Felbermayr, Gabriel; Larch, Mario; Wolfgang, Lechthaler

Working Paper

Endogenous Labor Market Insitutions in an Open Economy

ifo Working Paper, No. 108

Provided in Cooperation with:
Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

Ifo Institute for Economic Research at the University of Munich

Endogenous Labor Market Institutions in an Open Economy

Gabriel J. Felbermayr
Mario Larch
Wolfgang Lechthaler

Ifo Working Paper No. 108

August 2011

Ifo Working Paper No. 108

Endogenous Labor Market Institutions in an Open Economy*

Abstract

The paper sets up a two-country asymmetric trade model with heterogeneous firms, search frictions and endogenous labor market institutions. Countries are linked by trade in goods and non-cooperatively set unemployment benefits to maximize national welfare. We show that more open and smaller economies have more generous unemployment benefit replacement rates as a larger fraction of the costs is borne by foreign trading partners. These results are in line with empirical stylized facts. Additionally, we find that the optimal level of unemployment benefits is independent from the level of unemployment benefits abroad and that non-cooperatively set unemployment rates are inefficiently high.

JEL Code: F11, F12, F16, J64, L11.
Keywords: Endogenous labor market institutions, unemployment, international trade, search frictions, heterogeneous firms.

Gabriel J. Felbermayr
Ifo Institute for Economic Research
at the University of Munich
and University of Munich
CESifo, and GEP
Poschingerstr. 5
81679 Munich, Germany
Phone: +49(0)89/9224-1428
felbermayr@ifo.de

Mario Larch
Chair of Empirical Economic Research
University of Bayreuth
CESifo, and GEP
Universitätsstraße 30
95440 Bayreuth, Germany
Phone: +49(0)921/55-2871
mario.larch@uni-bayreuth.de

Wolfgang Lechthaler
Kiel Institute for the World Economy
Düsternbrooker Weg 120
24105 Kiel, Germany
Phone: +49(0)431/8814-272
wolfgang.lechthaler@ifw-kiel.de

* We are grateful for excellent comments and suggestions to the editor Devashish Mitra and to an anonymous referee. Felbermayr thanks the Fritz Thyssen Foundation for financial support (Az.: 10.10.1.124.).

1 Introduction

Countries differ dramatically with respect to the generosity of their labor market institutions. For instance, OECD data show that the average net unemployment benefit replacement rate varies between about 82% in Denmark to 8% in Italy.[1] What are the determinants of these differences? Using data for OECD countries from 1961-2007, we present two stylized facts: the generosity of unemployment benefits is larger in more open economies and smaller in larger countries. This correlation holds unconditionally, but also survives conditioning on country effects or GDP per capita. It is both statistically and economically significant. So far, the literature has documented similar patterns for very general measures of government size (Rodrik, 1998) but not for the specific case of labor market institions. In this paper, we show that a plain vanilla combination of a workhorse trade model (Melitz, 2003) and the leading search-matching labor market paradigm (Pissarides and Pissarides, 1994), with governments choosing unemployment benefits non-cooperatively, yields implications that are consistent with these stylized facts.

Our model deviates from the standard search model by allowing firms to operate on declining marginal revenues schedules due to monopolistic competition. With individual intra-firm wage bargaining, this gives rise to an over-hiring externality. Firms hire workers beyond the point where employment costs equal marginal product. This reduces the threat point of the marginal worker whose contribution to the total value of the firm is depressed by expanding the work force. However, this strategic incentive is socially harmful as it increases the tightness of the labor market beyond the constrained Pareto efficient level. This implies that, in the context of monopoly power on the product markets and individual bargaining, the well-known Hosios condition, that guarantees efficiency of the decentralized equilibrium in the standard search model, is no longer sufficient. So, our model generates a welfare rationale for the existing of unemployment benefits while the standard model would not, in particular if the Hosios condition is fulfilled.

We use this framework to study trade between two asymmetric countries. Since our stylized

[1] Averaged over four family situations and over 60 months of unemployment.

facts hinge on data from OECD countries, where trade is mostly of the intra-industry type, we work with a one-sector model of trade in differentiated goods. However, we allow for an endogenous non-traded sector, since firms with low levels of labor productivity will sell only to domestic consumers, foreign markets being too costly to enter. For the sake of simplicity, we assume that governments set unemployment benefits to maximize the representative agent's welfare and that benefits are financed in a non-distortive fashion.[2] In a closed economy, governments would fully internalize the effect of unemployment benefits on the size of demand for their firms. In a model with monopolistic competition and increasing returns to scale at the firm-level, market size is a key variable as it determines the number of varieties available to consumers. With international trade, domestic consumers purchase varieties from foreign firms and domestic firms sell to foreign consumers. Taking the foreign market size as given, the government does not internalize the effect of its policies for foreign firms nor does it internalize their effect on foreign demand for domestic varieties. Since that externality is negative, it follows that, in a non-cooperative Nash equilibrium, governments set unemployment benefits too generously than if they would set them cooperatively. It also follows that the extent to which countries depend on foreign markets matters. Countries that are more open or that are smaller rely to a larger extent on foreign demand for their exports and on foreign production for their imports. In those countries, the externality is larger and hence benefits are provided more generously.

In this paper, we show that the intuition sketched above holds in an asymmetric two-country version of the model by Felbermayr, Prat, and Schmerer (2011), who have introduced labor market search frictions into the perfectly symmetric Melitz (2003) trade model. That symmetric model is fully understood analytically. It is well known, that asymmetric models of that kind cannot be solved analytically so that we resort to a calibration-cum-simulation approach. This has tradition in the macro labor literature, but also in the trade literature; see Bernard, Redding and Schott (2007). In a fully standard calibration of the model satisfying the parametrical restriction implied by the Hosios condition (in absence of monopoly power), we show that the over-hiring externality implies an optimal gross unemployment benefit replacement rate of about 12%. Violating the Hosios condition, we calibrate the elasticity of the matching function, for

[2]The most interesting alternative assumption would probably be to study lobbying for or against generous benefit systems by trade unions and firms.

which empirical estimates are fairly uncertain in order to replicate the 40% gross replacement rate in the data. For given bargaining power of workers, this implies a stronger monopsony position of firms, but the required violation of the Hosios condition remains minor. We show that welfare maximizing unemployment benefits are decreasing in variable trade costs so that more open economies opt for more generous benefits. We also show that domestic market size is negatively correlated with generosity of unemployment benefits.

While other papers highlight the role of uncertainty for the correlation between openness and government size (Rodrik, 1998) or terms-of-trade effects (Epifani and Gancia, 2009), we illustrate a new mechanism that relates to the role of market size. Moreover, we focus on a very specific feature of the welfare state: unemployment benefits.

Related literature. Our paper is related to at least three strands of literature. First, the literature provides essentially three efficiency reasons why non-zero unemployment benefits are optimal. In the context of the standard (linear utility) Pissarides (2000) search-and-matching framework, a violation of the Hosios condition (workers' bargaining power *smaller* than elasticity of the matching function with respect to vacancies relative to searching workers) gives firms too much local monopsony power while workers have too little relative bargaining power; this can be remedied by unemployment benefits. When wages are not bargained between workers and employers but posted as take-it-or-leave-it offers by employers, then monopsony power of firms again warrants policy intervention. Burdett-Mortensen (1998) show that in this context unemployment benefits are efficiency enhancing.[3] A second line of thinking views benefits as search subsidies that can enhance efficiency when the composition of jobs matters. Acemoglu (2001) changes the standard Pissarides (2000) model in that he allows vacancy creation costs to differ across sectors. Those costs have to be sunk before wages are bargained and are irreversible. In this situation, workers can extract higher wages in the high-cost sector where the hold-up problem is larger. Firms create too little high-cost jobs, and job composition is inefficient. Unemployment benefits can remedy this in that they make low-cost jobs particularly more expensive. Other papers, such as Marimon and Zilibotti (1999) make similar arguments

[3]Manning (2006) shows that, when unemployment benefits are conditioned on search activities (i.e. not granted if agents exit from the labor market altogether), they can restore the first-best allocation.

but work with a model that features two-sided heterogeneity. A last welfare argument relies on insurance. When financial markets are incomplete and workers are risk averse, there is an efficiency rationale for unemployment insurance. Acemoglu and Shimer (1999) develop a search-and-matching model for risk-averse workers which deviates significantly from the standard Pissarides or Burdett-Mortensen models. Workers queue for jobs, and workers post wages. In that setup, they show how unemployment benefits work as insurance. In our paper we follow the monopsony tradition because this is most straight-forwardly implemented in a canonical search model with international trade.

Our paper is also related to a large and growing literature on the interaction between international trade and labor market outcomes under search frictions or other non-Walrasian features. Davidson, Martin, and Matusz (1988, 1999) and Dutt, Mitra and Ranjan (2009) have implemented search frictions into a Heckscher-Ohlin model of international trade. More recently, research has turned towards trade models featuring monopolistic competition as in Krugman (1980) and firm-level heterogeneity as in Melitz (2003). While Egger and Kreickemeier (2009) draw on the fair wage approach, Helpman and Itskhoki (2010) and Felbermayr, Prat, and Schmerer (2011) use the search and matching approach. It is well known that models featuring monopolistic competition and country asymmetries, while realistic, do no allow analytical results. There are suggestions to overcome this problem.[4] However, all these strategies have shortcomings. For example, the symmetry assumption does not allow to study endogenous labor market institutions, as in order to do so, countries have to be allowed to be potentially asymmetric. And ruling out income effects via an outside good shuts down an important transmission channel between trading countries. Therefore, the present paper adopts a calibration-cum-simulation approach as is customary in the macro labor literature. Also note that our work is related to a literature that views labor market institutions as sources for comparative advantage; see Cunat and Melitz (2010) for an example and further references.

Finally, our work relates to research on the role of openness and market extension for the

[4]For example, concentrate on symmetric countries, fix expected wages in a numéraire sector that remains unaffected by monopoly power and trade costs, or fix the number of potential entrants. See Egger, Egger, and Markusen (2010), Egger and Kreickemeier (2008, 2009), Eckel and Egger (2009), Felbermayr, Prat, and Schmerer (2011a).

share of public spending in GDP. While we focus on a specific feature of the welfare state, unemployment benefits, Rodrik (1998) has more generally asked "Why do more open economies have bigger governments?". His response relies on the presumption that public spending provides insurance against the risks of international markets. Since smaller economies tend to be more open, country size is negatively related to public insurance; see also Alesina and Wacziarg (1998). More closely related to our work, Epifani and Gancia (2009) study the role of international spillovers and find empirical evidence for their terms-of-trade channel.

The remainder of the paper is structured as follows. Section 2 presents the stylized facts. Section 3 outlines the theoretical model. Section 4 describes the model calibration. Section 5 discusses the question whether there is a case for labor market institutions in the proposed framework. Section 6 investigates the relationship between optimal unemployment benefits and openness, whereas Section 7 discusses the relationship between optimal unemployment benefits and country size. Section 8 deals with the case where both countries set their optimal unemployment benefits simultaneously, whereas in Section 9 we investigate the outcome under cooperation. The last section concludes.

2 Stylized Facts

We motivate our analysis by two simple stylized facts: in the cross-section, openness to international trade and gross unemployment benefit replacement rates are positively correlated while market size is negatively correlated to the generosity of benefits. To illustrate these facts, we use data provided by the OECD on gross unemployment replacement rates for every second year from 1961 to 2007.[5] The data covers 29 OECD member states. In 2005, in our sample, the average gross replacement rate was about 24.9 with a standard deviation of 13.2. That measure does not include social assistance payments. The OECD also provides information on net replacement rates that do include social assistance payments.[6] The sample average for 2005

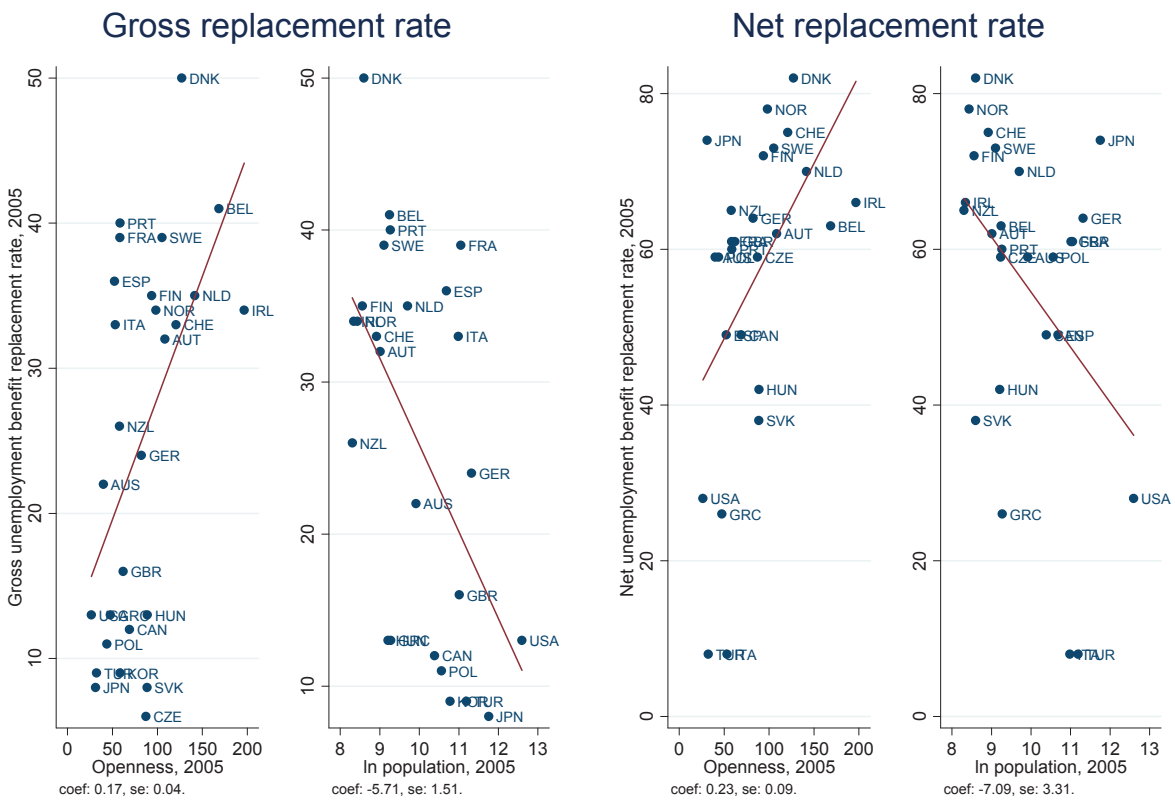
[5]The OECD summary measure is defined as the average of the gross unemployment benefit replacement rates for two earnings levels, three family situations and three durations of unemployment. Data is freely available at the site www.oecd.org/els/social/workincentives.

[6]The measure is calculated as the average over four family situations (single, married, with and without children) and over 60 months of unemployment.

is 55.8 with a standard deviation of 19.9. The correlation between the net and the gross measure is 0.47 (statistically significant at the 2% level).

Figure 1 provides scatter plots of openness or log population against the gross or net replacement rate for data from the year of 2005. Openness is measured based on the usual (imports+exports)/GDP measure, but using the correction proposed by Alcala and Ciccone (2004). The correlation in all diagrams is quite striking: more open economies have both higher gross and net replacement rates; larger economies (as measured by the log of population) have lower replacement rates, both gross and net. The partial correlations are statistically significant at the 1% level and economically quite substantial. An increase in the openness index by one standard deviation (42.33) is associated with a 7.20 percentage points increase in the net replacement rate and a 9.74 percentage points increase in the gross rate. A doubling of size lowers the gross rate by 4.43 percentage points and the net rate by 7.09 points. We do not want to argue for a causal relationship; the degree of openness as measured in the data and the replacement rate being both endogenous in our model. However, repeating the exercise illustrated in Figure 1 with initial openness (as of 1971) yields a very similar picture.

Table 2 provides more rigorous empirical evidence about the conditional effects of openness and size on the generosity of unemployment insurance, controlling also for GDP per capita. Rather than using the cross-section, it exploits the panel dimension of the OECD data. The first seven columns use the log of the gross replacement rate as the dependent variable; the last 2 columns use the log of the net replacement rate. Columns (1) to (6) draw on odd years from 1961-2007, while the net rates are available only from 2001 onwards until 2007. The sample of net rates is therefore considerably smaller. We use a log-log specification, so that all coefficients are interpreted as elasticities. Using a model in levels yields similar results, but the RMSE and R2 statistics suggest using the log-log approach.



Univariate linear regressions; robust standard errors (s.e.).

Figure 1: Openness, size, and the level of unemployment benefits.

Table 1: Openness and Unemployment benefits: Panel regressions

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	log **gross** replacement rate							log **net** replacement rate	
	Long panel							Short panel	
	pooled OLS	FE	FE	FE	RE	FE	FE	FE	FE
ln Openness	0.588***	0.563***	0.340*	0.518***	0.521***	0.268**	0.329**	0.485***	0.485***
	(0.087)	(0.182)	(0.182)	(0.192)	(0.162)	(0.132)	(0.163)	(0.182)	(0.180)
ln population	0.032		-2.423***	-2.434***	-0.026	-2.664***	-1.649**	-1.767**	-1.767**
	(0.035)		(0.474)	(0.471)	(0.076)	(0.450)	(0.670)	(0.743)	(0.738)
ln GDP per capita	-0.022			-0.705***	-0.073	-0.715***	-0.210	-1.302***	-1.304***
	(0.127)			(0.257)	(0.192)	(0.236)	(0.244)	(0.275)	(0.273)
Year dummies	YES	YES	YES	YES	YES	NO	YES	YES	NO
Linear and cubic time trends	NO	NO	NO	NO	NO	YES	NO	NO	YES
Number of observations	520	520	520	520	520	520	110	110	110
Number of countries	29	29	29	29	29	29	28	28	28
adj. R2 / within R2	0.25	0.38	0.39	0.34	0.34	0.38	0.29	0.13	0.29
F / Chi2	7.46	10.14	11.31	11.31	11.31	58.72	5.89	5.26	6.39
RMSE	0.71	0.50	0.49	0.49	0.51	0.48	0.08	0.09	0.09

Long panel: Odd years, 1961-2007, for 29 OECD countries. **Short panel**: Balanced panel for odd years 2001-2007, 28 OECD countries observed. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$. FE: Fixed effects regression (OLS with country fixed-effects). RE: Random effects specification (GLS). Hausman tests on specifications (4) and (8) yield Chi^2 statistics of 48.98 and 22.96, respectively, therefore rejecting the Null of non-systematic estimator differences; hence FE regressions preferred (this is true in all regressions shown).

Column (1) presents the results of a pooled regression with year dummies. Size and GDP per capita do not turn out statistically significant, but openness does. A one percent increase in openness increases the generosity of net benefits by about 0.6 percent. Adding country fixed effects (along with the year dummies) to account for constant country characteristics that may correlate with the replacement rate and openness, the estimated elasticity of openness remains close to the one found in specification (2). Adding size (column (3)) or GDP per capita (column (4)) carves out a fairly robust pattern that was already visible in the scatter plots: openness increases the generosity of benefits and size decreases it. Controlling for GDP per capita does not undo this. Actually, it allows more precise estimation of the openness elasticity. The elasticity of openness (0.52) is about a quarter as big as the elasticity of size (2.4).

Regression (5) to (7) are robustness checks to (4). Column (5) uses a random effects specification instead of the fixed effects model. While signs do not change, only the significance of openness remains. However, the Hausman test strongly indicates that the fixed effects approach is to be preferred. Column (6) uses a linear, a quadratic and a cubic time trend instead of year dummies. This choice does reduce the elasticity of openness to 0.27, but statistical significance is restored. The other elasticities remain fairly similar to those in column (4). Finally, we use the short panel (for which net benefits are available) in column (7). Again, openness turns out to increase generosity while size reduces it.

Regressions (8) to (9) turn to the net replacement rate as the dependent variable. The results confirm those for gross rates. It does not matter at all how exactly we control for time trends (using dummies as in column (8) or using parametric time trends (as in (9)). Summarizing, our empirical results suggest that more open economies have more generous unemployment benefits, both gross and net. And larger countries have less generous ones. These findings are in line with those presented by Rodrik (1998), Alesina and Wacziarg (1998) or Epifani and Gancia (2009) who study more comprehensive measures of public spending and government size.

3 Model Setup

As we allow countries to endogenously choose the generosity of unemployment benefits, we need a model that allows for asymmetries between countries. We model the labor market following

the search and matching approach. In that setup, unemployment is a function of observable determinants, such as unemployment benefits, so that endogenizing the labor market institutions is straightforward. Other ways of modeling labor markets, such as fairness concerns, are less suitable when allowing for an endogenous choice by countries. Finally, we use the extension to heterogeneous firms of the Krugman (1980) model by Melitz (2003). That generalization provides additional channels through which labor market institutions in one country affect outcomes in its trading partners, which are well in line with recent empirical findings on firm selection.[7] Moreover, it comes at little additional modeling cost, since the asymmetric Krugman (1980) model does not allow closed form analytical solutions, neither. Our model description follows closely Felbermayr, Prat, and Schmerer (2011a) with the extension to allow for two potentially asymmetric countries and endogenous labor market institutions.

3.1 Demand for Intermediate Inputs

Our world consists of two potentially asymmetric countries, labeled home H and foreign F, respectively. The countries have work forces denoted by L_H and L_F, respectively. Labor is the only original factor of production. In each country, firms produce a final output good Y under perfect competition. The single, final output good can be consumed or used as an input in the production process. That good is assembled from a continuum of intermediate inputs, indexed by ω, and supplied by domestic and foreign firms who operate under conditions of monopolistic competition. Denoting the quantity of such an input as $q(\omega)$, the aggregate production function in country $i = \{H, F\}$ is

$$Y_i = \left\{ (\bar{M}_i)^{-\frac{1}{\sigma}} \int_{\omega \in \Omega_i} q[\omega]^{\frac{\sigma-1}{\sigma}} d\omega \right\}^{\frac{\sigma}{\sigma-1}}, \tag{1}$$

where $\sigma > 1$ is the elasticity of substitution between any two varieties. The set of available intermediate inputs in country i, Ω_i, has measure $\bar{M}_i$. Premultiplying by $(\bar{M}_i)^{-\frac{1}{\sigma}}$ shuts down the usual love for variety channel so that the number of available varieties is irrelevant for total output for symmetric countries.

[7] See Bernard and Jensen (2004) and references therein.

Similar to Melitz (2003), intermediate input firms are uniquely described by different productivity levels φ and place of origin, so that we can use φ to index intermediate input producers. Input producers at home face per-period fixed costs on the domestic and foreign market, f_{HH} and f_{HF} respectively. Serving some market j by a firm located in i entails iceberg trade costs $\tau_{ij} \geq 1$, where $\tau_{ii} = 1$. An intermediate goods producer in i faces the following inverse demand schedule in j:

$$p_{ij}[\varphi] = \left(\frac{q_{ij}[\varphi]}{\tau_{ij}}\right)^{-\frac{1}{\sigma}} (P_j)^{\frac{\sigma-1}{\sigma}} \left(\frac{Y_j}{\bar{M}_j}\right)^{\frac{1}{\sigma}}, \text{ with } P_i = \left(\frac{1}{\bar{M}_i}\int_{\omega\in\Omega_i} p[\omega]^{1-\sigma} d\omega\right)^{1/(1-\sigma)}, \quad (2)$$

where P_i is the aggregate price index and $p[\omega]$ is the price of variety ω. We choose the price index of the home country as the numéraire, i.e., $P_H = 1$. Profit maximizing firms allocate sales across markets such that marginal revenues are equalized. This implies $p_{ij}[\varphi] = \tau_{ij} p_{ii}[\varphi]$ for all markets j on which a firm φ based in country i is active. Operating revenues of firms based in country i from sales to market j are therefore equal to $R_{ij}[\varphi] = p_{ij}[\varphi] q_{ij}[\varphi]/\tau_{ij}$. Total revenue of an intermediate input producer based in country i with productivity φ, is then given by:

$$R_i[\varphi] = \sum_{j\in\{H,F\}} I_{ij}[\varphi] q_{ij}[\varphi]^{\frac{\sigma-1}{\sigma}} (P_j)^{\frac{\sigma-1}{\sigma}} \left(\frac{\tau_{ij}^{1-\sigma} Y_j}{\bar{M}_j}\right)^{\frac{1}{\sigma}}, \quad (3)$$

where $I_{ij}[\varphi]$ is an indicator function that takes value one if a firm in country i with productivity φ is active on market j and zero otherwise.

3.2 The Labor Market

Firms operate with linear production functions $q_{ij}[\varphi] = \varphi L_{ij}[\varphi]$, where $L_{ij}[\varphi]$ is the level of employment at firm φ in country i used for the production of goods destined for country j. Our model is in discrete time and all payments are made at the end of each period. At the end of each period, firms and workers are hit by two different types of shocks: With probability χ a job is destroyed due to a match-specific shock and with probability δ firms are forced to leave the market. Assuming independence of these shocks, the actual rate of job destruction is given by $\eta = \delta + \chi - \delta\chi$.

The flow cost of posting a single vacancy is c, measured in units of the final good. We

denote by $m_i[\theta_i] = \bar{m}\,(\theta_i)^{-\alpha}$ the share of posted vacancies v filled each period, where θ_i is the vacancy-unemployment ratio in country i and $\bar{m}$ measures the efficiency of the labor market in country i, while α is the elasticity of the matching function. The rate at which unemployed workers find employment is $\theta_i m_i\,[\theta_i]$.

Each period, an intermediate input producer φ in country i decides (i) about the optimal number of vacancies to post, $v_i\,[\varphi]$, anticipating the bargained wage, and (ii) how to allocate total production over the domestic and the foreign markets.

The value of an intermediate input producer is given by:

$$\begin{aligned} J_i\,[\varphi] &= \max_{v_i[\varphi]} \frac{1}{1+r}\Bigg(R_i[\varphi] - w_i\,[\varphi]\,L_i[\varphi] - P_i v_i\,[\varphi]\,c - P_i \sum_{j\in\{H,F\}} I_{ij}[\varphi] f_{ij} + (1-\delta) J_i'\,[\varphi]\Bigg) \quad (4) \\ s.t. \qquad & L_i'\,[\varphi] = (1-\chi) L_i\,[\varphi] + m_i[\theta_i] v_i\,[\varphi]\,, \end{aligned}$$

where r denotes the interest rate, $w_i\,[\varphi]$ is the wage rate, $J_i'\,[\varphi]$ is the value of an intermediate input producer next period, and $L_i'\,[\varphi]$ is firm $\varphi' s$ total employment next period. The constraint is the law of motion of employment at the firm level. Using the first order conditions for vacancy posting and labor units and employing the steady-state condition, we can determine the pricing behavior of the firm. The important conclusions are that a firm equalizes marginal revenues across markets and that the optimal pricing behavior is the same for firms with different productivities (see for more details Felbermayr, Prat, and Schmerer, 2011a).[8]

Concerning the wage-setting process we follow Cahuc, Marque, and Wasmer (2008) and assume that wages are bargained before production takes place and that every worker is treated as the marginal worker.[9] Market power of firms on product market and individual bargaining imply an over-hiring externality: firms wish to hire more workers than socially optimal because this depresses the contribution of the marginal worker to the value of the firm, thereby reducing her bargaining power. However, this strategic behavior increases labor market tightness beyond

[8]We choose to work work with discrete time as we ultimately aim to calibrate the model. The continuous time model can be thought of as the limit of the discrete time model where $\Delta t \to dt$; model predictions are not affected by this. However, note that the job fill and the job find rates ($\bar{m}\,(\theta_i)^{-\alpha}$ and $\bar{m}\,(\theta_i)^{1-\alpha}$, respectively) are Poisson rates in the continuous time version (with support over R^+. They are probabilities in the discrete time framework with support in $[0,1]$. To meet this restriction, $\bar{m}$ must be small enough.

[9]The axiomatic foundation of this approach is laid out in Stole and Zwiebel (1996).

the Pareto constrained efficient level and congests the labor market so that firms pay higher search costs. The total surplus from a successful match is split between the employee and the intermediate input producer. The worker's surplus is equal to the difference between the value of being employed at firm φ, i.e., $E_i[\varphi] = (w_i[\varphi] + (1-\eta)E_i[\varphi] + \eta U_i)/(1+r)$ and the value of being unemployed $U_i = \left(b_i\Phi_i P_i + \theta_i m[\theta_i]\bar{E}_i + (1-\theta_i m_i[\theta_i])U_i\right)/(1+r)$, where $\bar{E}_i$ is the value of employment at the average firm. The flow value of unemployment in real terms is given by $b_i\Phi_i$ with $b_i \in [0,1]$ and is proportional to the marginal value product of labor at the average domestic firm deflated by the price index: $\Phi_i \equiv \tilde{\varphi}_{ii} p_{ii}[\tilde{\varphi}_{ii}]/P_i$, with $\tilde{\varphi}_{ii}$ denoting the productivity of the average firm. The variable b_i is a proxy for the gross unemployment benefit replacement rate. Benefits are financed lump-sum. b_i is a parameter in most of the literature. In this paper, it is the key policy variable that will be set endogenously by governments.[10]

The firms's surplus is equal to the marginal increase in the firm's value $\partial J_i[\varphi]/\partial L_{ij}[\varphi]$, which results from the assumption that every worker is treated as the marginal worker. The outcome of the bargaining process over the division of the surplus follows the "surplus-splitting" rule: $(1-\beta)(E_i[\varphi] - U_i) = \beta \frac{\partial J_i[\varphi]}{\partial L_{ij}[\varphi]}$, where the parameter β measures the bargaining power of workers and belongs to $(0,1)$. We then can derive the job creation curve as:

$$\mathbf{JC}_i: \quad \frac{w_i}{P_i} = \frac{\sigma-1}{\sigma-\beta}\Phi_i - \frac{c}{m_i[\theta_i]}\frac{r+\eta}{1-\delta}. \tag{5}$$

The job creation curve slopes downward in θ. The reason is that a higher wage rate makes it less attractive for firms to post vacancies, leading to a lower degree of labor market tightness. Importantly, the wage rate depends only on aggregate variables such as P, Φ or θ and does, therefore, not vary across firms. There is rent sharing 'in the aggregate', i.e., a lower net surplus leads to lower wages, or a higher bargaining power of workers leads to higher wages, but there is no firm-level rent sharing.

[10] We could easily link the flow value of unemployment to wages by setting it equal to $b_i w_i$. We decide to link it to the average productivity Φ_i. In the model, w_i is proportional to Φ_i, so that the two strategies are similar in terms of their implications. It turns out that choosing the latter specification somewhat simplifies the analysis; see the discussion in Felbermayr, Prat, Schmerer (2011a).

To close the labor market, we also derive the wage curve given by:

$$\mathbf{W}_i: \quad \frac{w_i}{P_i} = b_i\Phi_i + \frac{\beta}{1-\beta}\frac{c}{1-\delta}\left(\frac{r+\eta}{m_i[\theta_i]} + \theta_i\right). \tag{6}$$

The wage curve is an increasing function of θ since workers have more power to hold-up the firm when the labor market is tight and the costs of a break-down of negotiations are high for firms. Labor market equilibrium is found by interacting the job creation curve and the wage curve.[11]

3.3 Entry- and Export Decisions of Firms

There is an infinite number of potential firms which can enter the market after paying a fixed and sunk entry cost f^e, measured in terms of the final consumption good. After entering, they draw their life-time constant productivity φ from a known distribution with p.d.f. $g[\varphi]$ and c.d.f. $G[\varphi]$. Only firms which draw a φ favorable enough to make non-negative profits will start production. A firm with productivity φ located in country i will engage in market j if the expected discounted operating profits exceed costs. Hence, the firm recruits workers with the aim to produce output for market j if and only if

$$\Pi_{ij}[\varphi] = \frac{1-\delta}{r+\delta}\pi_{ij}[\varphi] - \frac{P_i c}{m_i[\theta_i]}L_{ij}[\varphi] - P_i f_{ij} \geq 0. \tag{7}$$

The first term in expression (7) is the discounted flow of operating profits that a firm in country i with productivity φ obtains from sales in country j. The second term describes the costs of initially recruiting all necessary workers. The flow of profits from sales to market j is given by $\pi_{ij}[\varphi] = R_{ij}[\varphi] - \left(w_i + P_i c\frac{\chi}{m_i[\theta_i]}\right)L_{ij}[\varphi] - P_i f_{ij}$, which are revenues in country j of a firm based in country i with productivity φ, $R_{ij}[\varphi]$, minus total costs of employing the necessary amount of workers L_{ij} to achieve those revenues including the costs to replace the workers who quit (at exogenous rate χ) and the fixed costs (in units of the final good).

We may characterize the productivity level which makes a firm indifferent between operating in a market or not by solving $\Pi_{ij}\left[\varphi^*_{ij}\right] = 0$. Empirical evidence strongly supports the view that

[11] See for more details, specifically the uniqueness of the equilibrium and the general influence of trade on the labor market Felbermayr, Prat, Schmerer (2011a).

only the most productive firms select into foreign markets. Hence, we focus on parameter values where $\varphi_{ij}^* > \varphi_{ii}^*$ for all i, j. The ex ante probability of successful entry into the home market i is $(1 - G[\varphi_{ii}^*])$, whereas the ex ante probability of exporting to country j conditional on successful entry is $\varrho_{ij} = \left(1 - G\left[\varphi_{ij}^*\right]\right) / (1 - G\left[\varphi_{ii}^*\right])$. The entry of new firms ensures zero expected profits in equilibrium. The mass of available varieties in country i is given by $\bar{M}_i = \varrho_{ji} M_j + M_i, i \neq j$, where M_j is the mass of active producers in country j.

3.4 Stationarity, Market Clearing Conditions, and General Equilibrium

As usual, we focus on a situation where flows into and out of unemployment are of equal size, hence $\eta\left(1 - u_i\right) = \theta_i m_i\left[\theta_i\right] u_i$. Similarly, we require that the flow into the pool of operating firms is equal to the flow out of this pool; hence, $(1-\delta)\left(1 - G\left[\varphi_{ii}^*\right]\right) M_i^e = \delta M_i$, where M_i^e is the total mass of firms that attempt entry.[12] On the labor market, by definition, we have $L_i^e = (1-u_i)L_i$, where L_i^e is aggregate employment and L_i is labor supply in country i. The mass of active domestic firms adjusts so that the labor market clears, hence $M_i = L_i^e / (\varrho_{ij} L_{ij}\left[\tilde{\varphi}_{ij}\right] + L_{ii}\left[\tilde{\varphi}_{ii}\right])$.

Total spending on the aggregate output good is defined as the sum of revenues generated by intermediate goods producing firms from sales on the domestic and export markets. Aggregate income is the sum of payments to employed workers (equal to aggregate consumption expenditure), on flow fixed costs f_{ij}, on appropriately discounted up-front investments f^e, and on search costs. In equilibrium trade is balanced. The budget constraint of the government is balanced. Unemployment benefits are financed in a lump-sum fashion, so that they only redistribute income between employed and unemployed workers who share the same preferences.

3.5 Endogenous Labor Market Institutions

We now have built our two-country asymmetric trade model with heterogeneous firms and search and matching frictions on the labor market. There are various ways how to endogenize labor market institutions. Given our search and matching framework, one straight forward way is to allow countries to choose the level of unemployment benefits.

[12] Note that only a fraction $1 - \delta$ firms survive to the end of their first period of existence.

As we are interested in the interaction of the optimal level of unemployment benefits with trade openness and country size, we allow the home country to choose the level of benefits for a given level of unemployment benefits abroad. Specifically, we allow the home country to set unemployment benefits in order to maximize utility, which is equivalent to maximizing consumption, given by $w_H(1-u_H)L_H$ (remember that $P_H = 1$ due to our normalization). Note that in general equilibrium, both wages w_H and the unemployment rate u_H are functions of unemployment benefits.

Hence, the utility-maximizing level of unemployment benefits in home is given by:

$$b_H^* = \underset{b_H}{\operatorname{argmax}}\{w_H[b_H](1-u_H[b_H])L_H\}. \tag{8}$$

The first order condition can be written as:

$$\frac{\partial w_H[b_H]}{\partial b_H}(1-u_H[b_H])L_H = \frac{\partial u_H[b_H]}{\partial b_H}w_H[b_H]L_H. \tag{9}$$

Hosios (1990) showed in a model with search and matching unemployment, perfect competition and homogeneous firms that the equality of the bargaining power β and the elasticity of the matching function α leads to a constraint efficient equilibrium. Hence, there are no Pareto improvements possible. Note, however, that in our case this condition is not sufficient to ensure an efficient allocation because of the over-hiring externality. In terms of the first order condition, this means that the marginal increase of wages weighted by $(1-u_H[b_H])L_H$, due to an increase of unemployment benefits at a level of unemployment benefits of zero, is larger than the marginal increase of the unemployment rate weighted by $w_H[b_H]L_H$. We will discuss this result in more detail in Section 5.

In addition to this utility-maximizing level of non-cooperative unemployment benefits, we investigate two sorts of cooperative outcomes. First, we allow the two countries to cooperatively set unemployment benefits in order to maximize joint utility. In particular we calculate the joint utility-maximizing level of unemployment benefits given by:

$$b_C^* = \underset{b_C}{\operatorname{argmax}}\{w_H[b_C](1-u_H[b_C])L_H + w_F[b_C](1-u_F[b_C])L_F\}, \tag{10}$$

where $b_C = b_H = b_F$. The first order condition then reads:

$$\frac{\partial w_H[b_C]}{\partial b_C}(1-u_H[b_C])L_H + \frac{\partial w_F[b_C]}{\partial b_C}(1-u_F[b_C])L_F = \frac{\partial u_H[b_C]}{\partial b_C}w_H[b_C]L_H + \frac{\partial u_F[b_C]}{\partial b_C}w_F[b_C]L_F. \tag{11}$$

Hence, any spill-overs due to changes in the labor market institutions from one country to the other, as for example discussed in Felbermayr, Larch, and Lechthaler (2009), will be partly internalized by the joint utility-maximization, as can bee seen from the first order condition (11).

In this cooperative outcome we restrict countries to set equal levels of unemployment benefits. Since the countries are heterogenous and country features affect the optimal choice of unemployment benefits as an instrument for internalizing the over-hiring externality, in general, one requires two instruments to ensure an efficient equilibrium. For example, the two cooperative governments could decide on *country-specific* unemployment benefits that maximize joint welfare. In more formal terms:

$$[b^*_{CH}, b^*_{CF}] = \underset{b_{CH}, b_{CF}}{\operatorname{argmax}}\{w_H[b_{CH}, b_{CF}](1-u_H[b_{CH}, b_{CF}])L_H + w_F[b_{CH}, b_{CF}](1-u_F[b_{CH}, b_{CF}])L_F\}, \tag{12}$$

where b_{CH} and b_{CF} are the cooperatively set unemployment benefits in country H and F, respectively. The first order conditions then read as follows:

$$\begin{aligned}
&\frac{\partial w_H[b_{CH}]}{\partial b_{CH}}(1-u_H[b_{CH}])L_H + \frac{\partial w_F[b_{CH}]}{\partial b_{CH}}(1-u_F[b_{CH}])L_F = \\
&\frac{\partial u_H[b_{CH}]}{\partial b_{CH}}w_H[b_{CH}]L_H + \frac{\partial u_F[b_{CH}]}{\partial b_{CH}}w_F[b_{CH}]L_F, \\
&\frac{\partial w_H[b_{CF}]}{\partial b_{CF}}(1-u_H[b_{CF}])L_H + \frac{\partial w_F[b_{CF}]}{\partial b_{CF}}(1-u_F[b_{CF}])L_F = \\
&\frac{\partial u_H[b_{CF}]}{\partial b_{CF}}w_H[b_{CF}]L_H + \frac{\partial u_F[b_{CF}]}{\partial b_{CF}}w_F[b_{CF}]L_F.
\end{aligned} \tag{13}$$

Similar to the case where the countries set a common level of unemployment benefits in both countries, this joint utility-maximization internalizes any spill-over effects to the other country via trade. However, additionally it does not restrict countries to symmetric policies.

4 Model Calibration

Both the Mortensen-Pissarides and the Melitz models have been calibrated extensively in the literature so that we can follow the standard practice here. We calibrate the model for two countries. In the benchmark case both countries are completely symmetric in the initial steady-state and their equilibrium allocations replicate key empirical moments of the United States. The size of the population is normalized to one for both countries. P_H serves as the numéraire. In our asymmetric settings, the larger country suffers less from trade costs because a smaller share of varieties is imported and thus affected by trade costs. So, the larger country has a higher level of average productivity, and a lower rate of unemployment. Time is discrete and the time interval is set to one month.

Following Bernard, Redding, and Schott (2007), we assume that firms sample their productivities from a Pareto distribution, so that the p.d.f. is $g(\varphi) = \gamma\bar{\varphi}^{\gamma}\varphi^{-(1+\gamma)}$, where the shape parameter γ measures the rate of decay of the sampling distribution and is set equal to 3.4. $\bar{\varphi} > 0$ is the minimum possible value of φ and, without loss of generality, is normalized to $\bar{\varphi} = 0.5$.

Job separations occur either because the firm leaves the market or because the match itself is destroyed. We consider that the first type of shock δ arrives at a Poisson rate of 0.916 per month. This implies that the annual gross rate of firm turnover is equal to 22%, as suggested by the estimates in Bartelsman, Haltiwanger, and Scarpetta (2004). The match-specific shocks account for the job separations which are left unexplained by the firm-specific shock. Given that Shimer (2005) estimates the monthly rate of job separation to be 0.034, it follows that the rate of arrival of match-specific shocks χ should be equal to 0.025 per month.

We set the interest rate to 4% per year ($r = 0.33\%$). The elasticity of substitution is set equal to $\sigma = 3.8$. In order to calibrate the value of non-market activity abroad, we follow Shimer (2005) and set $b_F = 0.4$ to match an earnings replacement ratio close to 40%. The cost of posting a vacancy c is set equal to one.

The share of exporters is put at about 21% by Bernard, Eaton, Jensen, and Kortum (2003). Together with $\tau = 1.3$ and assuming a symmetric benchmark equilibrium, this pins down the

ratio f_{ij}/f_{ii} at about 1.7. We use the values of entry costs f^e and flow fixed costs f_{ij} to match the following two moments. First, we ensure that the equilibrium tightness $\theta_i = 0.5$ for all countries in the benchmark equilibrium. Second, we target an average firm size equal to 21.8 employees, as estimated by Axtell (2001). The values following are $f^e = 39.57$, $f_{ii} = 0.116$ and $f_{ij} = 0.197$. The calibrated entry costs are equivalent to 2.82 years of income per capita.

The matching function is Cobb-Douglas $\bar{m}\left(\theta_i\right)^{-\alpha}$. The results of Abowd and Allain (1996) suggest that, in the case of individual bargaining, workers' bargaining power is close to $\beta = 0.5$. To calibrate the scale parameter $\bar{m}$ and the elasticity of the matching function α, we use empirical estimates of the job finding rate and labor market tightness (Shimer, 2005, Hall, 2005). We match an equilibrium tightness of 0.5, a monthly job filling rate to 0.9, and an optimal level of unemployment benefits of 40%. These choices imply $\bar{m} = 0.636$ and α of 0.62.[13] Hence, $\beta < \alpha$, so that even without the over-hiring externality present in our model, there is a welfare rationale for using unemployment benefits.

5 Is There a Case for Labor Market Institutions?

As we have laid out our model, the question might have arisen whether there is a case for labor market institutions in this framework. Note that due to the matching friction on the labor market and due to the heterogeneity of firms, marginal recruitment costs are increasing at the aggregate level due to a congestion externality.

Hosios (1990) has shown that in the standard search and matching model with constant returns to scale and perfect competition, the equality of the bargaining power and the elasticity of the matching function implies that there is no government policy that leads to Pareto improvements. In other words, under this condition, which is known as the Hosios condition,

[13]There are estimates of the elasticity of the matching function that point to a value of 0.5 (see for example Petrongolo and Pissarides (2001)). However, this means that the Hosios-condition would be fulfilled and the optimal level of unemployment too low compared to what we observe. Hence, we have chosen the approach to calibrate the elasticity of the matching function in order to ensure higher optimal unemployment benefits in equilibrium. The empirical evidence for unemployment benefits seems much more reliable than the estimates for the elasticity of the matching function. Note that we also could have set the elasticity of the matching function to the value of 0.5 and calibrate the bargaining power in order to fit optimal unemployment benefits. However, this would not effect our results qualitatively. Our results hinge on the relative magnitudes of the bargaining power and the elasticity of the matching function. But their absolute levels are not important for the qualitative results.

unemployment is at its efficient level. This implies that unemployment can be both too low and too high when the condition is violated. Specifically, full employment is not efficient, because hiring becomes increasingly expensive as unemployment goes down. Note, however, that due to the existence of the over-hiring externality, in our case, the Hosios condition is not sufficient to ensure an efficient allocation. For that reason, equilibrium unemployment will be generally too low. Increasing unemployment benefits counteracts the externality by "taxing" firms for over-hiring workers (and, more generally, for posting too many vacancies, therefore creating congestion costs).

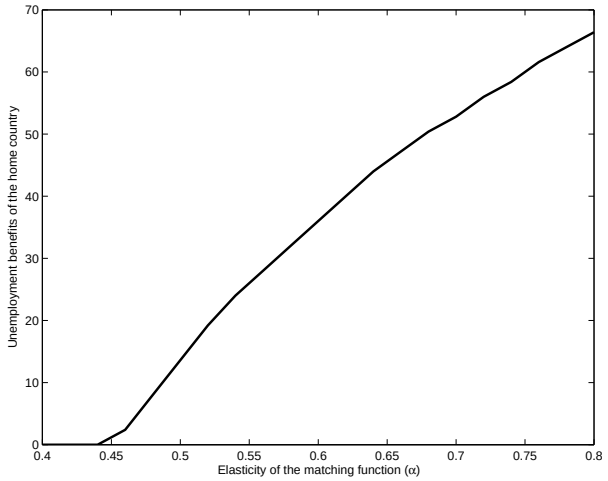


Figure 2: The relationship between the optimal level of unemployment benefits b_H^* and the elasticity of the matching function α.

Figure 2 plots the optimal level of unemployment benefits at home, b_H^*, for various levels of the elasticity of the matching function, α. Note that we have set the bargaining power of workers, β, equal to 0.5. Hence, the Hosios-condition is fulfilled when $\alpha = 0.5$. However, as can be seen, even in this case there exists a positive utility-maximizing level of unemployment benefits for the home country. When the elasticity of the matching function, α, increases, holding constant the bargaining power of workers, β, the bargaining power of workers becomes too low compared to the efficient level. This leads to wages that are too low compared to the efficient level. Low wages will lead firms to hire too many workers and result in an inefficiently low unemployment rate. Hence, a utility-maximizing policy of the home country is to increase unemployment benefits (up to a certain point).

6 Endogenous Labor Market Institutions and Openness

In this section we study the effect of trade openness on the choice of labor market institutions. As we have seen in the previous section, even when the Hosios-condition holds, i.e., $\beta = \alpha$, there exists a positive level of utility-maximizing unemployment benefits in our framework. However, in order to demonstrate the effects more clearly, we proceed with a value of 0.62 for the elasticity of the matching function.

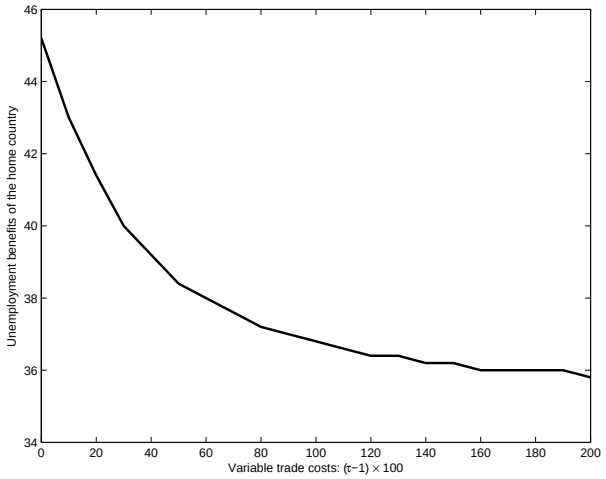


Figure 3: The relationship between the optimal level of unemployment benefits b_H^* and openness as measured by τ.

As can be seen from Figure 3, the optimal level of unemployment benefits in the home country is an increasing function of trade openness. The more the home country is connected to a foreign country, measured via lower variable trade costs, the higher are the optimal unemployment benefits. How can this result be explained? Before we can answer this question we have to explain how trade liberalization affects unemployment and how unemployment benefits interact with trade.

We begin our discussion by noting that trade liberalization affects the distribution of productivity among firms. Inefficient firms in both countries face stronger competition by efficient foreign firms, making it impossible for them to cover the flow fixed costs. Additionally, labor is reallocated towards exporters, which are the most productive firms, and away from purely domestic firms, which are the least productive firms. If $f_{ij} > f_{ii}$, a fall in variable trade costs leads to an increase of average domestic firm's productivity, a fall in the equilibrium unemploy-

ment rate and a rise in the real wage (see Felbermayr, Prat, and Schmerer, 2011a, Proposition 2). Note, that this result is in line with aggregate empirical evidence presented by Dutt, Mitra, and Ranjan (2009), or Felbermayr, Prat, and Schmerer (2011b).

Concerning the effect of changes in unemployment benefits, b_H, we have to distinguish three channels. The first channel is an *income effect*. When the home country increases unemployment benefits, unemployment goes up at home. As both the home and the foreign country spend part of their income on foreign varieties, increased unemployment at home reduces not only demand for home goods but also for goods from the foreign country. The second channel works via the change in *competitiveness*. An increase of unemployment benefits at home increases the home workers' threat point and therefore pushes up the real wage at home. Higher wages translate into higher prices for domestic varieties, making domestic varieties relatively more expensive compared to foreign varieties. Additionally, higher unemployment leads to an equilibrium with fewer firms at home. Both of these effects lead to an increase of the competitiveness of foreign firms. The last channel is a *selection effect* due to productivity heterogeneity of firms. A reduction of aggregate spending is most harmful for highly productive firms. Hence, there is a shift towards less productive firms, which are not affected as much due to a reduction of aggregate spending. This is exactly the opposite side of the selection effect after trade liberalization described by Melitz (2003). Summing up, we see that the competitiveness effect tends to decrease unemployment, but the unemployment-increasing income and the selection effects dominate. Hence, changing unemployment benefits does not only affect the home country, but also the foreign country. Actually, an increase in unemployment benefits at home will not only increase unemployment at home but also abroad (for more details see Felbermayr, Larch, and Lechthaler, 2009).

Thus, there is an externality between countries in the setting of labor market institutions. If the home country increases its unemployment benefits, part of the cost is spilled over to the foreign country. Imports from the foreign country will be lower and the selection will lead to more purely domestic and less productive firms at home. This increases the price for home varieties, but not only for the home consumers, but also for the foreign consumers. Additionally, some home firms stop exporting, as they are no longer able to cover the exporting fixed costs. Hence, the negative effects of increasing unemployment benefits are partly spilled over to the

foreign country. The higher the level of trade openness, the more of the negative effects can be spilled over and, thus, the less costly becomes an increase in unemployment benefits for the home country. This explains the positive relationship between the utility-maximizing unemployment benefits and openness. It should be noted that this strategy, while maximizing utility in the home country, reduces utility in the foreign country.

Note that this result fits nicely with the empirical findings that more open countries seem to have a larger welfare state (Cameron, 1978; Rodrik, 1998; Epifani and Gancia, 2009). Rodrik (1997, 1998) argues that public spending may provide insurance in economies subject to the risk of international markets. When exposure to risk grows after trade liberalization, the demand for public insurance will increase, leading to a positive relationship between openness and the size of the welfare-state. Epifani and Gancia (2009) add an additional channel to explain the relationship between openness and government size. They argue that trade lowers the cost of taxation due to a terms-of-trade externality. They find empirical support for the terms-of-trade channel. The two channels have very different welfare implications. If the insurance argument was correct, high unemployment benefits would be efficient from a world welfare perspective. If the latter was correct high unemployment benefits would be inefficient, leaving room for policy interventions.

Similar to the terms-of-trade externality, in our framework a positive level of unemployment benefits results from the inefficiency of the non-internalized labor market frictions. However, our externality stems from an over-hiring of firms. The spill-overs to the foreign countries are richer, working through the income, competitiveness and selection channel.

7 Endogenous Labor Market Institutions and Country Size

Besides openness, country size and the size of the welfare-state is a heavily discussed topic. Specifically, Alesina and Wacziarg (1998) argue that smaller countries have a larger share of public consumption in GDP, and are also more open to trade. As compared to Rodrik (1997), Alesina and Wacziarg (1998) findings imply a different but not mutually exclusive explanation for the positive empirical relationship between openness and government size. In their framework, openness is mediated through country size, leading to the conclusion that the direct link between

openness and the share of government consumption is at least not as strong as suggested by Rodrik (1997).

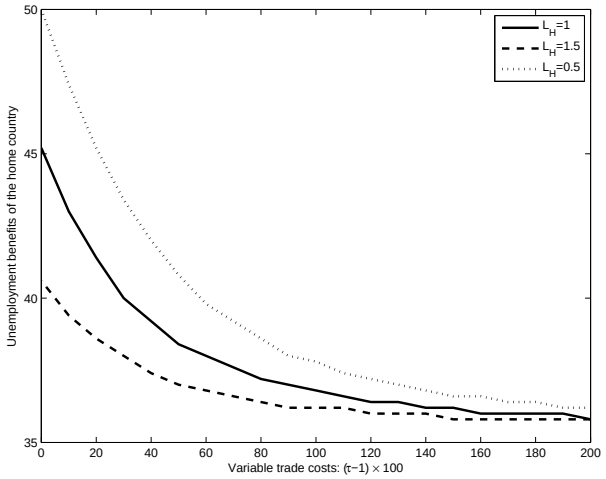


Figure 4: The relationship between the optimal level of unemployment benefits b_H^*, openness as measured by τ and country size (L).

Hence, we next investigate in our framework the link between endogenous labor market institutions and country size. The results are shown in Figure 4. In the first scenario, we decrease the size of the home country from 1 to 0.5 and increase the size of the foreign country to 1.5, all else equal, in order to keep the absolute size of the world economy constant at 2. This is the scenario labeled $L_H = 0.5$. In the second scenario, we increase the size of the home country from 1 to 1.5 and decrease the size of the foreign country from 1 to 0.5. This scenario is labeled $L_H = 1.5$. As in Figure 3, we plot the optimal unemployment benefits at home, b_H^*, as a function of variable trade costs, τ. Alongside with the two new scenarios, we reproduce the basic scenario with symmetric countries, i.e., $L_H = 1$ and $L_F = 1$, as given in Figure 3.

As we can see, smaller countries will find it optimal to choose higher unemployment benefits than larger ones. The reason for this result lies in the channels described above. A smaller country will spill-over a larger part of the negative consequences of higher unemployment benefits to the foreign trading partner through both the income and the selection channel. Note that in this model a smaller country is more open, measured in terms of value of exports as a share of GDP. Hence, the smaller country exports more abroad and imports more from abroad as a share of GDP. Therefore the large foreign country will bear a larger share of the costs of an increase in unemployment benefits at home.

8 Simultaneous Setting of Labor Market Institutions

So far we investigated the optimal level of unemployment benefits of the home country, without considering the foreign country. However, as labor market policies are set independently in each country, one may wonder whether the foreign country has an incentive to react to changes of unemployment benefits at home.

In an interview with the Financial Times (March 16, 2010) France's finance minister Christine Lagarde suggested that Germany is hurting its European partners by "putting very high pressure on its labor costs". In other words, France's finance minister claims that Germany's labor market framework influences economic outcomes in other European countries. She considers convergence in different institutional factors to be a necessary step towards economic success of European countries. Her insinuation has sparked a vivid policy debate.

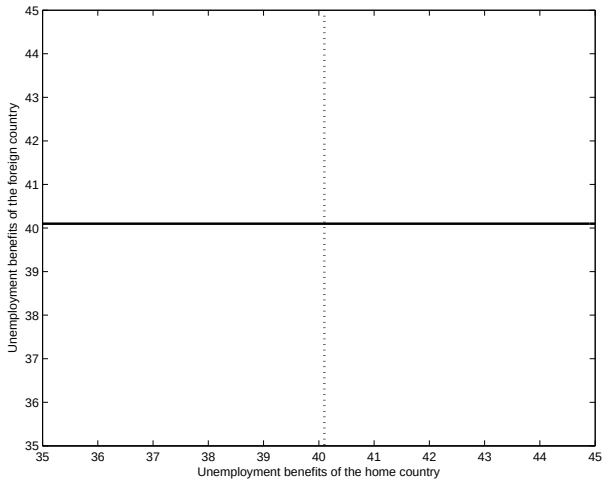


Figure 5: The best-response functions for unemployment benefits of two symmetric countries.

Given this statement, we may first investigate how independent countries would set optimal unemployment benefits, taken the reaction of other countries into account, as suggested by France's finance minister, who worries about labor market policies in Germany. Specifically, we calculate the best-response functions in the b_F^*-b_H^*-space. Hence, for each value of unemployment benefit of the other country, we calculate the optimal unemployment benefit. The intersection of the best response functions leads to the non-cooperative Nash-equilibrium unemployment rates. For this scenarios we set $\tau = 1.3$ and $\alpha = 0.62$.

Figure 5 gives the best-response function for two perfectly symmetric countries. The striking feature from this figure is the fact that the optimal unemployment benefits at home are independent from the level of foreign unemployment benefits. Hence, there is a dominant strategy which determines the level of optimal unemployment benefits. This is astonishing, as we know that the level of trade openness influences the optimal level of unemployment benefits, and as we know that the level of unemployment benefits has an effect on the trading partner.

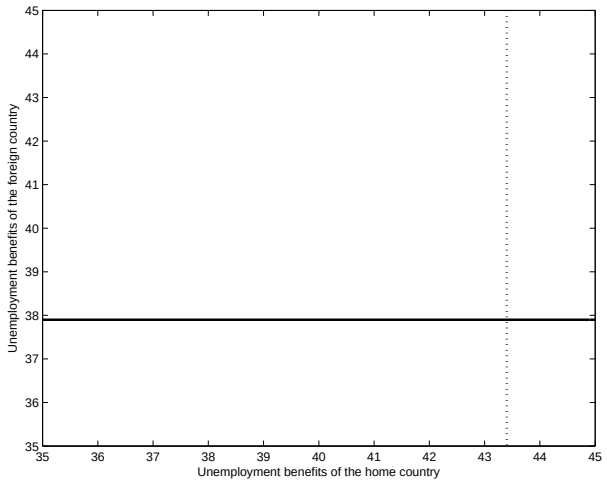


Figure 6: The best-response functions for unemployment benefits when the home country is relatively small ($L_H = 0.5$) and the foreign country relatively large ($L_F = 1.5$).

This result is not driven by the symmetry assumption. In Figure 6 we plot the best-response functions for unemployment benefits when the home country is relatively small ($L_H = 0.5$) and the foreign country relatively large ($L_F = 1.5$). Again, the optimal levels of unemployment benefits are independent from each other. And in line with previous results, the smaller country (in this case the home country) sets higher unemployment benefits than the large country (in this case the foreign country).

The reason for these results is the following. Changing unemployment benefits raises wages and thereby prices of varieties. However, it does so equally for all domestically produced varieties. Raising unemployment benefits at home raises wages and therefore prices for domestic varieties and export varieties. Hence, consumers will shift demand to foreign varieties, which are relatively cheaper now. At the same time higher unemployment benefits lead to lower income, which reduces demand for domestic and imported varieties. What are then the effects of changes of home unemployment benefits for the foreign country? On the one hand, imports from abroad

increase due to the relative cheaper price. On the other hand, imports from abroad decrease due to lower aggregate home income. These two effects off-set each other, so that the optimal level of unemployment benefits in the foreign country is not affected by the level of unemployment benefits at home.

Note the difference of this result as compared to import tariffs. Due to the terms-of-trade externality there are positive Nash-equilibrium tariffs and the reaction functions are negatively slopped (see Gros, 1987, Demidova and Rodríguez-Clare, 2009, and Felbermayr, Jung, and Larch, 2011). However, import tariffs only affect prices of imported goods directly. In contrast, unemployment benefits directly affect prices of domestic and exported varieties. Hence, the latter has not only a positive affect on the terms-of-trade, as import tariffs, but also has a considerable effect on income due to the changes of prices for domestic varieties. Import tariffs only affect income via tariff revenues and general equilibrium affects. Hence, the negative income affect of higher tariffs is much smaller and not able to off-set the positive terms-of-trade affect in the case of import tariffs.

To sum up, these results suggests that even though the trading partner is affected by labor market policies abroad, changing own labor market policies as a reaction thereof is not a utility-maximizing strategy. Independently of what other countries do, and even though welfare will be influenced by that, the optimal level of unemployment benefits does not depend on foreign policies.

9 Cooperative Setting of Labor Market Institutions

As a second step we ask what level of unemployment benefits would be set by two coordinating governments that cooperatively chose the optimal unemployment benefits. This gives us a benchmark against which we can judge on the one hand side the influence of the congestion externality and on the other hand the role of openness and country size on the chosen level of unemployment benefits.

As explained in Section 3.5 we can either allow for country-specific levels of unemployment benefits or for one joint level of unemployment benefits. In our symmetric setting these two

cases coincide. Using the same calibration as above, i.e., $\tau = 1.3$ and $\alpha = 0.62$, we find that cooperatively set unemployment benefits would be 35.7%, i.e., 4.4 percentage points lower than the non-cooperatively set unemployment benefits. Cooperative governments internalize the spill-over effects of labor market institutions, which leads to a lower optimal level of unemployment benefits in the cooperative setting. This lower level of unemployment benefits corresponds to a decrease in the unemployment rate of 0.2 percentage points from 6.9% to 6.7%.

In our asymmetric setting illustrated in Figure 6, the smaller home country sets the non-cooperative unemployment benefits at 43.4%, whereas the larger foreign country sets the unemployment benefits to 37.9%. When we allow the countries to cooperatively agree on country-specific levels of unemployment benefits, they will end up with unemployment benefits of 37.8% and 35% for the home and foreign country, respectively. Hence, even cooperatively set unemployment benefits vary with country size. The smaller country ends up with a higher level of unemployment benefits than the larger one. The reason lies in the effects described in Sections 6 and 7. A smaller country has less labor to start with but trades relatively more than the larger country. Hence, the smaller country has higher wages and a lower unemployment rate. Due to the tightness of the labor market, the congestion externality on the labor market is stronger in the smaller country, leading to a higher optimal level of unemployment benefits. Remember that the non-cooperative levels of unemployment benefits for the home and foreign country was 43.4% and 37.9%, respectively. Hence, cooperation leads to a decrease in the level of unemployment benefits by about 5.6 and 2.9 percentage points, respectively. Concerning the unemployment rate we find a decrease of about 0.3 and 0.15 percentage points in the home and foreign country from around 6.7% to 6.4% and 7.0% to 6.85%.

When countries have to agree on a common level of unemployment benefits, they end up with a level of unemployment benefits of 35.6%. Hence, in that case the larger country has much more weight. The smaller country even looses in terms of welfare compared to the non-cooperative setting. Hence, if countries cannot agree on country-specific unemployment benefits or side payments, a cooperation could not be reached. The smaller country has no incentive to engage in cooperation, but instead prefers to set the non-cooperative level of unemployment benefits. This result is driven by our assumption that countries seek to maximize the weighted

sum of utilities.[14] It highlights the fact that also small countries need to be brought on board in order to reach an agreement, even though in aggregate terms the welfare effects of doing so appear to be small. But they are not small if failure of coordination is taken into account.

10 Conclusion

Is there an optimal utility-maximizing level of labor market policies? This question is an old one from a labor market perspective. However, with the increased interdependencies between countries, this question has to be reevaluated. There is a quite substantial literature discussing whether more open countries have a larger welfare state. Others brought country size into the discussion: Smaller countries tend to trade more, and smaller countries have larger governments. The causality seems not to be fully sorted out yet.

Concerning the theoretical work, there is renewed interest in studying the effects of labor market imperfections in trade models based on love-of-variety preferences, monopolistic competition and heterogeneous firms. While this literature brought new understanding of the effects of trade liberalization on unemployment, wages and inequality, the question about the optimal level of labor market policies was not investigated so far.

This paper uses a two-country, one-sector, asymmetric trade model with heterogeneous firms with search and matching frictions on the labor market, to investigate the question of how countries optimally adopt their labor market institutions in the course of trade liberalization. The main results are that more open economies and smaller economies tend to have larger welfare states, and that the optimal level of unemployment benefits is independent from the level of unemployment benefits abroad. This copes with the empirical facts that smaller and more open countries have larger governments. Additionally, cooperatively set unemployment benefits are lower than non-cooperatively set unemployment benefits.

There are at least two questions open for future research. First, it may be interesting to jointly consider the optimal choice of labor market policies and import tariffs. By making do-

[14] An alternative assumption not followed here would be to model the bargaining process between the two countries.

mestic varieties more expensive, unemployment benefits make the markup distortion present in monopolistic competition trade models stronger. Import tariffs, in turn, can mitigate that distortion. Therefore, there may be an interesting complementarity between these two instruments. Second, we have chosen to rationalize unemployment benefits by violating the Hosios condition. This is a natural choice in the context of a Melitz (2003) plus search-and-matching model. However, it would be worth investigating, how international trade affects the optimal choice of benefits when the underlying efficiency rationale is different, e.g., if benefits improve job composition or if there is a real insurance issue. We have sidestepped comparative advantage concerns. Including those into the analysis is a third interesting avenue for research.

References

Abowd, J., and L. Allain (1996): "Compensation Structure and Product Market Competition," *Annales d'Economie et de Statistique*, 41/42, 207–218.

Acemoglu, D. (2001): "Good Jobs Versus Bad Job," *Journal of Labor Economics*, 19(1), 1–21.

Acemoglu, D., and R. Shimer (1999): "Efficient Unemployment Insurance," *Journal of Political Economy*, 107(5), 893–928.

Alcala, F., and A. Ciccone (2004): "Trade and Productivity," *Quarterly Journal of Economics*, 119(2), 613–646.

Alesina, A., and R. Wacziarg (1998): "Openness, Country Size and Government," *Journal of Public Economics*, 69(3), 305–321.

Axtell, R. (2001): "Zipf Distributions of U.S. Firm Sizes," *Science*, 293, 1818–1820.

Bartelsmann, E., J. Haltiwanger, and S. Scarpetta (2004): "Microeconomic Evidence of Creative Destruction in Industrial and Developing Countries," *IZA Discussion Paper No. 1374*.

Bernard, A., J. Eaton, J. Jensen, and S. Kortum (2003): "Plants and Productivity in International Trade," *American Economic Review*, 93(4), 1268–1290.

Bernard, A., and J. Jensen (2004): "Why Some Firms Export," *Review of Economics and Statistics*, 86(2), 561–569.

Bernard, A., S. Redding, and P. Schott (2007): "Comparative Advantage and Heterogeneous Firms," *Review of Economic Studies*, 74(1), 31–66.

Burdett, K., and D. Mortensen (1998): "Wage Differentials, Employer Size, and Unemployment," *International Economic Review*, 39(2), 257–273.

Cahuc, P., F. Marque, and E. Wasmer (2008): "Intrafirm Wage Bargaining in Matching Models: Macroeconomic Implications and Resolution Methods with Multiple Labor Inputs," *International Economic Review*, 49(3), 943–972.

Cameron, D. (1978): "The Expansion of the Public Economy: A Comparative Analysis," *American Political Science Review*, 72(4), 1243–1261.

Cuñat, A., and M. Melitz (2010): "A many country, many good model of labor market rigidities as a source of comparative advantage," *Journal of the European Economic Association*, 8(2-3), 434–441.

Davidson, C., L. Martin, and S. Matusz (1988): "The Structure of Simple General Equilibrium Models with Frictional Unemployment," *Journal of Political Economy*, 96(6), 1267–1293.

——— (1999): "Trade and Search Generated Unemployment," *Journal of International Economics*, 48(2), 271–299.

Demidova, S., and A. Rodrï¿½guez-Clare (2009): "Trade Policy under Firm-Level Heterogeneity in a Small Economy," *Journal of International Economics*, 78(1), 100–112.

Dutt, P., D. Mitra, and P. Ranjan (2009): "International Trade and Unemployment: Theory and Cross-National Evidence," *Journal of International Economics*, 78(1), 32–44.

Eckel, C., and H. Egger (2009): "Wage Bargaining and Multinational Firms in General Equilibrium," *Journal of International Economics*, 77(2), 206–214.

Egger, H., P. Egger, and J. Markusen (2010): "International Welfare and Employment Linkages Arising from Minimum Wages," *unpublished manuscript*.

Egger, H., and U. Kreickemeier (2009): "Firm Heterogeneity and the Labour Market Effects of Trade Liberalisation," *International Economic Review*, 50(1), 187–216.

Epifani, P., and G. Gancia (2009): "Openness, Government Size and the Terms of Trade," *Review of Economic Studies*, 76(2), 629–668.

Felbermayr, G., B. Jung, and M. Larch (2011): "Optimal Tariffs, Retaliation and the Welfare Loss from Tariff Wars in the Melitz Model," *unpublished manuscript*.

Felbermayr, G., M. Larch, and W. Lechthaler (2009): "Unemployment in an Interdependent World," *CESifo Working Paper 2788*.

Felbermayr, G., J. Prat, and H.-J. Schmerer (2011a): "Globalization and Labor Market Outcomes: Wage Bargaining, Search Frictions, and Firm Heterogeneity," *Journal of Economic Theory*, 146(1), 39–73.

——— (2011b): "Trade and Unemployment: What Do the Data Say?," *European Economic Review*, forthcoming.

Gros, D. (1987): "A Note on the Optimal Tariff, Retaliation and the Welfare Loss ¿From Tariff Wars in a Framework with Intra-Industry Trade," *Journal of International Economics*, 23(3-4), 357–367.

Hall, R. (2005): "Employment Fluctuations with Equilibrium Wage Stickiness," *American Economic Review*, 95(1), 50–65.

Helpman, E., and O. Itskhoki (2010): "Labor Market Rigidities, Trade and Unemployment," *Review of Economic Studies*, 77(3), 1100–1137.

Hosios, A. (1990): "On the Efficiency of Matching and Related Models of Search and Unemployment," *Review of Economic Studies*, 57(2), 279–298.

Krugman, P. (1979): "Inreasing Returns, Monopolistic Competition and International Trade," *Journal of International Economics*, 9(4), 469–479.

——— (1980): "Scale Economies, Product Differentiation, and the Pattern of Trade," *American Economic Review*, 70(5), 950–959.

Manning, A. (2006): "A generalised model of monopsony," *The Economic Journal*, 116(508), 84–100.

Marimon, R., and F. Zilibotti (1999): "Unemployment Versus Mismatch of Talent," *Economic Journal*, 109(455), 266–291.

Melitz, M. (2003): "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, 71(6), 1695–1725.

Petrongolo, B., and C. Pissarides (2001): "Looking into the Black Box: A Survey of the Matching Function," *Journal of Economic Literature*, 39(2), 390–431.

Rodrik, D. (1997): *Has Globalization Gone Too Far?* Institute for International Economics, Washington, DC.

Rodrik, D. (1998): "Why Do More Open Economies Have Bigger Governments?," *Journal of Political Economy*, 106(5), 997–1032.

Shimer, R. (2005): "The Cyclical Behavior of Equilibrium Unemployment and Vacancies," *American Economic Review*, 95(1), 25–49.

Stole, L., and J. Zwiebel (1996): "Intra-Firm Bargaining under Non-Binding Contracts," *Review of Economic Studies*, 63(3), 375–410.

Ifo Working Papers

No. 107 Piopiunik, M., Intergenerational Transmission of Education and Mediating Channels: Evidence from Compulsory Schooling Reforms in Germany, August 2011.

No. 106 Schlotter, M., The Effect of Preschool Attendance on Secondary School Track Choice in Germany, July 2011.

No. 105 Sinn, H.-W. und T. Wollmershäuser, Target-Kredite, Leistungsbilanzsalden und Kapitalverkehr: Der Rettungsschirm der EZB, Juni 2011.

No. 104 Czernich, N., Broadband Internet and Political Participation: Evidence for Germany, June 2011.

No. 103 Aichele, R. and G. Felbermayr, Kyoto and the Carbon Footprint of Nations, June 2011.

No. 102 Aichele, R. and G. Felbermayr, What a Difference Kyoto Made: Evidence from Instrumental Variables Estimation, June 2011.

No. 101 Arent, S. and W. Nagl, Unemployment Benefit and Wages: The Impact of the Labor Market Reform in Germany on (Reservation) Wages, June 2011.

No. 100 Arent, S. and W. Nagl, The Price of Security: On the Causality and Impact of Lay-off Risks on Wages, May 2011.

No. 99 Rave, T. and F. Goetzke, Climate-friendly Technologies in the Mobile Air-conditioning Sector: A Patent Citation Analysis, April 2011.

No. 98 Jeßberger, C., Multilateral Environmental Agreements up to 2050: Are They Sustainable Enough?, February 2011.

No. 97 Rave, T., F. Goetzke and M. Larch, The Determinants of Environmental Innovations and Patenting: Germany Reconsidered, February 2011.

No. 96 Seiler, C. and K. Wohlrabe, Ranking Economists and Economic Institutions Using RePEc: Some Remarks, January 2011.

No. 95 Itkonen, J.V.A., Internal Validity of Estimating the Carbon Kuznets Curve by Controlling for Energy Use, December 2010.

No. 94 Jeßberger, C., M. Sindram and M. Zimmer, Global Warming Induced Water-Cycle Changes and Industrial Production – A Scenario Analysis for the Upper Danube River Basin, November 2010.

No. 93 Seiler, C., Dynamic Modelling of Nonresponse in Business Surveys, November 2010.

No. 92 Hener, T., Do Couples Bargain over Fertility? Evidence Based on Child Preference Data, September 2010.

No. 91 Schlotter, M. und L. Wößmann, Frühkindliche Bildung und spätere kognitive und nicht-kognitive Fähigkeiten: Deutsche und internationale Evidenz, August 2010.

No. 90 Geis, W., High Unemployment in Germany: Why do Foreigners Suffer Most?, August 2010.

No. 89 Strobel, T., The Economic Impact of Capital-Skill Complementarities in German and US Industries – Productivity Growth and the New Economy, July 2010.

No. 88 Falck, O., M. Fritsch and S. Heblich, The Phantom of the Opera: Cultural Amenities, Human Capital, and Regional Economic Growth, June 2010.

No. 87 Strobel, T., Institutions and Innovations as Sources of Productivity Growth – Cross-Country Evidence, April 2010.

No. 86 Strobel, T., Unraveling the Origins of EU Countries Productivity Growth – Evidence on R&D and Competition from Cross-Country Industry Analysis, April 2010.

No. 85 Podlich, N., D. Illyasov, E. Tsoy and S. Shaikh, The Methodology of Stress Tests for the Kazakh Banking System, April 2010.

No. 84 Jaeger, U., Working or stay-at-home mum? The Influence of family benefits and religiosity, March 2010.

No. 83 Montén, A. and C. Thater, Determinants of Efficiency in Child Care Provision, March 2010.

No. 82 Ebertz, A., The Determinants of Joint Residential and Job Location Choice: A Mixed Logit Approach, December 2009.