EUR 80.00 (PDF: EUR 65.00)

---

### **wiiw Monthly Report 3/12**

edited by **Leon Podkaminer**

- The European Union and the MENA countries: fostering North-South economic integration
- Europe's position in trade in knowledge-intensive business services
- What kind of socio-economic order do we need in Europe?
- Statistical Annex: Selected monthly data on the economic situation in Central, East and Southeast Europe

wiiw, March 2012  
26 pages including 9 Tables and 5 Figures  
(exclusively for subscribers to the wiiw Service Package)

## **wiiw Monthly Report 2/12**

edited by **Leon Podkaminer**

- Higher global grain output but still fairly high food prices
- The speed of catch-up depends on human capital
- Two transitions: a brief on analyses and policies for MENA and CESEE
- Statistical Annex: Selected monthly data on the economic situation in Central, East and Southeast Europe

wiiw, February 2012

24 pages including 11 Tables and 4 Figures

(exclusively for subscribers to the wiiw Service Package)

---

## **Transition in the MENA Region: Challenges, Opportunities and Prospects**

by Vladimir Gligorov, Peter Havlik, Sándor Richter and Hermine Vidovic

wiiw Research Reports, No. 376, January 2012

68 pages including 16 Tables and 10 Figures

hardcopy: EUR 24.00 (PDF: EUR 15.00)

---

## **wiiw Monthly Report 1/12**

edited by **Leon Podkaminer**

- Hungary suffers from a severe lack of credibility
- Russia's WTO accession: impacts on Austria
- The impact of customs procedures on business performance: evidence from Kosovo
- Statistical Annex: Selected monthly data on the economic situation in Central, East and Southeast Europe

wiiw, January 2012

28 pages including 14 Tables

(exclusively for subscribers to the wiiw Service Package)

---

## **Reallocation Gains in a Specific Factors Model with Firm Heterogeneity**

by **Eddy Bekkers and Robert Stehrer**

wiiw Working Papers, No. 77, December 2011

23 pages including 7 Tables

hardcopy: EUR 8.00 (PDF: free download from wiiw's website)

---

## **Models for Stability and Growth, Structural Reforms, Conditionality, and EU Surveillance Criteria**

by Vladimir Gligorov

wiiw Research Reports, No. 375, December 2011

30 pages including 2 Tables and 1 Figure

hardcopy: EUR 24.00 (PDF: EUR 15.00)

### **wiiw Service Package**

The Vienna Institute offers to firms and institutions interested in unbiased and up-to-date information on Central, East and Southeast European markets a package of exclusive services and preferential access to its publications and research findings, on the basis of a subscription at an annual fee of EUR 2,000.

This subscription fee entitles to the following package of **Special Services**:

- A free invitation to the Vienna Institute's **Spring Seminar**, a whole-day event at the end of March, devoted to compelling topics in the economic transformation of the Central and East European region (for subscribers to the wiiw Service Package only).
- Copies of, or online access to, **The Vienna Institute Monthly Report**, a periodical consisting of timely articles summarizing and interpreting the latest economic developments in Central and Eastern Europe and the former Soviet Union. The statistical annex to each *Monthly Report* contains, alternately, country-specific tables or graphs with monthly key economic indicators, economic forecasts, the latest data from the wiiw Industrial Database and excerpts from the wiiw FDI Database. This periodical is not for sale, it can only be obtained in the framework of the wiiw Service Package.
- Free copies of the Institute's **Research Reports** (including *Reprints*), **Current Analyses and Forecasts**, **Country Profiles** and **Statistical Reports**.
- A free copy of the **wiiw Handbook of Statistics** (published in October/November each year and containing more than 400 tables and graphs on the economies of Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Russia, Serbia, the Slovak Republic, Slovenia and Ukraine)
- Free online access to the **wiiw Monthly Database**, containing more than 1200 leading indicators monitoring the latest key economic developments in ten Central and East European countries.
- **Consulting**. The Vienna Institute is pleased to advise subscribers on questions concerning the East European economies or East-West economic relations if the required background research has already been undertaken by the Institute. We regret we have to charge extra for *ad hoc* research.
- Free access to the Institute's specialized economics library and documentation facilities.

Subscribers who wish to purchase wiiw data sets **on CD-ROM** or special publications not included in the wiiw Service Package are granted considerable **price reductions**.

**For detailed information about the wiiw Service Package  
please visit wiiw's website at [www.wiiw.ac.at](http://www.wiiw.ac.at)**

To  
The Vienna Institute  
for International Economic Studies  
Rahlgasse 3  
A-1060 Vienna

- ☐ Please forward more detailed information about the Vienna Institute's Service Package
- ☐ Please forward a complete list of the Vienna Institute's publications to the following address

Please enter me for

- ☐ 1 yearly subscription of *Research Reports* (including *Reprints*) at a price of EUR 120.00 (hardcopy, Austria), EUR 135.00 (hardcopy, Europe), EUR 155.00 (hardcopy, overseas) and EUR 48.00 (PDF download with password) respectively
- ☐ 1 yearly subscription of *Current Analyses and Forecasts* a price of EUR 150.00 (hardcopy, Austria), EUR 155.00 (hardcopy, Europe), EUR 170.00 (hardcopy, overseas) and EUR 120.00 (PDF download with password) respectively

Please forward

- ☐ the following issue of *Research Reports* .....
- ☐ the following issue of *Current Analyses and Forecasts* .....
- ☐ the following issue of *Working Papers* .....
- ☐ the following issue of *Research Papers in German language* .....
- ☐ the following issue of *wiiw Database on Foreign Direct Investment* .....
- ☐ the following issue of *wiiw Handbook of Statistics* .....
- ☐ (other) .....

.....  
Name

.....  
Address

.....  
Telephone

Fax

E-mail

.....  
Date

.....  
Signature

---

Herausgeber, Verleger, Eigentümer und Hersteller:

Verein „Wiener Institut für Internationale Wirtschaftsvergleiche“ (wiiw),  
Wien 6, Rahlgasse 3  
ZVR-Zahl: 329995655

Postanschrift: A-1060 Wien, Rahlgasse 3, Tel: [+431] 533 66 10, Telefax: [+431] 533 66 10 50

Internet Homepage: [www.wiiw.ac.at](http://www.wiiw.ac.at)

Nachdruck nur auszugsweise und mit genauer Quellenangabe gestattet.

P.b.b. Verlagspostamt 1060 Wien