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Abstract

Foreign direct investment can increase productivity and wages. However, it is also often accompanied by primary income deficits as foreign-owned firms repatriate their profits. The welfare effects of FDI are thus ambiguous. A particularly illustrative example of this phenomenon are the Visegrád 4 (V4) countries (Czech Republic, Hungary, Poland, Slovakia). This paper investigates whether FDI can be beneficial in the presence of profit repatriation using a general equilibrium model calibrated to the V4 economies. Counterfactual simulations suggest that the benefits of FDI outweigh the costs for these countries. On average, a 1% increase in the number of foreign firms is associated with a 0.17% increase in welfare. However, incentivising foreign firms to reinvest more of their profits domestically is, *ceteris paribus*, welfare-improving. A 10-percentage-point increase in the profit repatriation rate is associated with a 1.06% welfare gain on average.

Keywords: foreign direct investment, primary income flows, profit repatriation.
JEL classification: F21, F23, F36, F40, E60.

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1 Introduction

Foreign direct investment (FDI) is often considered to be a positive contributor to a country's welfare. One of the key reasons for this is that foreign-owned firms facilitate the transfer of technology across borders (Yao and Wei, 2007), which can raise productivity and growth rates (Ford et al., 2008; Grossman and Helpman, 1991). However, an almost mechanical counterpart of FDI is profit outflows. As foreign companies invest in an economy, they often repatriate a substantial share of their profits (Akkermans, 2017; Graham et al., 2011; Seabra and Flach, 2005).

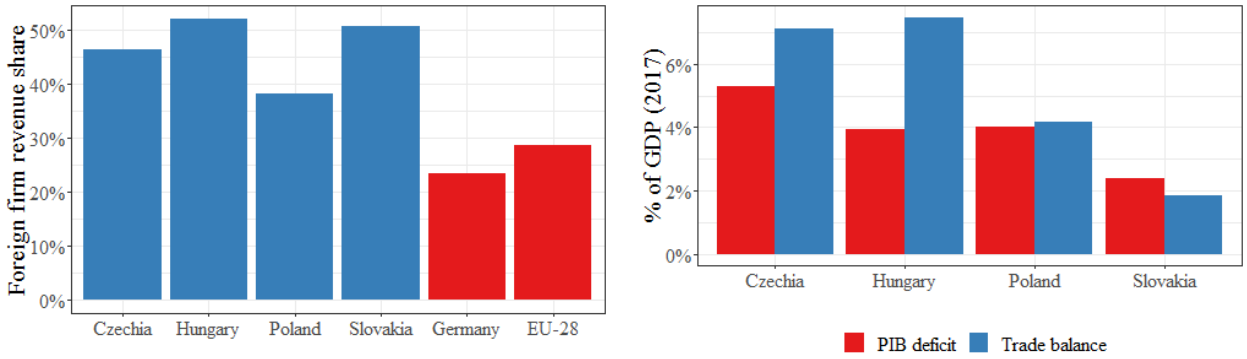
In terms of national accounting, these profit outflows are recorded on the primary income account, which is part of the current account. Net profit outflows from a country result in primary income deficits, which, when sizeable, can significantly affect the current account balance (CAB) as CAB = TB + PIB + SIB, where TB is the trade balance, PIB is the primary income balance, and SIB is the secondary income balance (e.g. remittances, foreign aid).

It has been well-documented that the primary income balance has gradually become a more important component in the current account (Adler and Garcia-Macia, 2018; Akkermans, 2017; Forbes et al., 2017; Langhammer, 2012; Strauss, 2016). This is seen as a result of the globalisation of financial markets (Forbes et al., 2017) and the expansion of FDI (Lane and Milesi-Ferretti, 2007, 2018). While the primary income account includes flows from other sources such as portfolio investment as well, Joyce (2020) documents that for emerging markets the key contributor to PIB deficits are FDI-related profit outflows.

Traditionally, analyses of current account balances have focused on the trade balance, which has historically been its most important component. But the trends described above suggest this may no longer be the case. Both Joyce (2020) and Forbes et al. (2017) point out that PIB deficits are so large in some countries that they are rivalling the trade balance, thereby significantly affecting the current account balance. This is especially true for emerging markets.

The profit outflows induced by FDI can be problematic. When foreign-owned firms enter an economy, they take a chunk of aggregate profits that used to accrue to domestic firms. While the size of the pie (aggregate profits) is likely larger as a result of more FDI, the size of the slice (amount of profits) going to foreign-owned firms will also be higher. If foreign-owned firms repatriate a significant fraction of their profits, then the overall amount of profits staying in the country may actually be lower as a result of FDI. Reis (2001) highlights this trade-off in an endogenous growth model.

The welfare effects of FDI are thus ambiguous. On the one hand, more productive foreign-owned firms should mechanically increase a country's productivity, and they may also lead to technological transfers and spillovers. This can push wages up, prices down, and create more product variety – all contributing to higher welfare. On the other hand, with more FDI a higher



(a) Foreign firms' revenue share

(b) Trade balance and primary income balance

Figure 1: The role of foreign-owned firms in the V4

share of profits accrues to foreign-owned firms. Given that foreign-owned firms tend to repatriate a significant chunk of their profits, FDI may lead to a lower amount of profits retained in the economy, which can shift households' budget constraints inward leading to a loss of welfare.

This paper quantitatively investigates which of these forces prevail. The focus is on four emerging economies in East-Central Europe, the so-called Visegrád 4 (V4). The paper employs a general equilibrium model featuring the trade-off outlined above.

The V4 countries are composed of the Czech Republic, Hungary, Poland, and Slovakia. The paper focuses on these four countries because the net effect of FDI has been subject to considerable debate in the context of the V4 (Piketty, 2018; Bershidsky, 2018; Darvas, 2018). The V4 have actively focused on attracting FDI (Narula and Bellak, 2009), and are among the biggest recipients of FDI per capita when compared to other emerging markets (Medve-Bálint, 2014). Reasons for this include the accession of these countries to the European Union in 2004, which makes them an attractive FDI destination for EU firms (Medve-Bálint, 2014; Baldwin et al., 1997; Breuss, 2002), especially given their relatively low labour costs and a well-trained labour force (Bevan and Estrin, 2004; Galego et al., 2004; Gauselmann et al., 2011; Nölke and Vliegenthart, 2009).

The impact of high FDI in the V4 is well-illustrated by the high market share of foreign-controlled firms in these economies. Figure 1a shows that this is hovering around 40-50% in the V4 countries as opposed to 25-30% in other EU economies.

As expected, the flip side of high FDI and an important foreign firm presence is high profit outflows. Figure 1b shows that net profit outflows, as measured by the primary income balance, are comparable in size to the trade balance in these economies. Therefore, profit outflows, ultimately stemming from FDI, have a sizeable impact on the current account balance. It is for these reasons, in addition to the fact that this topic has received considerable attention in the media and in policy circles in these countries, that the paper focuses on the V4.

Methodologically, a general equilibrium model is built featuring both the positive effect of

foreign-owned firms on productivity, and their negative effect on profits retained domestically. Firms are heterogeneous and can be either domestic or foreign-owned. On the one hand, foreign-owned firms are more productive and tend to be larger. This has positive macroeconomic effects by decreasing prices, and increasing wages and aggregate profits. On the other hand, foreign-owned firms repatriate a fraction of their profits, while all of domestic firms' profits are paid out as dividends to households. This means that the presence of foreign firms may shift households budget constraint inward creating an adverse macroeconomic effect.

The coexistence of a cost and a benefit to having foreign-owned firms in the economy implies that this model can generate a positive, a negative, or a non-linear relationship between the share of foreign-owned firms and aggregate welfare. To discipline the model and to connect it to the data, it is calibrated to the case of the V4 economies to match the firm revenue distribution, the relative productivity of foreign and domestic firms, and the market share of foreign firms. The calibrated model is then used to carry out counterfactual simulations to estimate the welfare effects of foreign firm presence.

There are two key findings. First, further increasing the number of foreign-owned firms in the V4 economies would on net be beneficial for welfare. This result holds for all four countries. On average, increasing the number of foreign-owned firms by 1% would lead to a 0.21% gain in welfare. The country-specific estimates are 0.05% for Poland, 0.19% for Hungary, 0.23% for the Czech Republic, and 0.37% for Slovakia. The effect is not symmetric: on average, reducing the number of foreign-owned firms by 1% would lead to a 0.13% loss of welfare.[1] The country-specific estimates are a 0.02% loss in the Czech Republic, 0.11% in Slovakia, 0.18% in Hungary, and 0.20% in Poland. Due to the large productivity advantage of foreign-owned firms and the relatively low share of profits in total income, the benefit of FDI easily outweighs the cost in the V4 countries.

The second key finding is that, as expected, increasing the share of profits that are reinvested by foreign-owned firms would increase welfare in all countries. On average, increasing the reinvestment rate by 10 percentage points would lead to a 1.06% improvement in welfare. Hungary and the Czech Republic would both experience a 0.93% gain, Poland's gain would be 1.09%, and Slovakia's 1.29%. The combination of the paper's two key results gives rise to a policy trade-off: incentivising the domestic reinvestment of profits can improve welfare, but could potentially reduce the number of foreign-owned firms present offsetting some of the welfare gains.

The limitations of the paper are two-fold. First, productivity spillovers from foreign to domestic firms are ignored. However, empirical estimates of these spillovers vary considerably, and meta-analyses find negative to non-existent spillovers (Harrison and Rodríguez-Clare, 2010; Wooster and Diebel, 2010; Mebratie and van Bergeijk, 2013; Herzer, 2012), especially in more developed

[1] The elasticity reported in the abstract is the average of 0.21% and 0.13%.

emerging markets such as the V4 (Nicolini and Resmini, 2010). Second, the paper ignores some additional costs of FDI that have been proposed in the literature. These include, for instance, the ability of foreign firms to access international capital markets more easily (Reis, 2001) or their higher reliance on imported inputs (Rodríguez-Clare, 1996). Addressing these issues in a quantitative framework is difficult due to a lack of data availability.

2 Model

This section provides a description of the model, which consists of households with a "taste for variety" utility function and monopolistically competitive firms. Firms can be domestic or foreign-owned. The key difference between these two types of firms is that foreign-owned firms do not keep all of their profits in the country. Below, the household sector, the firm sector, and general equilibrium in the model are discussed in detail.

2.1 Households

A representative household maximises utility by choosing its consumption of each final good variety. There is a continuum of varieties indexed by $i \in [0,N]$. Household income consists of labour income and firm profits. Since there is no disutility of labour, $L > 0$ units of labour are inelastically supplied to firms. The household's problem is

$$\max_{c_i \geq 0} (1-x) \left[\int_0^N c_i^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}} \text{ s.t.}$$
$$\int_0^N w_i \delta_i di L + \Pi_d + \rho \Pi_f \geq (1-x) \int_0^N p_i c_i di,$$

where c_i is consumption of variety i, $\sigma > 1$ is the elasticity of substitution between varieties, $\delta_i \in (0,1)$ is the fraction of workers employed by firm i, w_i is the wage rate of firm i, $L > 0$ is the size of the labour force, Π_d and Π_f are the aggregate profits of domestic and foreign firms, $\rho \in (0,1)$ is the fraction of profits foreign firms do not repatriate, p_i is the price of variety i, and x is the share of output that's exported.

There are three things to note about this household problem. First, as apparent from the household's budget constraint, domestic firms keep all their profits in the country, while foreign firms repatriate a fraction $1-\rho$.

Second, a fraction δ_i of households are employed by firm i with $\delta_i = \delta g_i^d$ for domestic and $\delta_i = (1-\delta) g_i^f$ for foreign firms. The weights $g_i^d \in (0,1)$ and $g_i^f \in (0,1)$ describe the employment distribution across domestic and foreign firms, respectively. Ordering firms' indices so that

domestic firms come first and denoting the number of domestic firms by N_d, it is also true that $\int_0^{N_d} g_i^d di = \int_{N_d}^{N} g_i^f = 1$. This implies that $\delta \in (0,1)$ is the share of domestic firms in employment overall. In the calibration of the model, g_i^d and g_i^f will be set so that the empirical employment size distribution of domestic and foreign firms is matched, while δ will be set so that domestic firms' share in employment is matched.

Third, the fact that a fraction x of output is exported is primarily a technical one. Since $\rho < 1$, households do not have enough income to buy all domestic production, hence some production needs to be exported. In fact, intuitively $x = \frac{(1-\rho)\Pi_f}{Y}$. That is, the fraction of output exported is equal to the share of profit outflows from the economy in total income – this is precisely the "lost income" of households due to profit repatriation by foreign firms.

Let $w \equiv \int_0^N w_i \delta_i di$ and $\Pi \equiv \Pi_d + \rho \Pi_f$. Then this household problem gives rise to an inverse demand function of the form

$$p_i = \frac{(wL+\Pi)^{1/\sigma}}{P^{\frac{1-\sigma}{\sigma}}} c_i^{-1/\sigma} (1-x)^{-1/\sigma}, \tag{1}$$

where $P \equiv \left[\int_0^N p_i^{1-\sigma} di\right]^{\frac{1}{1-\sigma}}$ is an aggregate price index.

2.2 Firms

There are $N = N_d + N_f$ firms, where N_d and N_f denote the number of domestic and foreign-owned firms, respectively. Each firms produces a different variety of the final good. Each variety's market is a monopoly, and therefore the firms are monopolistically competitive. Firms also vary by their productivity, denoted γ_i. Firm i solves the problem

$$\max_{p_i, c_i} p_i c_i - w_i \gamma_i c_i \text{ s.t. } (1).$$

The technology parameter $\gamma_i > 0$ measures the units of labour the firm needs to produce one unit of the final good. Hence, a lower γ_i corresponds to a more productive firm. It follows from optimisation that the output (c_i) and price (p_i) of firm i are

$$c_i = \left(\frac{\sigma - 1}{\sigma} \frac{1}{w_i \gamma_i}\right)^{\sigma} \frac{wL + \Pi}{P^{1-\sigma}(1-x)} \tag{2}$$

$$p_i = \frac{\sigma}{\sigma - 1} w_i \gamma_i. \tag{3}$$

Intuitively, more productive (lower γ_i) firms can charge lower prices. Further, the price charged by firms is at a mark-up of $\frac{\sigma}{\sigma-1}$ over marginal cost ($w_i \gamma_i$).

As firms are heterogeneous in terms of productivity, there is a distribution of γ_i, which differs for domestic and foreign firms with mean productivities $\bar{\gamma}_d$ and $\bar{\gamma}_f$, respectively. Let the price charged by the foreign firm with productivity $\bar{\gamma}_f$ be the numeraire and let its index be $i = n$, so that $p_n = 1$ and $\gamma_n = \bar{\gamma}_f$. One can then take Equation (3) for the numeraire firm, set it equal to 1, and solve for the numeraire firm's wage rate to get

$$w_n = \frac{\sigma - 1}{\sigma} \frac{1}{\gamma_n}. \tag{4}$$

The numeraire firm, therefore, pays a higher wage the more productive it is (the lower γ_n is). In addition, its wage is inversely related to the mark-up.

2.3 Equilibrium

The variables left to be determined in general equilibrium include the aggregate price index (P), wage rates (w_i), aggregate profits (Π_d, Π_f), and the share of output exported (x). Let us look at each of these in turn.

2.3.1 Aggregate price index

The aggregate price index P can be backed out from the labour market clearing equation of the numeraire firm. In general, labour demand for firm i is $\gamma_i c_i$, while labour supply is $\delta_i L$. Setting these two equal to each other for the numeraire firm, and plugging in for c_n from (2) and for w_n from (4) allows to solve for P as

$$P = \left(\frac{wL + \Pi}{1 - x} \right)^{\frac{1}{1-\sigma}} \left(\frac{\delta_n L}{\gamma_n} \right)^{\frac{1}{\sigma - 1}}. \tag{5}$$

2.3.2 Labour market clearing

As noted above, labour market clearing requires $\gamma_i c_i = \delta_i L$. Plugging in for c_i from (2) and for P from (5) yields the wage rate of firm i as

$$w_i = \left(\frac{\gamma_i^{1-\sigma}}{\gamma_n} \right)^{\frac{1}{\sigma}} \left(\frac{\delta_n}{\delta_i} \right)^{\frac{1}{\sigma}} \frac{\sigma - 1}{\sigma}.$$

The same comparative statics that apply to the numeraire firm's wage rate carry through to all firms as well: w_i is increasing in productivity (decreasing in γ_i) and is decreasing in the mark-up. Furthermore, w_i is now also decreasing in the labour supplied to firm i, δ_i, relative to the labour supplied to the numeraire firm, δ_n.

2.3.3 Aggregate profits

To get the aggregate profits Π_d and Π_f, individual firm profits need to be calculated first as,

$$\begin{aligned}\pi_i &= p_i c_i - w_i \gamma_i c_i \\ &= \frac{\delta_n L}{\gamma_n}\left[\left(\frac{\sigma-1}{\sigma}\frac{1}{w_i\gamma_i}\right)^{\sigma-1} - \left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\left(\frac{1}{w_i\gamma_i}\right)^{\sigma-1}\right],\end{aligned}$$

which follows from plugging for c_i and p_i from Equations (2)-(3), and for P from Equation (5). Aggregate profits are then given by merely integrating over the π_i for domestic and foreign-owned firms separately. Recall that firm indices are arranged so that domestic firms come first, therefore,

$$\begin{aligned}\Pi_d &= \int_0^{N_d} \pi_i di \\ \Pi_f &= \int_{N_d}^{N} \pi_i di.\end{aligned}$$

2.3.4 Share of output exported

Finally, to pin down x, denote total output by $Y \equiv \int_0^N p_i c_i di$. This, by definition, is also equal to total income generated domestically, i.e. $Y = wL + \Pi_d + \Pi_f$. Domestic households' income, however, is only $wL + \Pi_d + \rho\Pi_f = Y - (1-\rho)\Pi_f$. This has to be equal to domestic households' consumption, which is just the non-exported part of output $(1-x)Y$. Hence, we have

$$\begin{aligned}(1-x)Y &= Y - (1-\rho)\Pi_f \\ x &= \frac{(1-\rho)\Pi_f}{Y}.\end{aligned}$$

That is, the fraction exported is equal to the share of domestic income that is repatriated by foreign-owned firms and hence is not in domestic households' budget constraint.[2]

3 Numerical simulations

While the model can be explicitly solved, its solution is quite complex and can exhibit a large number of qualitative behaviours. In order to proceed, the model is solved at specific parameter

[2] An alternative way of deriving x involves recalling that by definition $P = \left[\int_0^N p_i^{1-\sigma} di\right]^{\frac{1}{1-\sigma}}$. Setting this equal to Equation (5) also yields a solution to x as $x = 1 - \frac{(wL+\Pi)\left(\frac{\gamma_n}{\delta_n L}\right)}{\int_0^N \left(\frac{\sigma}{\sigma-1} w_i \gamma_i\right)^{1-\sigma} di}$. It is numerically verified during the simulations that this expression is indeed equal to the simpler expression derived in the main text.

values matching the V4 economies, then its policy implications are evaluated numerically. This section describes how the numerical parameter values are obtained, and how the counterfactual simulations are implemented.

The model's parameters are split into three groups: calibrated parameters, observable parameters, and other parameters. Calibrated parameters are picked so that the model reproduces an empirically observable data point at those parameter values. Observable parameters can be directly inferred from data. Other parameters are picked by the researcher.

3.1 Calibrated parameters

The parameters that are calibrated are the γ_i. Their values are chosen so that the model comes as close as possible to matching the revenue distribution of firms by size, the profit per employee of foreign firms relative to domestic firms, and the share of domestic firms in overall revenue. For the sources of these numbers, see Appendix D.1.

To implement the calibration, let θ be the vector of parameters to be calibrated, let m be the vector of data points to be matched, and let $f(\theta)$ be the model's output for those data points for a parameter vector θ. The parameters in θ are then obtained by minimising the distance between the data and the model's output by solving

$$\hat{\theta} = \arg\min_{\theta}(m - f(\theta))' W (m - f(\theta)),$$

where m and $f(\theta)$ are $k \times 1$ vectors, and k is the number of data points to be matched. W is a $k \times k$ weighting matrix whose diagonal elements are set to $1/m_i$ in row i.

The productivity distribution of firms is discretised. In particular, both domestic and foreign-owned firms are split into five groups with the γ_i being identical within groups. Therefore, there will ultimately be five different types of domestic and five different types of foreign-owned firms. This step is taken because the data about firms' revenue distribution also comes in five groups. There will thus be five productivity parameters for domestic firms ($\gamma_1^d, \gamma_2^d, \gamma_3^d, \gamma_4^d, \gamma_5^d$), and five for foreign-owned firms ($\gamma_1^f, \gamma_2^f, \gamma_3^f, \gamma_4^f, \gamma_5^f$).

Three more things are worth noting about calibrating the γ_i. First, the parameter γ_5^d is normalised to 1. So all other groups' productivities are measured relative to this group's. Second, an additional constraint placed upon the calibration is that larger firms should have (weakly) lower γ_i. In other words, it is assumed that larger firms are more productive.[3] Third, it is also assumed that foreign firms are (weakly) more productive than domestic firms in the same group ($\gamma_j^d \geq \gamma_j^f$ for

[3] While this assumption is not necessary for a successful calibration, it is imposed in order to ensure consistency with the empirical stylised fact that larger firms tend to be more productive (Leung et al., 2008; Pagano and Schivardi, 2003; van Biesebroeck, 2005).

$j \in [1,5]$). More details about how the calibration is implemented can be found in Appendix A.

The exact values of the calibrated parameters are presented in Table C.1. Furthermore, Figures B.1-B.2 show that the model does quite well in matching the targeted data points for all four countries.

3.2 Observable parameters

Some parameters are readily observable in the data. These include the relative number of domestic and foreign-owned firms (N_d, N_f), the profit reinvestment rate of foreign-owned firms (ρ), the share of domestic firms in total employment (δ), the mark-up parameter (σ), and the employment distribution of domestic and foreign-owned firms (g_i^d, g_i^f). For data sources on these variables, see Appendix D.2. Three of these merit a brief discussion.

To obtain the number of domestic firms (N_d) in the model, the total number of firms in the model (N) is exogenously picked (see next sub-section). Then $N_d = \mu N$, where $\mu \in [0,1]$ is the empirically observed share of domestic firms in all firms. Similarly, then $N_f = (1-\mu)N$.

Mark-ups are estimated following Cavalleri et al. (2019). The mark-up itself, $m \equiv \frac{\sigma}{\sigma-1}$, is obtained by dividing gross output by the sum of intermediate input costs and employee compensation. It follows then that $\sigma = \frac{m}{m-1}$.

The employment distribution variables (g_i^d, g_i^f) are split into five groups (for domestic and foreign-owned firms separately) corresponding to the γ_i groups. This is because the available data also breaks down employment distribution into five groups. The data gives the share of firms in total employment by firm size (e.g. the share of firms with 1-9 employees in total employment). The parameters g_i^d and g_i^f are picked so as to reproduce this distribution. So for instance, g_1^d is set to match the share of domestic firms with 250+ employees in total domestic-firm employment, g_2^d is set to match the share of domestic firms with 50-249 employees in total domestic-firm employment, and so on.

The list of observable parameters is shown in Table C.2. In addition, Figure B.3 verifies that the choices for g_i^d and g_i^f indeed reproduce the observed employment distributions.

3.3 Other parameters

The remaining parameters represent the number of households (L) and firms (N) in the model. These are of course picked without guidance from the data. The values of these parameters are listed in Table C.3. Also, recall that the productivity of the smallest domestic firms (γ_5^d) is normalised to 1.

3.4 Comparative statics

Once the model is calibrated, the goal is to run some counterfactual simulations. These will take the form of comparative statics with respect to μ and ρ. That is, these simulations show what would happen if the share of domestic firms in the economy were different, or if the profit repatriation rate of foreign firms were different. Comparative statics with respect to ρ are straightforward. However, comparative statics with respect to μ give rise to two issues. First, if the share of domestic firms (μ) is increased, then presumably so should their share in total employment (δ). It is uninformative to run comparative statics by changing μ while keeping δ unchanged. Second, if μ is decreased (more foreign firms enter the economy), then it is not necessarily realistic to assume that the total number of firms (N) remains unchanged. It could be that the additional foreign firms do not displace existing domestic firms one-for-one, thereby leading to a higher number of firms, N. These two issues are addressed in the remainder of this section.

3.4.1 Response of domestic employment share to domestic firm share

To address the first issue, one would need to know how the share of domestic firms in employment (δ) varies with the share of domestic firms in all firms (μ). To obtain an estimate of this, country-level Eurostat panel data for 2008-2017 is used to regress domestic share in employment on domestic share in the number of enterprises.

An unconditional scatter plot for this data is shown in Figure B.4. It is clear that there is a positive relationship. Three outlier and/or special case countries are highlighted (Estonia, Bosnia, Luxembourg). These are omitted from the data set, but the analysis can easily be redone with their inclusion as well.

A variety of different regression specifications are considered: with and without country fixed effects, and with a linear (μ), quadratic ($\mu + \mu^2$), and cubic ($\mu + \mu^2 + \mu^3$) independent variable. These different approaches all yield roughly the same fitted line for the domestic firm share range of 90% to 100%. They tend to diverge at the lower end where actual observations become non-existent. This is illustrated for three fixed-effects specifications in Figure B.5. Ultimately, the cubic specification with country fixed effects is chosen[4], and its parameters are summarised in Table C.4. The implication is that throughout the comparative statics analysis, whenever μ is changed, δ will be changed according to these regression coefficients. The intercept is chosen so as to ensure that the baseline values of μ and δ lie on the fitted line.

[4]Results with alternative specifications are available upon request.

3.4.2 Response of total firm number to domestic firm share

The second issue with comparative statics with respect to μ is that if μ is decreased, that means more foreign firms enter the country. But if the total number of firms, N, is kept unchanged then it is effectively assumed that foreign firms displace domestic firms one-for-one. This may be problematic as if this were not the case, then the total number of firms could increase when foreign firms enter, which could have positive welfare implications by increasing the variety of goods available to households.

In general, the change in the number of domestic firms as a function of the change in the number of foreign firms is $\Delta N_d = -\lambda \Delta N_f$. If N is kept constant, then $\lambda = 1$, and foreign firms displaces domestic ones one-for-one. The other extreme is $\lambda = 0$, in which case foreign firms do not displace any domestic firm.

An expression for N_f can be derived as a function of μ, λ, and the number of domestic and foreign firms in the baseline calibration ($\bar{N}_d, \bar{N}_f$). This is given by

$$N_f = \frac{(1-\mu)\bar{N}_d + (1-\mu)\lambda \bar{N}_f}{\mu(1-\lambda)+\lambda}.$$

At $\lambda = 1$, this intuitively collapses to $N_f = (1-\mu)\bar{N}$, that is N_f is a fraction $1-\mu$ of the baseline (unchanged) total number of firms, $\bar{N}$. At $\lambda = 0$, it collapses to $N_f = \frac{1-\mu}{\mu}\bar{N}_d$, which ensures that the number of domestic firms remains $\bar{N}_d$, and that this will make up μ fraction of total firms.

It is beyond the scope of this paper to empirically estimate λ. However, simulations are run covering the entire range of possible λ. As discussed in Section 4.3.3, the results are remarkably insensitive to variations in λ.

4 Results

The results are presented in three sections. First, counterfactual simulations are carried out with respect to the number of foreign-owned firms in each country. This amounts to evaluating the welfare effects of changing the domestic firm share (μ) and the domestic employment share (δ) while keeping everything else constant. Second, counterfactual simulations are carried out with respect to the profit repatriation rate of foreign-owned firms. In this case, the welfare effects of changing ρ while keeping everything else constant are examined. Finally, a sensitivity analysis shows that the results are largely invariant to alternative parameter values.

4.1 The effect of the number of foreign-owned firms

The share of domestic firms in all firms ($\mu = N_d/N$) lies around 95-99% in all countries in the data (see Table C.2). In the counterfactual simulations, it is examined what would happen if these numbers were different. The range considered is 75% to 99%. As explained in Section 3.4.1, changing the share of domestic firms is only realistic if their share in employment (δ) changes in tandem. This is done according to the procedure described in Section 3.4.1, essentially using fitted values from a regression of δ on μ.

The main result of these simulations is shown in Figure B.6. It is apparent that in all four countries both real output (Y/P) and welfare (measured by utility) are declining in the share of domestic firms. Therefore, having more foreign-owned firms leads to welfare gains on net for all four countries. Figure B.7 shows these welfare gains in percent relative to the baseline calibration. Figure B.8 shows the welfare gains by putting not the share of domestic firms on the x-axis, but the percent change in the number of foreign-owned firms. It is this figure that illustrates the key numbers of the paper: a 1% increase in the number of foreign-owned firms would lead to a 0.21% gain in welfare, on average. It is apparent from the figures that the welfare effects of changing the number of foreign firms are non-linear. This is why the welfare loss from a 1% decrease in the number of foreign-owned firms is somewhat lower in absolute value at 0.13% on average.

What is the reason for these results? Figure B.9 shows that real household income is decreasing in the share of domestic firms. Household income has two components: labour income and profit income. Real labour income increases with the share of foreign firms as expected. This is because more productive foreign-owned firms can afford to pay more to their workers. Real profit income, on the other hand, also increases with the share of foreign firms, contrary to expectations. This counterintuitive result is explained by the fact that while nominal profit income is indeed decreasing in the share of foreign firms (Figure B.10), the price level is also decreasing as the more productive foreign firms enter the economy (Figure B.11). It turns out that the latter effect is stronger, and so in real terms, the profit income of domestic households is actually increasing in foreign firm share.

Therefore, the productivity advantage of foreign-owned firms is so large that in general equilibrium even the fact that they repatriate a higher share of their profits is offset by their deflationary impact on prices. These results are remarkably stable: the sensitivity analysis in Section 4.3 shows that both qualitatively and quantitatively, little changes if parameter values are perturbed.

4.2 The effect of the repatriation rate

The share of profits foreign-owned firms reinvest (ρ) varies quite a bit between the four countries, from approximately 20% to 60% (see Table C.2). In the counterfactual simulations, values between 1% and 99% are considered, while keeping all other parameters constant.

The key result is shown in Figure B.12. In all four countries, welfare (measured by utility) is increasing in the reinvestment rate. Real output is unaffected by ρ, because the more profits are reinvested, the higher household income is, and the less output needs to be exported. Hence, production remains unchanged, but more output is consumed domestically as ρ rises. Figure B.13 shows the welfare gains in percent relative to the baseline calibration. The headline number of the paper regarding ρ comes from this figure: a 10 percentage point increase in the reinvestment rate leads to a 1.06% welfare gain on average.

The reason for this result is that household income increases in response to a higher reinvestment rate. Figure B.14 shows that this is driven entirely by an increase in profit income. Labour income is unchanged. Nominal and real incomes change the same way, as the price level (P) is unaffected by changes in ρ (Figure B.15).

Combining the two key results of the paper hints at a policy trade-off. While incentivising foreign-owned firms to reinvest more of their profits (higher ρ) leads to welfare gains, it would presumably also lead to a decline in the number of foreign-owned firms (higher μ), which would have an adverse effect on welfare. The net effect of such a policy is, therefore, ambiguous. It depends heavily on how exactly foreign firms are incentivised to reinvest more, and how many foreign firms opt to leave the country in response to the policy. This is an interesting topic to explore in future research.

4.3 Sensitivity analysis

4.3.1 Sensitivity of the μ/welfare relationship

Overall, the effect of foreign firm share on welfare is qualitatively and quantitatively stable. Figure B.16 shows what would happen if all foreign firms were more or less productive relative to the baseline calibration. Technically, the calibrated γ_i^f from Table C.1 are all simultaneously perturbed by $\pm$ 25%. Intuitively, more productive foreign firms lead to higher welfare gains. The difference relative to the baseline results is negligible for small changes in μ, but it grows for larger changes. There is no qualitative change in the baseline result.

Figure B.17 shows what would happen to the relationship between foreign firm share and welfare if the profit reinvestment rate (ρ) were different. Once again, ρ is perturbed by $\pm$ 25%. It is evident that the results are both qualitatively and quantitatively insensitive to this perturbation. Intuitively, a higher reinvestment rate increases the welfare gains relative to baseline, though only slightly (at least for the 25% perturbation of ρ).

Perturbing the mark-ups over marginal cost firms charge (σ) also leads to no qualitative change in the results as shown in Figure B.18. Quantitatively, the effect is once again small for small changes in μ, but deviation from baseline grows for larger changes in μ. If firms can charge higher

mark-ups (lower σ), then the welfare gains from foreign firms are higher. This may be because higher mark-ups drive prices higher, and in such a situation the deflationary effect of foreign firms might have stronger welfare effects.

Finally, Figure B.19 decomposes the welfare effects of foreign firms. It shows what the μ/welfare relationship would look like if foreign firms had the same size, same productivity, and both same size and productivity as domestic firms. Here, the results vary a bit between countries. In the Czech Republic and Hungary, the productivity and size difference of foreign firms explain about an equal fraction of the total welfare gain. In Poland and Slovakia, the size advantage of foreign firms appears to be a more important contributor to the welfare gain than their productivity advantage. In all countries, if foreign firms are fully identical to domestic ones, then there is a clear but quantitatively small welfare loss to having more foreign firms due to profit repatriation. The welfare loss is small, presumably because the share of profits in total household income is relatively low in all countries.

4.3.2 Sensitivity of the ρ/welfare relationship

The relationship between the profit reinvestment rate and welfare is also largely insensitive to the various perturbations. Figure B.20 shows that having more productive foreign-owned firms increases the welfare gains from a higher reinvestment rate. Quantitatively, the effect of foreign firm productivity on the ρ/welfare relationship is also fairly small.

Figure B.21 shows how the ρ/welfare relationship changes if there are more foreign firms. For this figure, μ was perturbed down by 5% and δ was changed according to the regression coefficients discussed in Section 3.4.1. It is apparent and intuitive that a larger foreign firm presence increases the welfare gains from higher profit reinvestment rates.

The effect of changing mark-ups (σ) is shown in Figure B.22. Intuitively, more profitable firms (lower σ) mean profits are a more important source of income for households, and hence the welfare gains for having more profits reinvested are larger.

Finally, Figure B.23 shows the decomposition of the welfare effects. It shows what the ρ/welfare relationship would look like if foreign firms had the same size, same productivity, and both same size and productivity as domestic firms. For all four countries, the size advantage of foreign firms appears to explain the bulk of the welfare gains that can be gained by increasing profit reinvestment rates. In other words, profit reinvestment rates matter primarily because foreign firms are larger and thus command a larger share of aggregate profits.

4.3.3 Sensitivity to domestic firm displacement

As discussed in Section 3.4.2, a challenge with changing the number of foreign-owned firms is not knowing to what extent new foreign-owned firms displace existing domestic firms. The baseline results assume $\lambda = 1$, which means the total number of firms is kept constant: if in the baseline $\mu = 0.95$ with $N_d = 9500$ and $N_f = 500$, then a counterfactual simulation with $\mu = 0.90$ would have $N_d = 9000, N_f = 1000$. But when replacement is not one-for-one, then the total number of firms can increase if there are more foreign firms. E.g. with $\lambda = 0.5$, we would have $N_d = 9234, N_f = 1026$ for $\mu = 0.90$. The fact that the total number of firms is increasing is beneficial for welfare in and of itself, because it increases the variety of goods available to households. As a general rule, a lower λ should be good for welfare.

This is indeed what Figures B.24-B.25 show. Lower values of λ lead to a steeper μ/welfare relationship indicating higher welfare gains for having more foreign firms. Reassuringly, the quantitative difference between the two extremes of perfect displacement ($\lambda = 1$) and no displacement ($\lambda = 0$) is negligible. Therefore, the paper's inability to estimate λ does not come at a cost of large inaccuracies.

The small effect of λ holds for other variables as well. Neither the evolution of real household income (Figure B.26) nor that of prices (Figure B.27) is significantly affected by λ. Qualitatively, when λ is lower, so are prices. This is presumably because of the pro-competition effect of having more firms in total. This, in addition to the increase in variety, explains why a lower λ is associated with higher welfare. However, the overall message here is that the model's predictions are not quantitatively sensitive to the value of λ.

5 Discussion

Discussion in media and policy circles has posited that the large number of foreign-owned firms in V4 countries can potentially be detrimental to welfare (Piketty, 2018; Bershidsky, 2018). Others have pointed out that more careful counterfactual simulations are necessary to determine whether this is really the case (Darvas, 2018). This paper implements these counterfactual simulations in a general equilibrium framework calibrated to the V4 countries. The two key findings are that foreign firm presence is positively related to welfare, and that higher profit reinvestment rates by foreign firms are also beneficial for welfare.

These results are not necessarily surprising given that a general equilibrium framework takes into account the positive effect of more productive foreign firms on wages, and their deflationary effect on prices. These positive effects are enough to offset the negative welfare effects stemming from profit outflows due to foreign firm profit repatriation in the V4 countries.

In fact, a somewhat surprising finding is that in real terms, domestic profit income is even increasing in the number of foreign firms. While in nominal terms, domestic profit income does indeed drop as more foreign firms enter a country due to profit repatriation, the deflationary effect of foreign firm presence offsets this drop leading to increasing profits in real terms.

On the surface, the policy implications are clear. Attracting FDI is welfare-improving for the V4 countries (at least without costly subsidies). But if they are able to make foreign firms reinvest more of their profits, that would be desirable as well. This is where a policy trade-off may appear: policy aimed at increasing reinvestment rates may deter some foreign firms from entering, making the net welfare effect unclear.

For this reason, it is advisable for governments to incentivise rather than force profit reinvestment. Of course one has to take into account the general equilibrium effects of different policies. Any subsidy for instance would increase government expenditures, which would have to be financed by higher taxes or lower expenditures elsewhere leading to a complex situation. Best may be to give tax breaks to foreign-owned firms for reinvesting profits over a certain amount. Such a policy can in theory be revenue-neutral, as without the tax breaks those profits would be repatriated. A detailed analysis of different policy options is left for future research.

The paper abstracts away from a few issues. First, there are no productivity spillovers from foreign to domestic firms. But empirically, these have been found to be non-existent to negative (Harrison and Rodríguez-Clare, 2010; Wooster and Diebel, 2010; Mebratie and van Bergeijk, 2013; Herzer, 2012) especially in the context of more developed emerging markets such as the V4 (Nicolini and Resmini, 2010). Second, some other costs of FDI cited in the literature such as the easier access of foreign-owned firms to international capital markets (Reis, 2001) or their higher reliance on imported inputs (Rodríguez-Clare, 1996) are ignored due to a lack of data availability. Third, the paper does not analyse the fiscal implications of FDI. Although one would expect the V4 are better off from a fiscal perspective, because total household income (a combination of labour and dividend income) rises as the share of foreign firms increase, thereby expanding the tax base.

Overall, the conclusion is that the V4 countries have benefited greatly from FDI. This is true even if the ensuing profit outflows are taken into account. While increasing the reinvestment rate of foreign-owned firms can be, *ceteris paribus*, welfare-improving, the presence of foreign firms in V4 countries is desirable from a macroeconomic perspective even if there is some profit leakage.

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A Calibration procedure

The key for the calibration is to note that the same number of targets is necessary as parameters to be calibrated. There are six targets in calibration, which are

- the share in revenue of firms employing 1-9 people,
- the share in revenue of firms employing 10-19 people,
- the share in revenue of firms employing 20-49 people,
- the share in revenue of firms employing 50-249 people,
- the profit per employee of foreign firms relative to domestic firms,
- the share of domestic firms' revenue in total firm revenues.

Six parameters can, therefore, be calibrated. But the goal is to calibrate ten γ_i. First, recall that γ_5^d is normalised to 1, so that leaves nine γ_i, which are recursively rewritten as

$$\begin{array}{llll} \gamma_4^d = k_4\gamma_5^d & \gamma_3^d = k_3\gamma_4^d & \gamma_2^d = k_2\gamma_3^d & \gamma_1^d = k_1\gamma_2^d \\ \gamma_5^f = k_5\gamma_5^d & \gamma_4^f = k_5\gamma_4^d & \gamma_3^f = k_5\gamma_3^d & \gamma_2^f = k_5\gamma_2^d \\ \gamma_1^f = k_6\gamma_1^d. & & & \end{array}$$

Given that $\gamma_5^d = 1$, only six parameters $(k_1, k_2, k_3, k_4, k_5, k_6)$ are now needed to pin down all ten γ_i. The parameters $\{k_j\}_{j=1}^4$ define the value of γ_j^d relative to γ_{j+1}^d. The parameter k_5 defines the value of γ_j^f relative to γ_j^d for $j \in [2,5]$. In other words, the productivities of foreign firms are defined relative to domestic firms in the same group. Finally, the parameter k_6 defines the value of γ_1^f relative to γ_1^d. So the relative productivities of the biggest and most productive domestic vs. foreign-owned firms (which are in group 1) can differ from the relative productivities of the other groups.

Groups are ordered so that firm size is inversely related to group number (i.e. firms in group 1 are the biggest, group 5 the smallest). Therefore, in order to ensure larger firms are more productive, the constraint $k_j \in (0,1) \forall j$ is imposed during calibration. This also means foreign firms are assumed more productive than domestic firms in the same category.

This calibration procedure ensures that (1) all ten γ_i can in theory be different despite only calibrating six parameters, (2) larger firms are (weakly) more productive, and (3) foreign firms are (weakly) more productive than domestic firms in the same size group.

The γ_i implied by the calibrated k_j are shown in Table C.1. The ability of this calibration procedure to match the targets outlined in the bullet points above is shown in Figures B.1-B.2.

B Figures

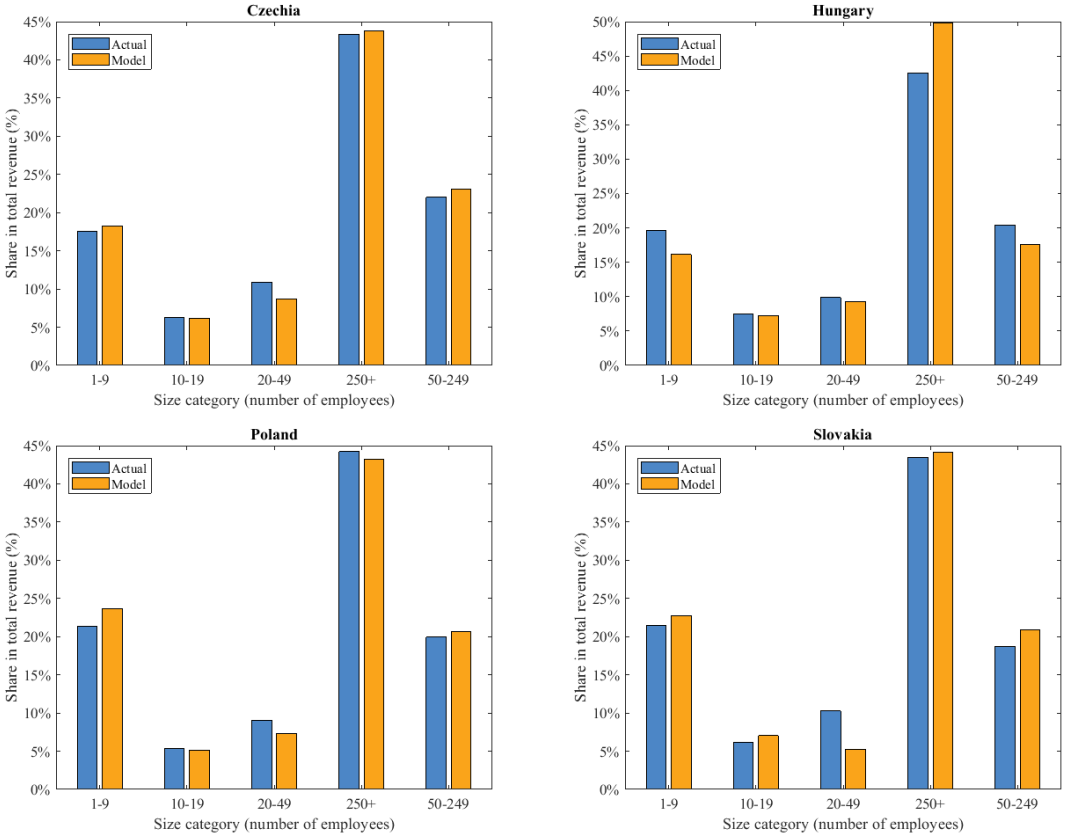
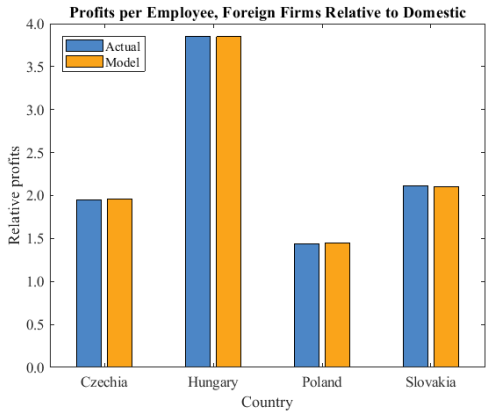
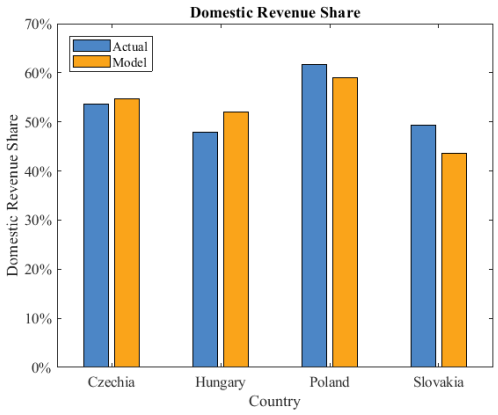


Figure B.1: Actual and modelled revenue distribution by firm size for each country



(a) Relative profit per employee



(b) Domestic revenue share

Figure B.2: Actual and modelled revenue share of domestic firms

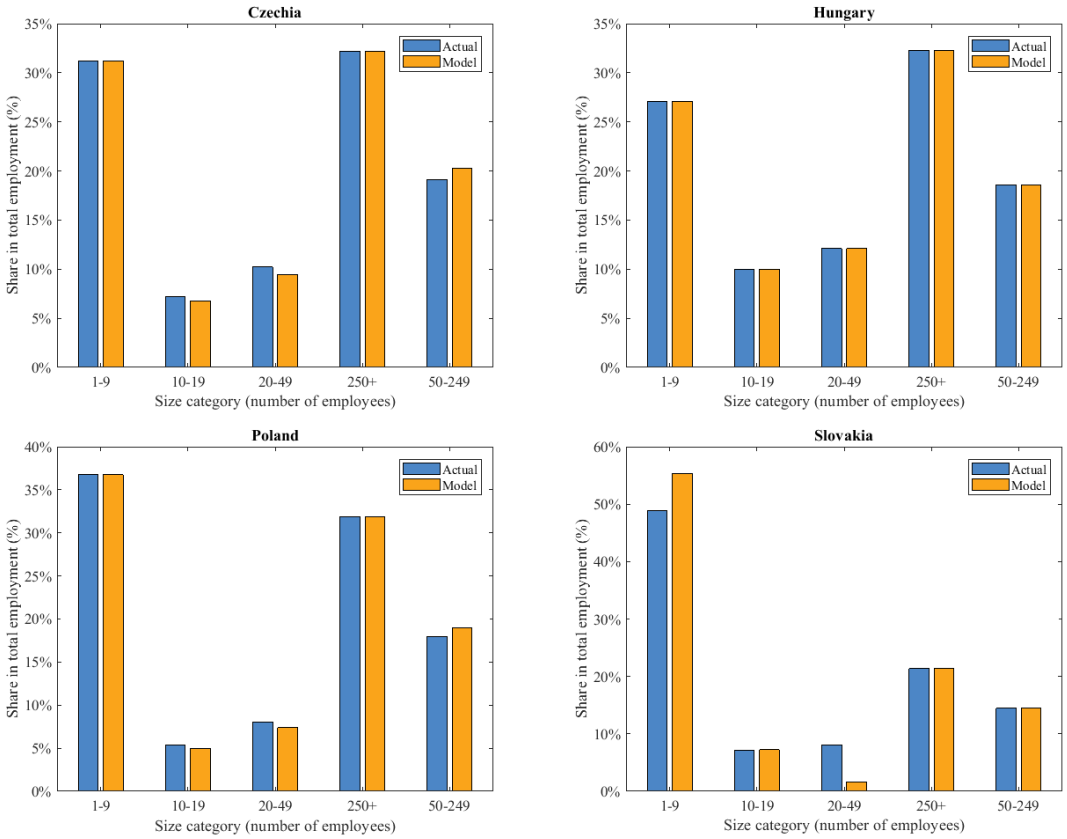


Figure B.3: Actual and modelled employment distribution by firm size for each country

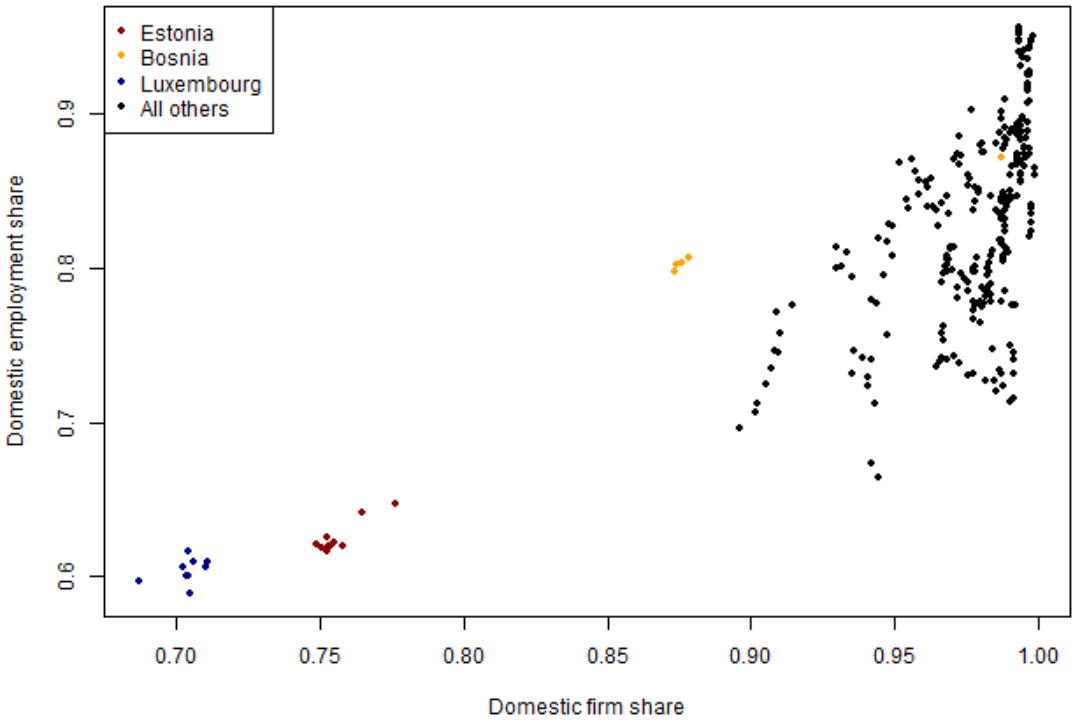


Figure B.4: Unconditional scatter plot of domestic firm number share vs. employment share (2008-2017)

Note: "Domestic firm share" refers to the share of domestic firms in the total number of firms. "Domestic employment share" refers to the share of domestic firms in total employment.

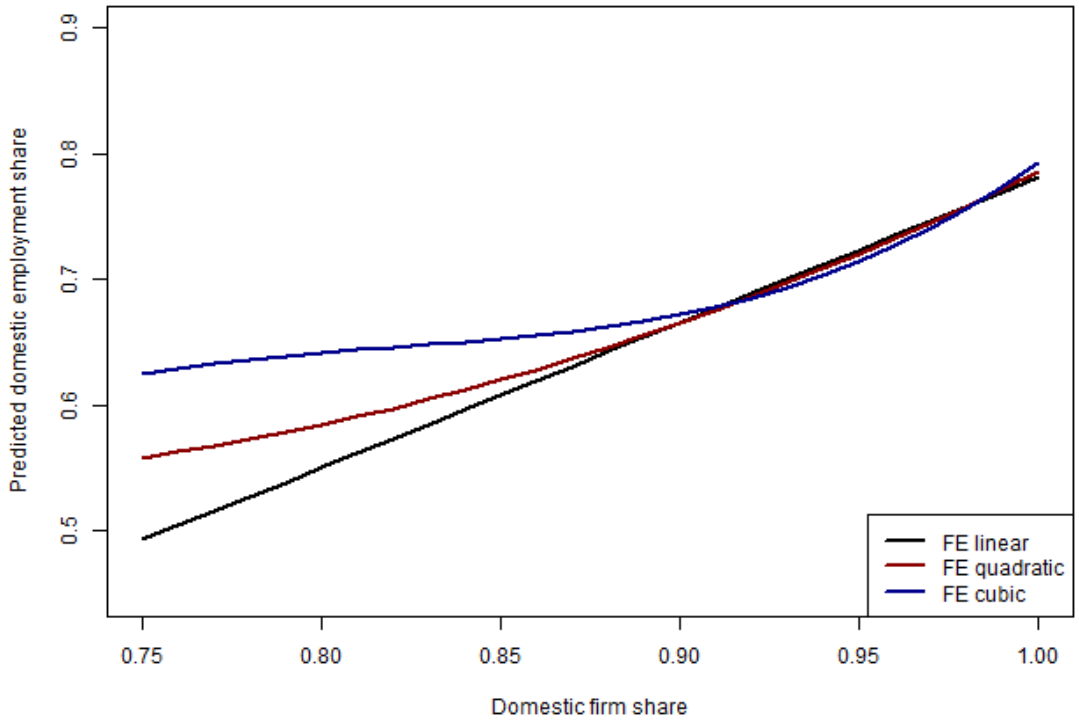


Figure B.5: Fitted lines for selected models for the regression of domestic employment share on domestic firm number share

Note: "FE linear" refers to a regression of the form $\delta_{ct} = \alpha_c + \beta\mu_{ct} + \varepsilon_{ct}$, where δ_{ct} is domestic employment share in country c in year t, α_c is a country fixed effect, and μ_{ct} is domestic firm number share. "FE quadratic" has a quadratic term for μ_{ct} as well. "FE cubic" has a quadratic and cubic term for μ_{ct} as well.

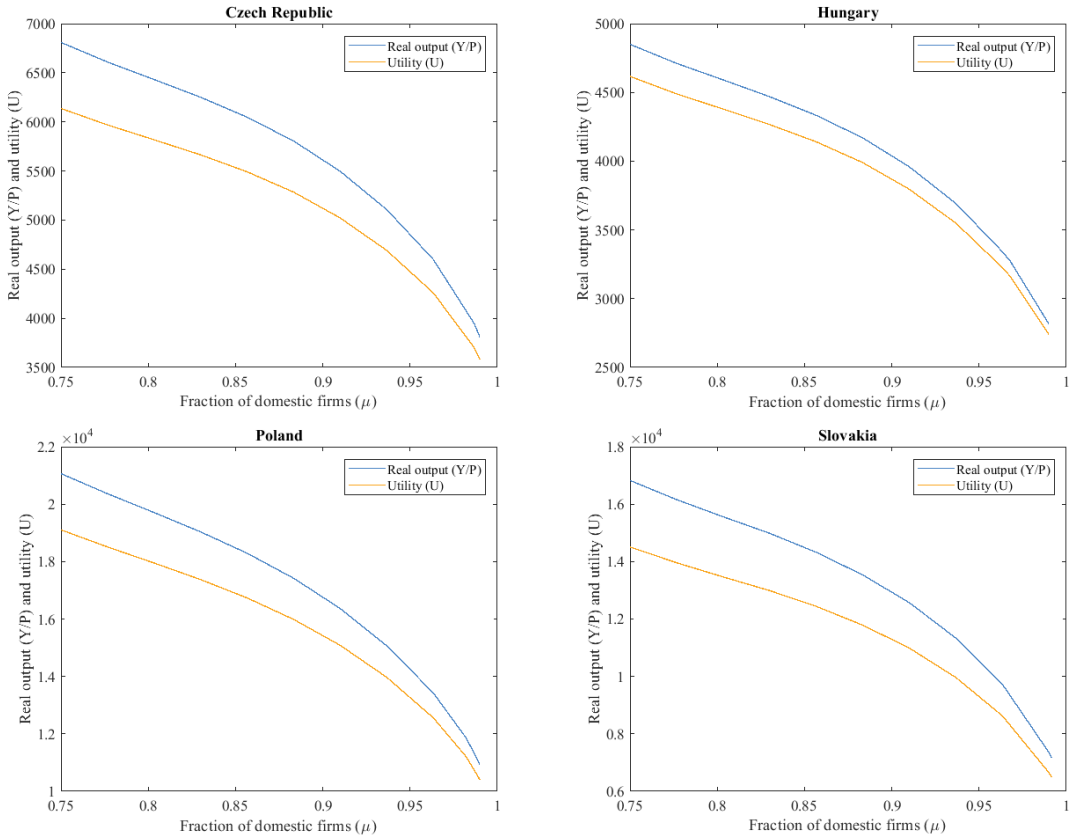


Figure B.6: The effect of changing the share of foreign-owned firms on output and welfare

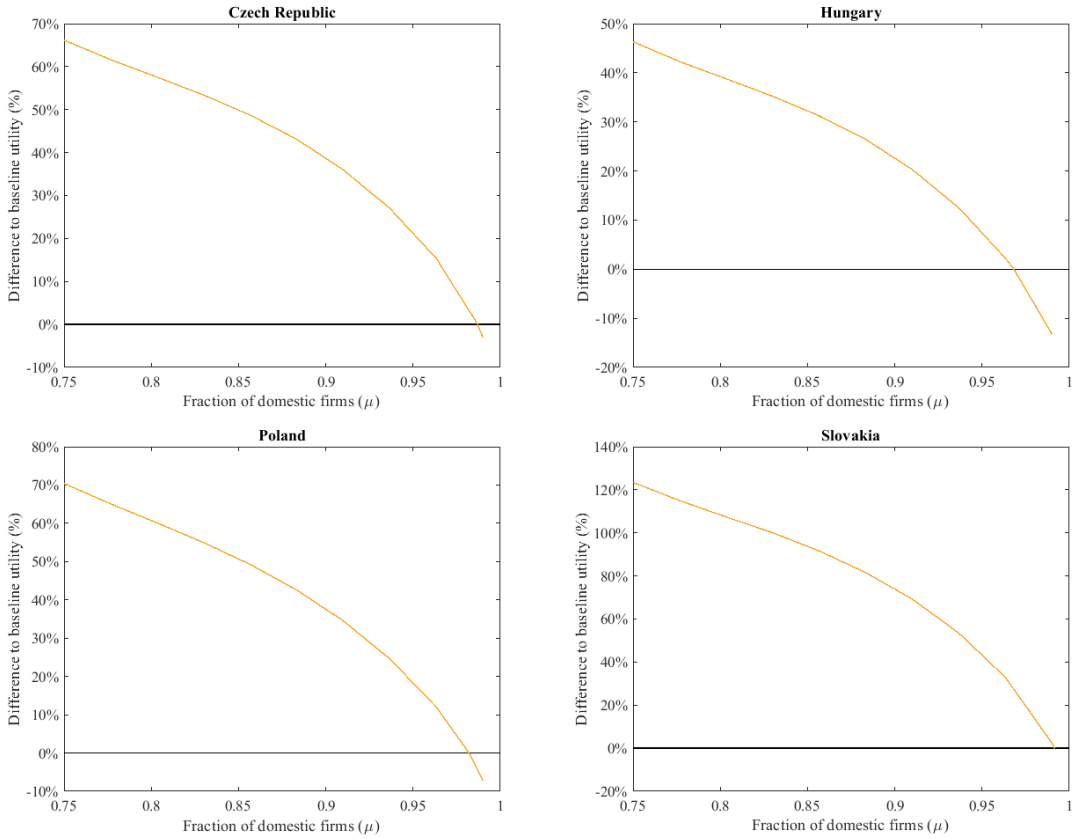


Figure B.7: The relative effect of changing the share of foreign-owned firms on welfare

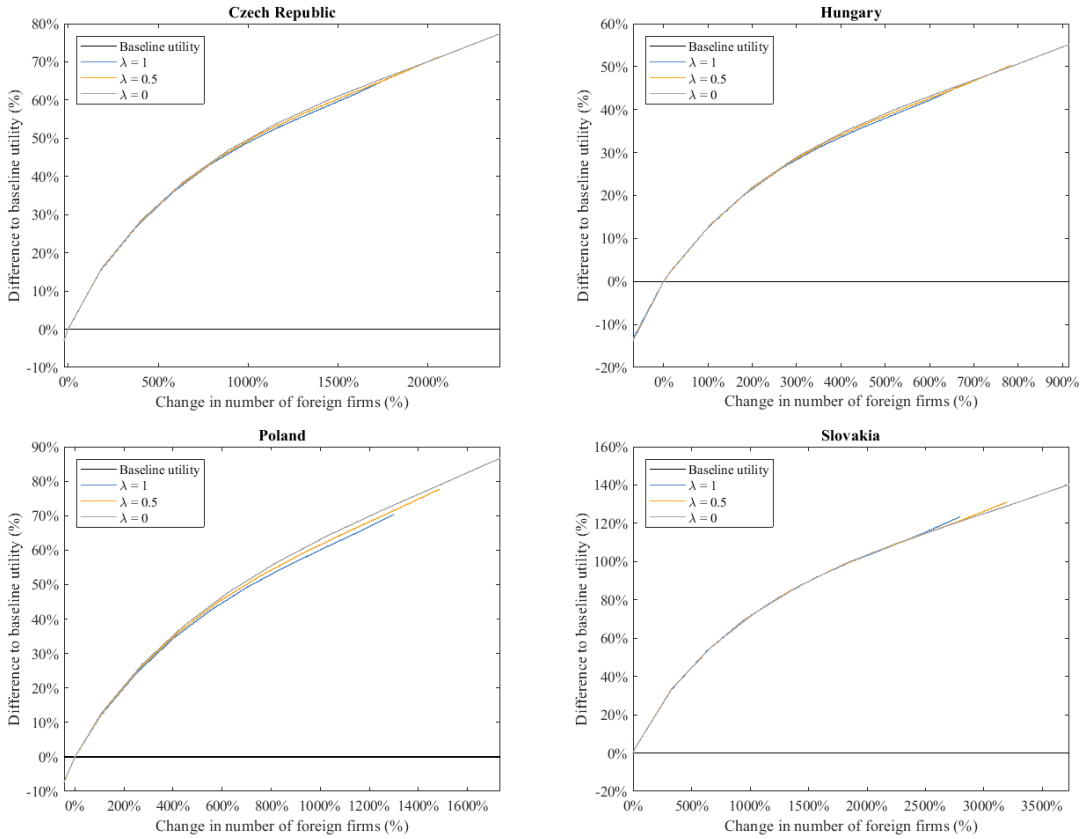


Figure B.8: The relative effect of changing the number of foreign-owned firms on welfare

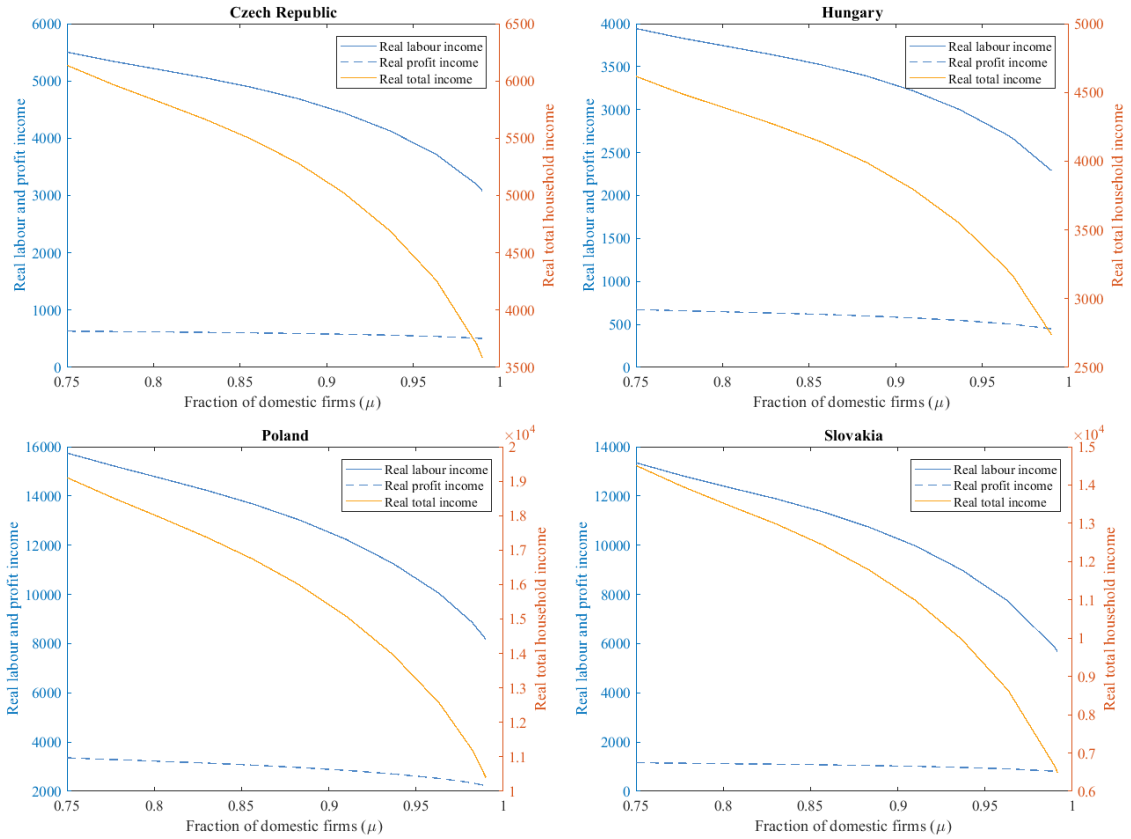


Figure B.9: The effect of changing the share of foreign-owned firms on household income

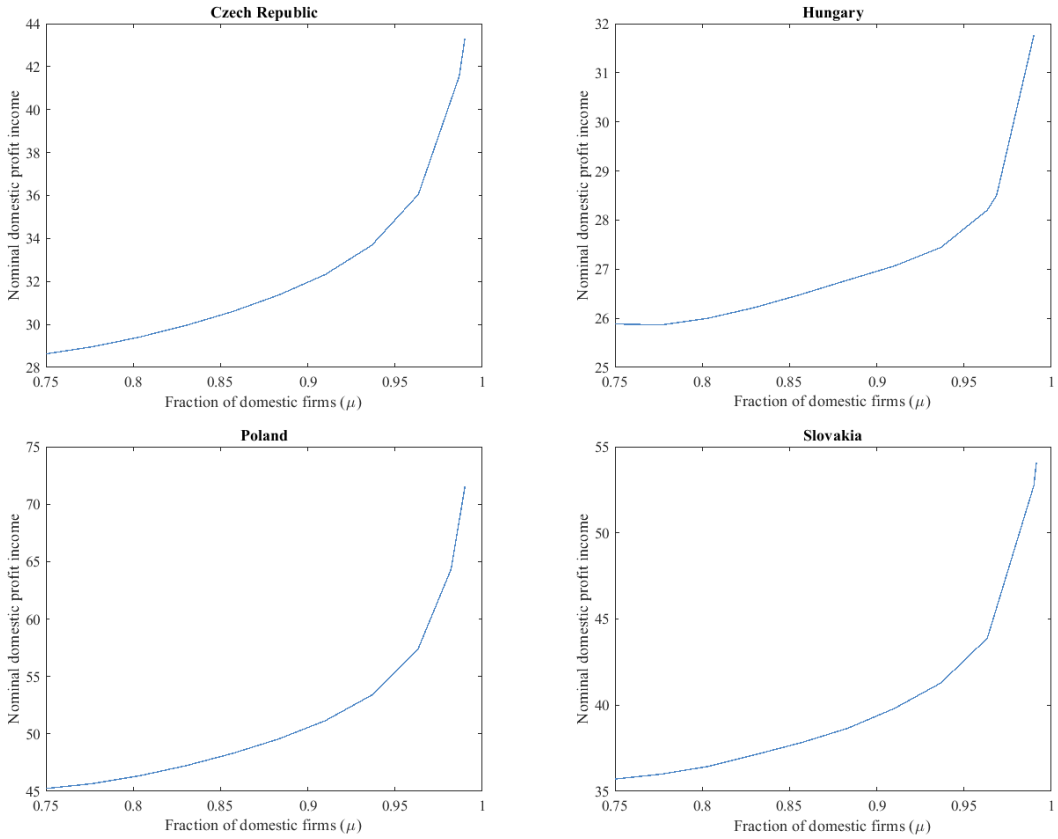


Figure B.10: The effect of changing the share of foreign-owned firms on nominal profits

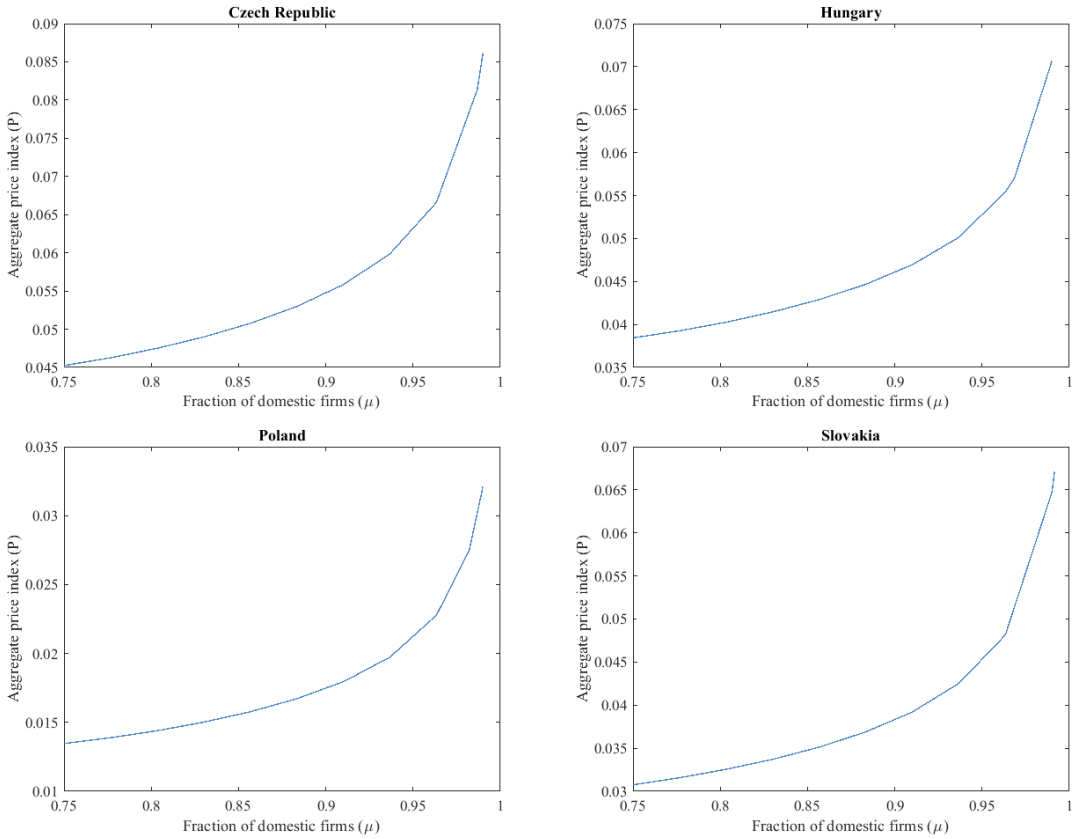


Figure B.11: The effect of changing the share of foreign-owned firms on prices

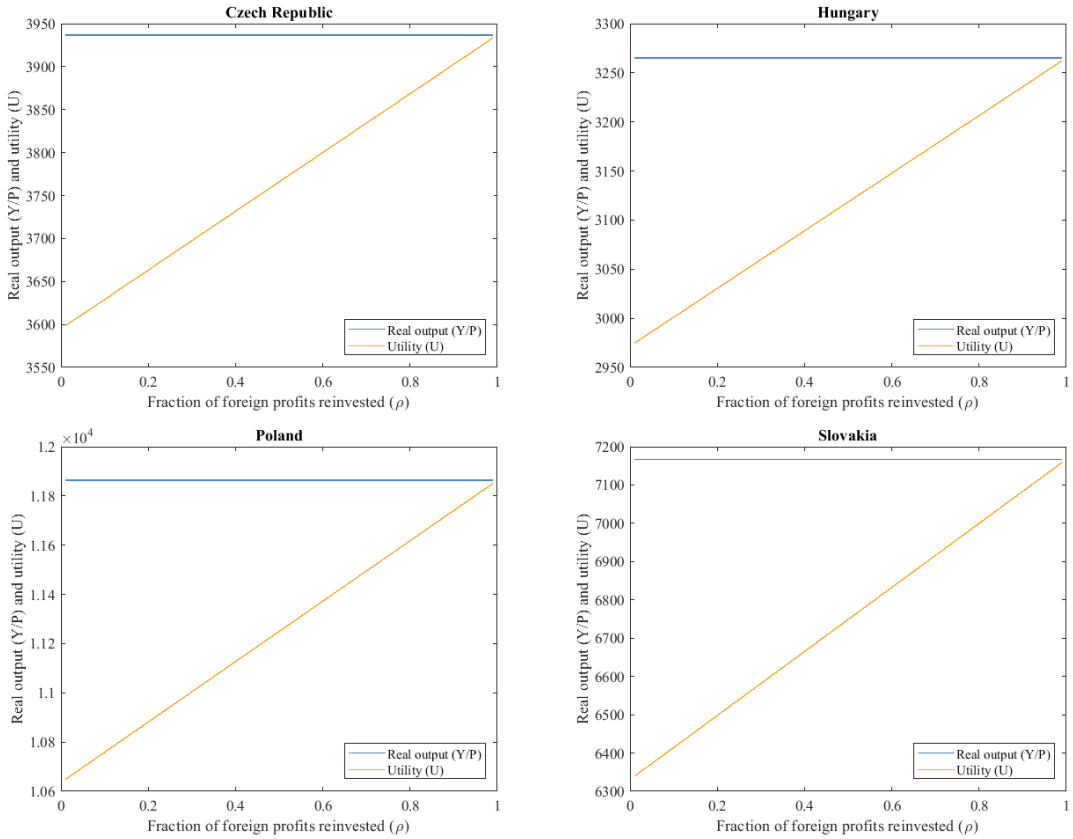


Figure B.12: The effect of changing the share of reinvested profits on output and welfare

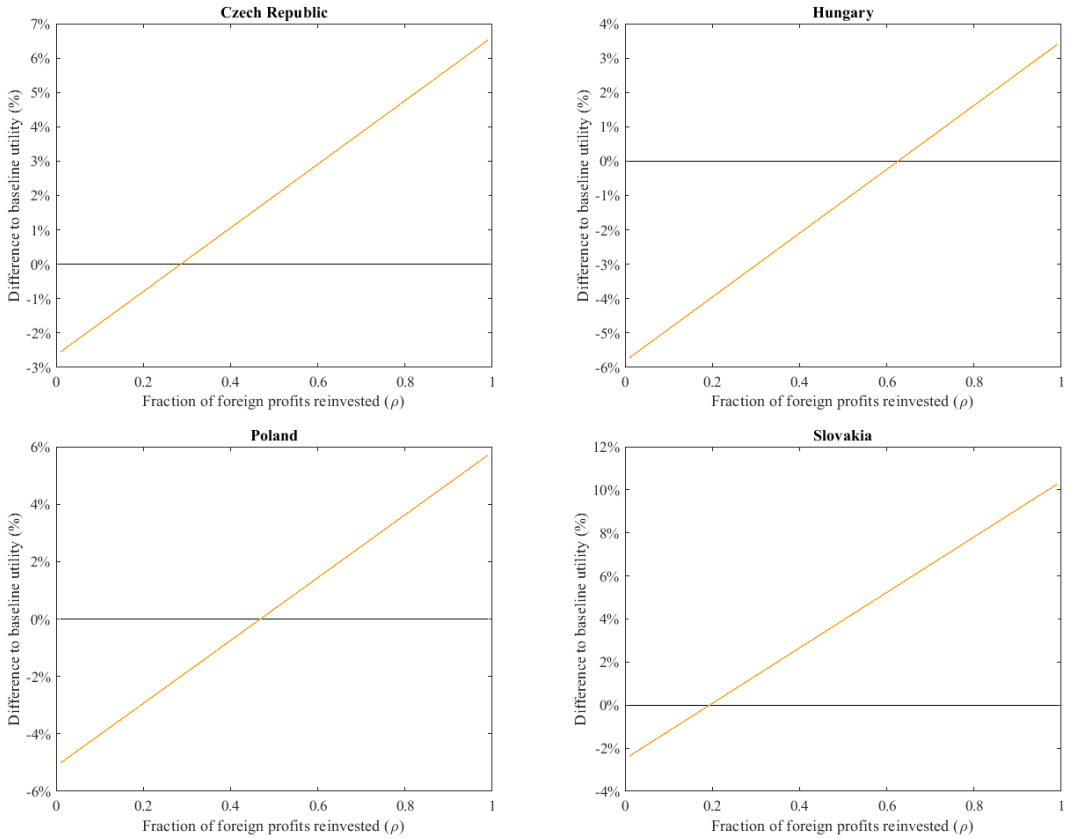


Figure B.13: The relative effect of changing the share of reinvested profits on welfare

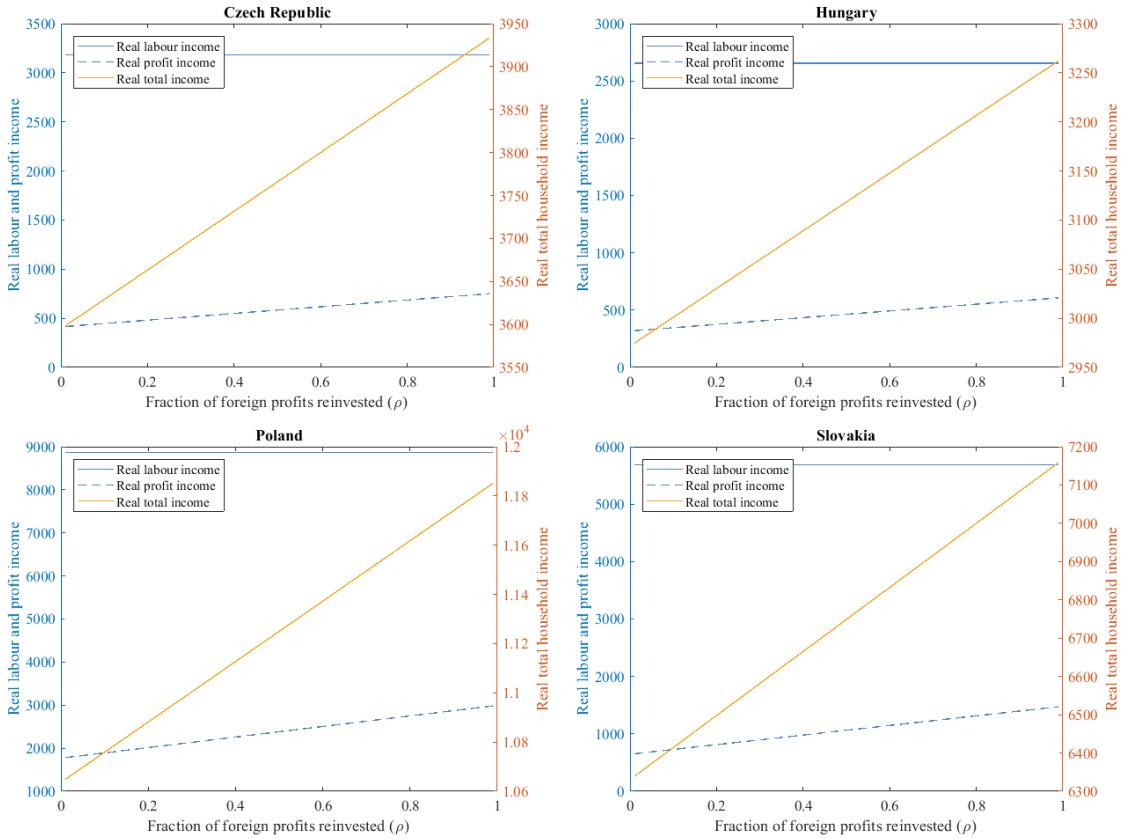


Figure B.14: The effect of changing the share of foreign-owned firms on household income

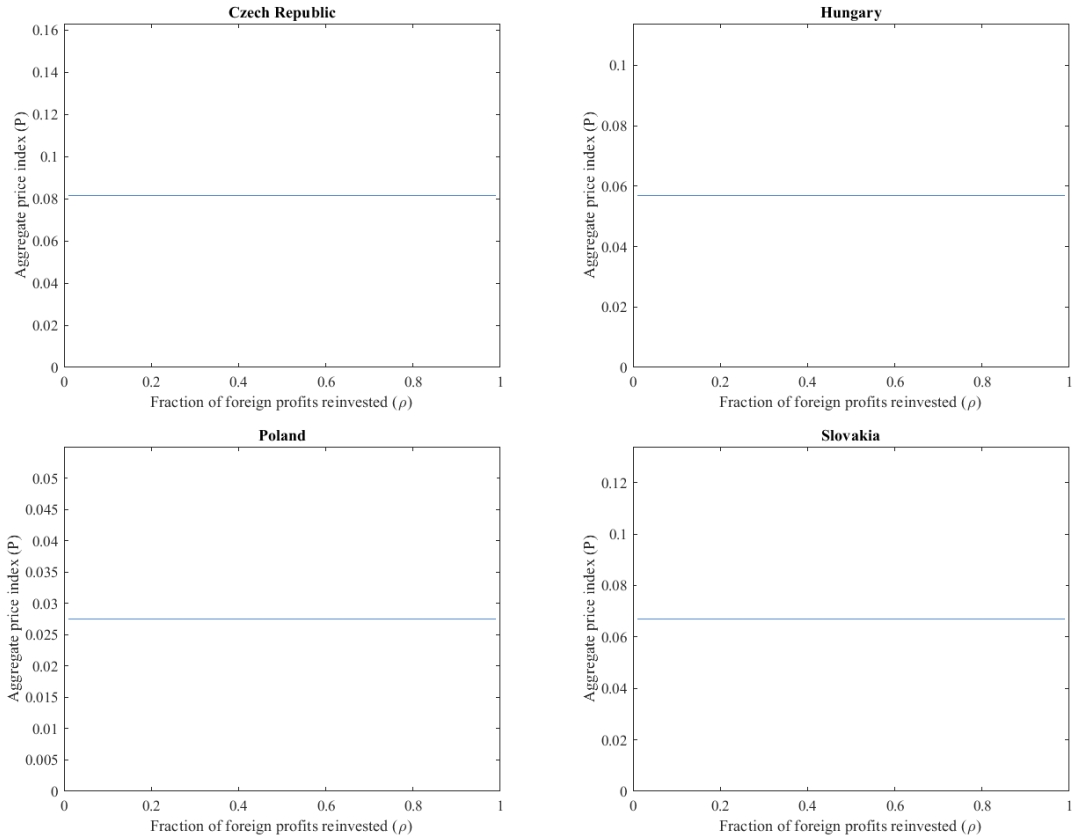


Figure B.15: The effect of changing the share of foreign-owned firms on prices

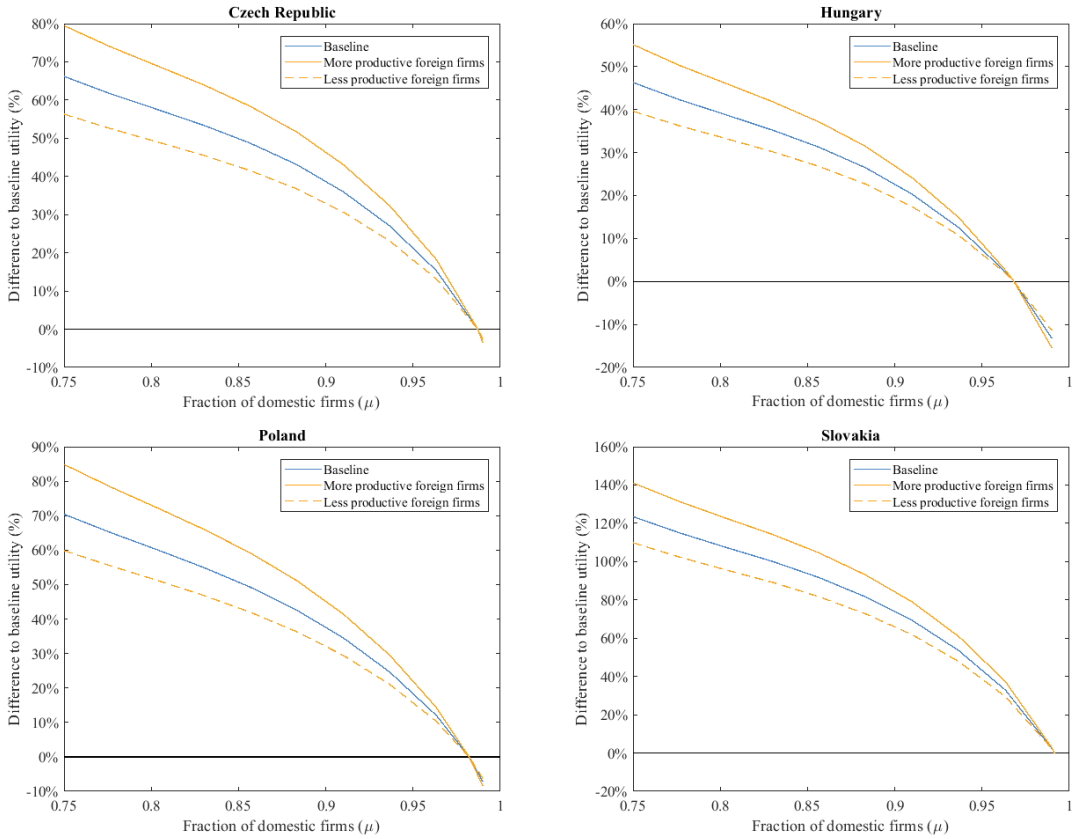


Figure B.16: Sensitivity of the μ/welfare curve to the γ_i^f

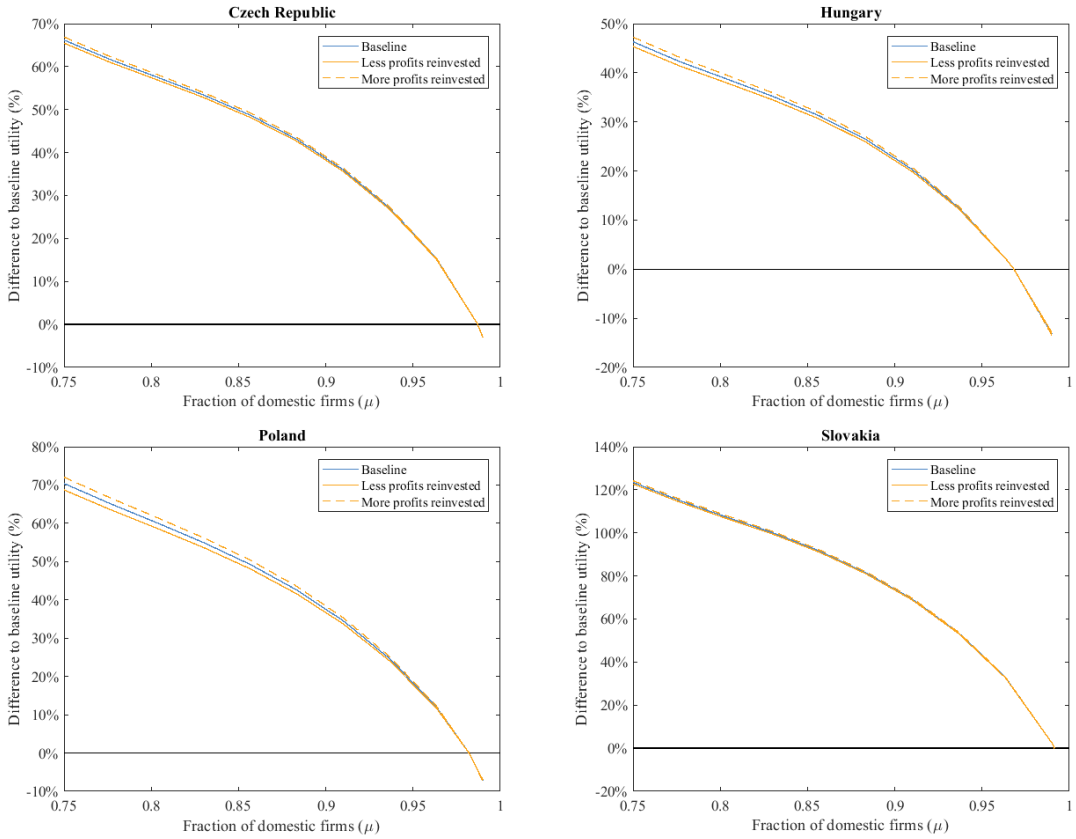


Figure B.17: Sensitivity of the μ/welfare curve to ρ

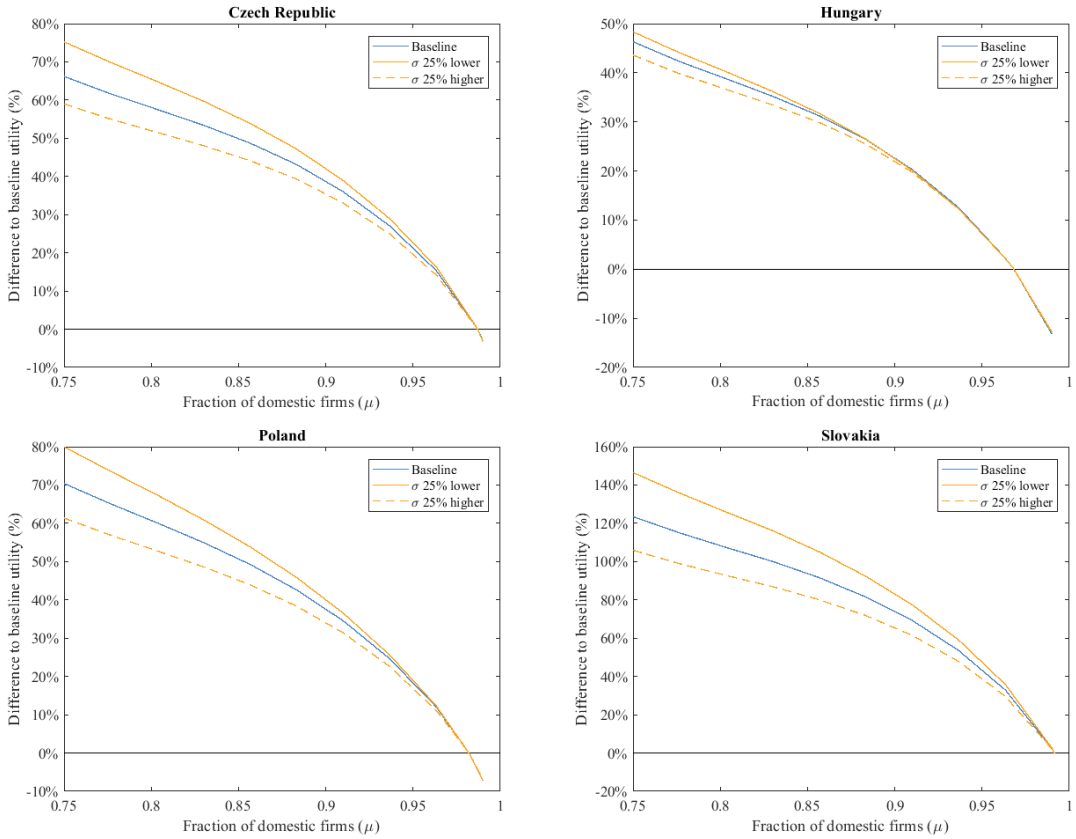


Figure B.18: Sensitivity of μ/welfare curve to σ

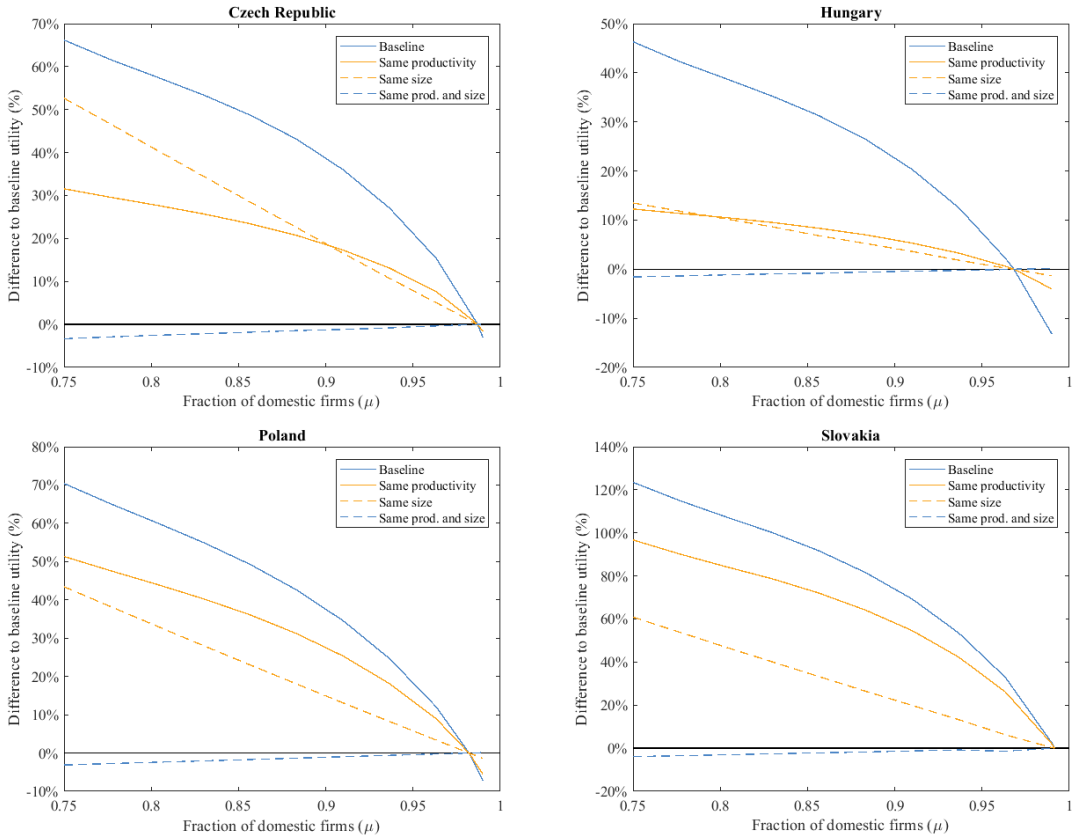


Figure B.19: Sensitivity of the μ/welfare curve to foreign firm size and productivity

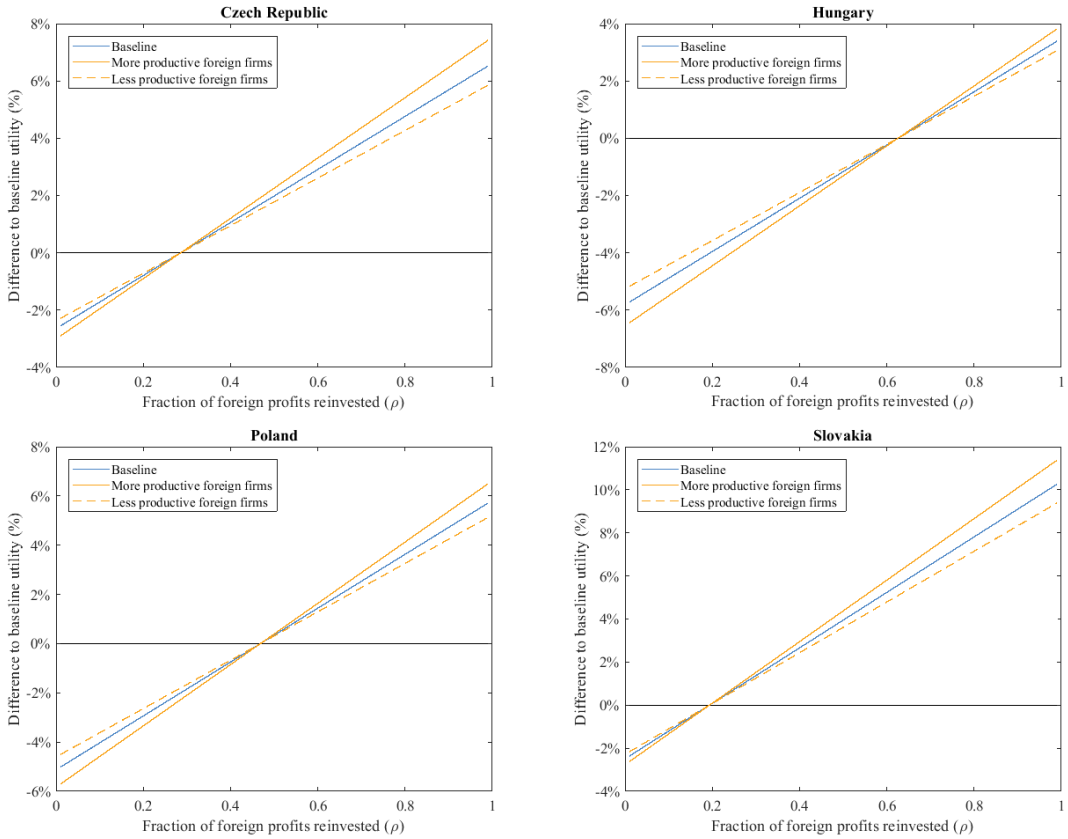


Figure B.20: Sensitivity of the ρ/welfare curve to the γ_i^f

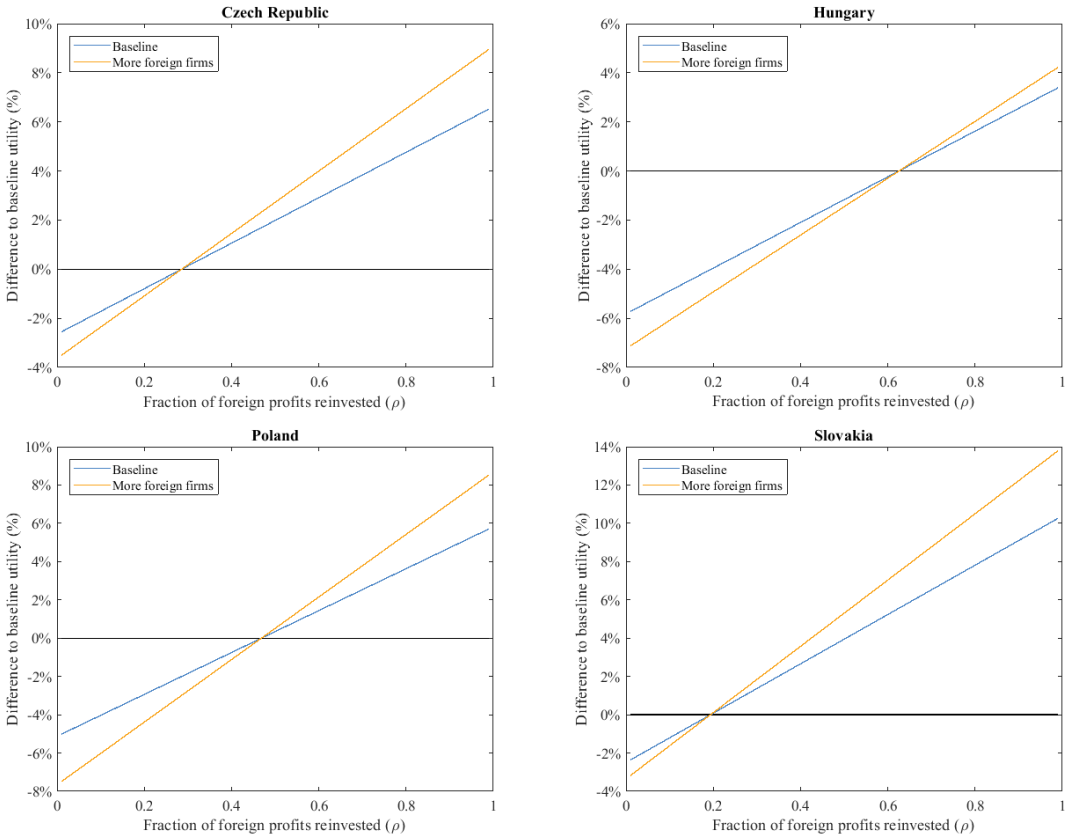


Figure B.21: Sensitivity of the ρ/welfare curve to μ and δ

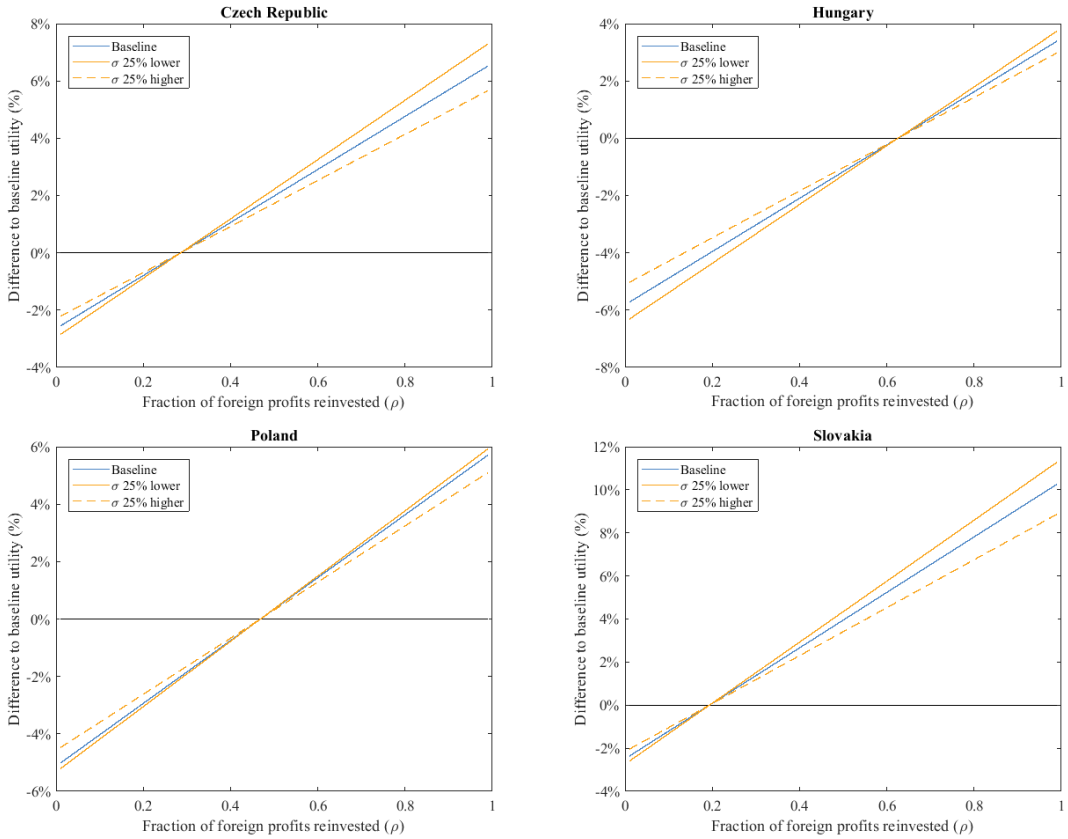


Figure B.22: Sensitivity of ρ/welfare curve to σ

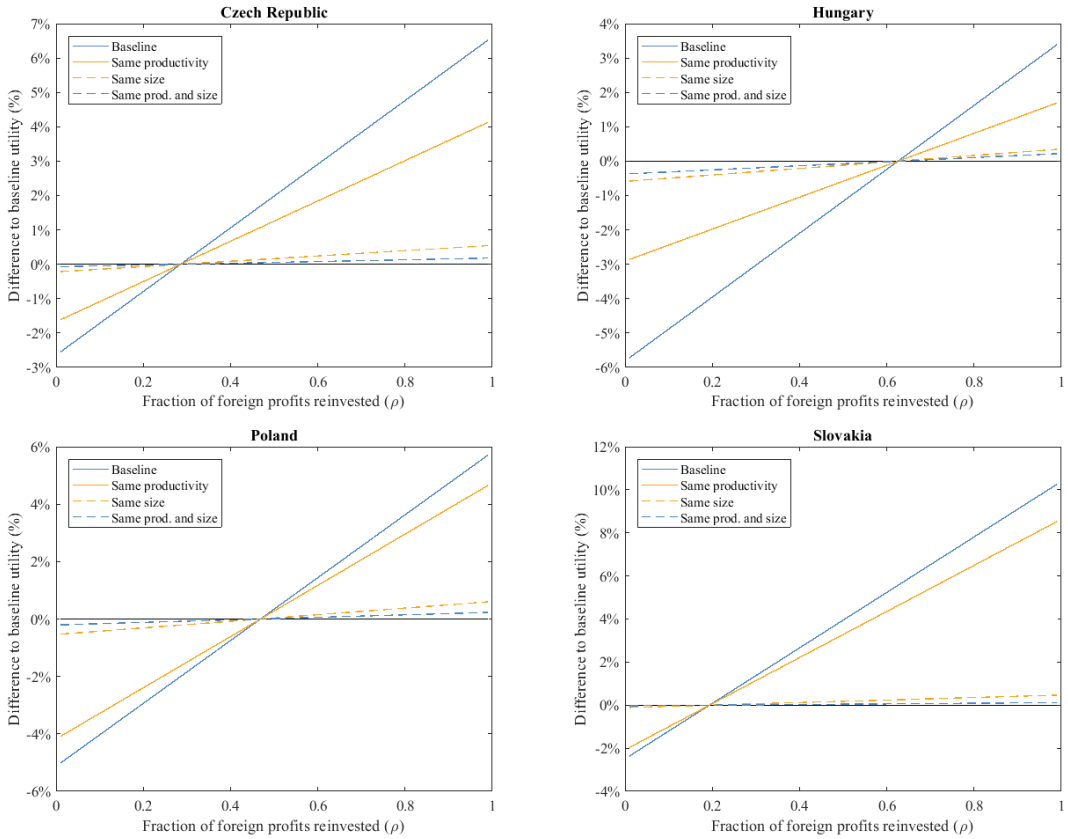


Figure B.23: Sensitivity of the ρ/welfare curve to foreign firm size and productivity

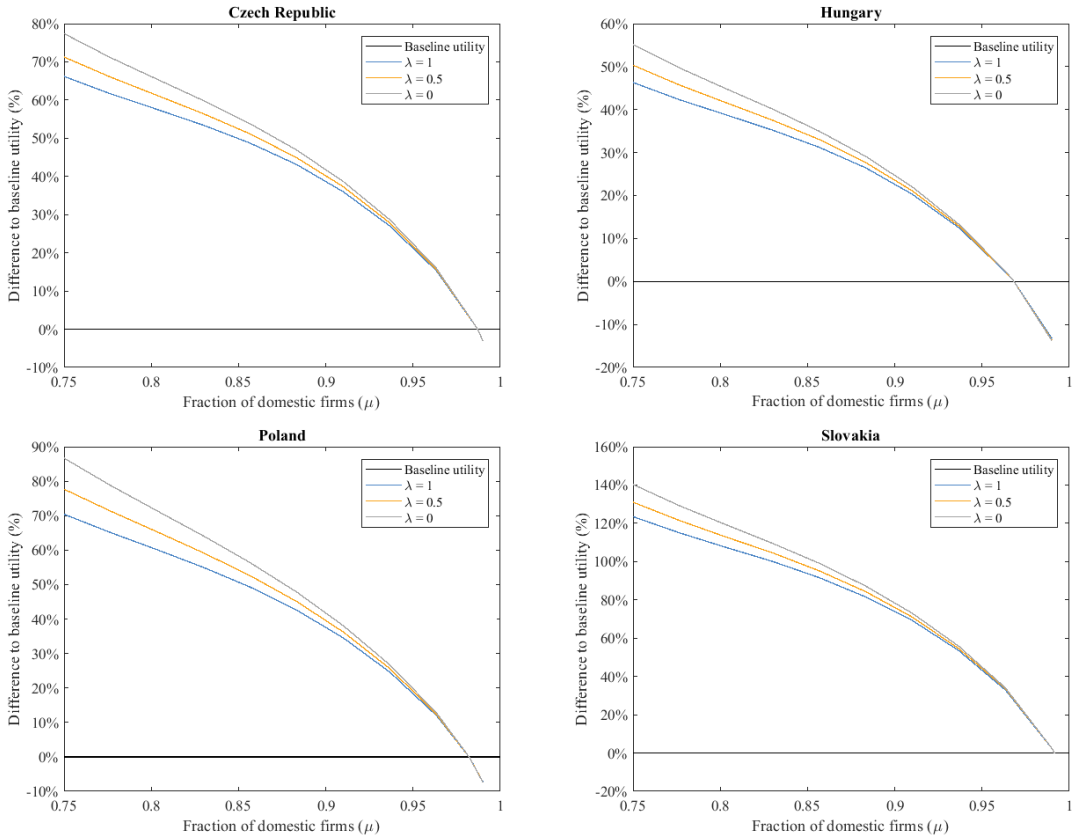


Figure B.24: Sensitivity of the μ/welfare curve to λ

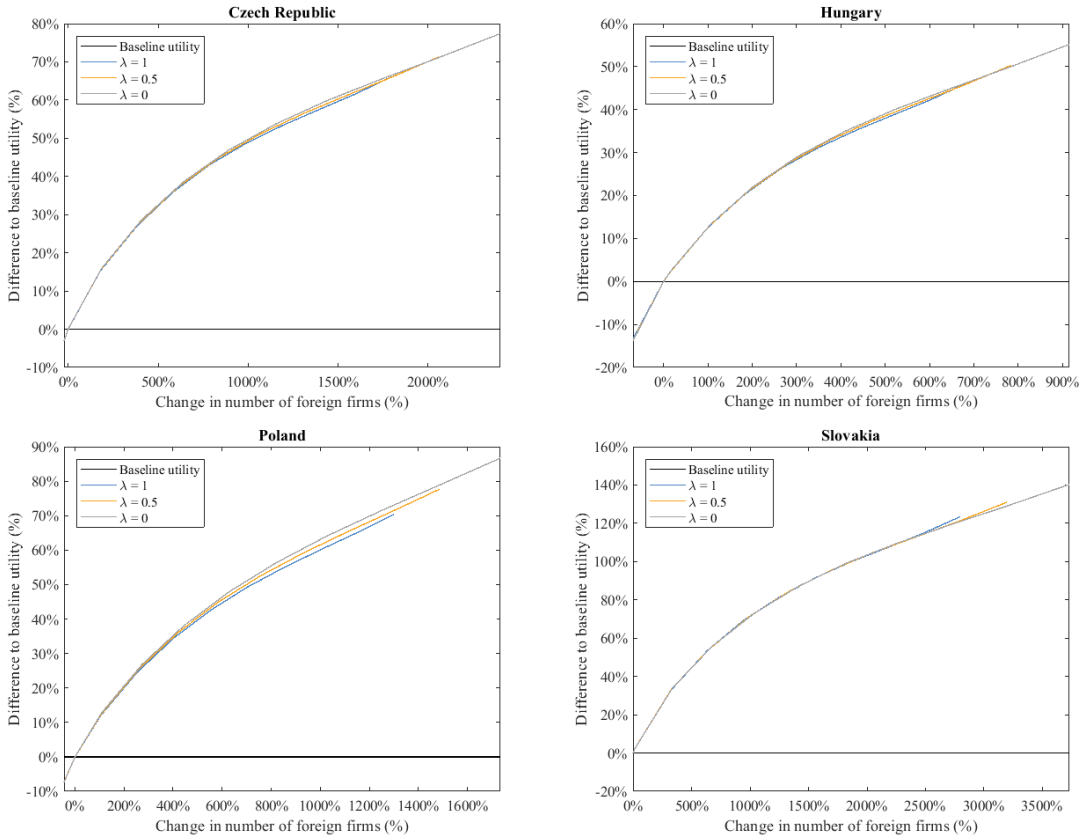


Figure B.25: Sensitivity of the $\%\Delta N_f$/welfare curve to λ

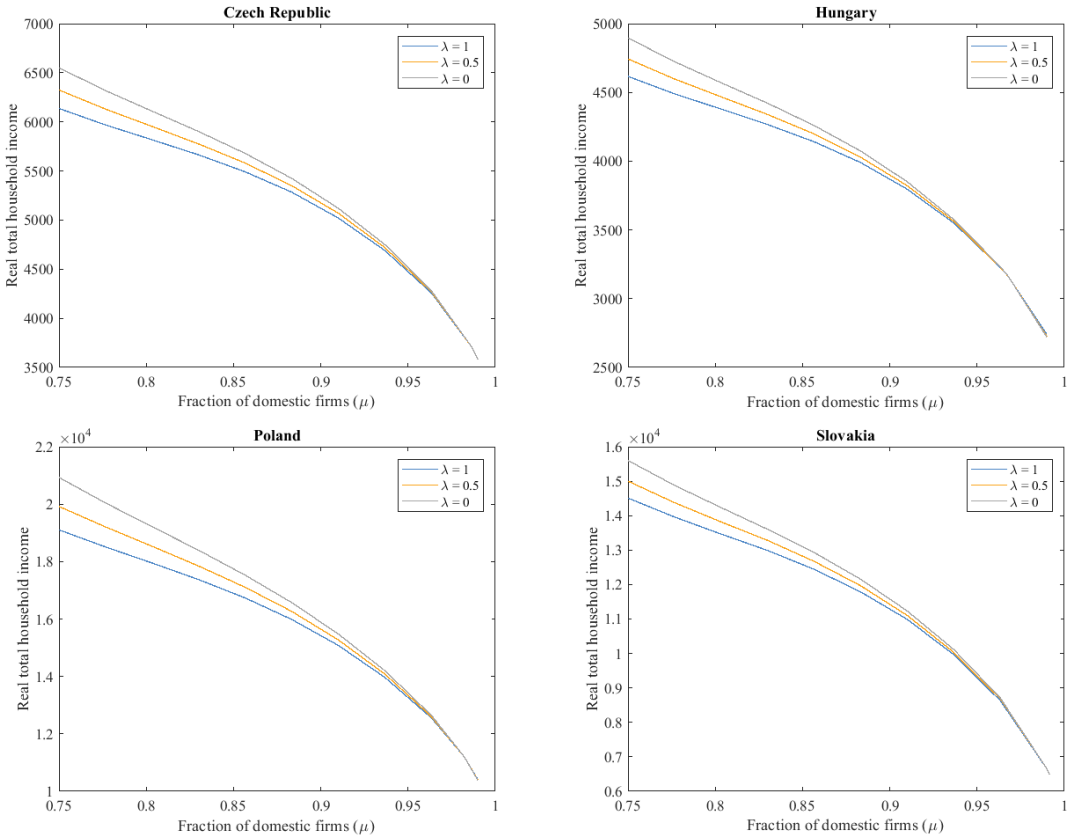


Figure B.26: Sensitivity of real household income to λ

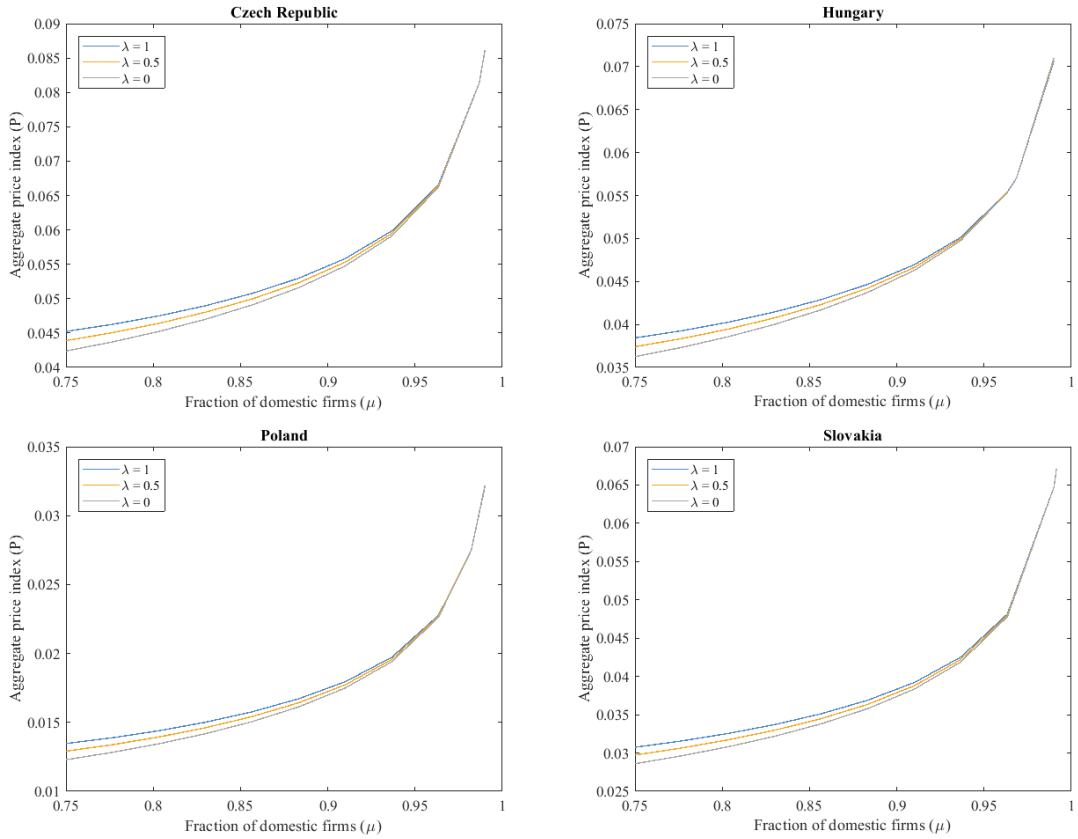


Figure B.27: Sensitivity of the aggregate price index to λ

C Tables

Table C.1: Calibrated parameters

Parameter	HU	SK	CZ	PL
γ_1^d	0.238	0.021	0.093	0.043
γ_2^d	0.238	0.157	0.278	0.241
γ_3^d	0.400	0.157	0.278	0.241
γ_4^d	0.510	0.487	0.300	0.259
γ_1^f	0.044	0.021	0.054	0.043
γ_2^f	0.207	0.027	0.054	0.048
γ_3^f	0.349	0.027	0.054	0.048
γ_4^f	0.444	0.083	0.059	0.052
γ_5^f	0.872	0.170	0.196	0.199

Table C.2: Observable parameters

Parameter	HU	SK	CZ	PL
N_d	67,776	69,396	69,080	68,750
N_f	2,224	604	920	1,250
ρ	0.626	0.194	0.286	0.468
δ	0.739	0.737	0.728	0.714
σ	5.350	4.839	5.218	3.960

Table C.3: Normalized parameters

Parameter	HU	SK	CZ	PL
L	100	100	100	100
N	70,000	70,000	70,000	70,000
γ_5^d	1	1	1	1

Table C.4: Parameters for the cubic fixed effects regression

	Dependent variable:
	Domestic employment share
Domestic firm share	37.661^{**}
	(16.749)
Domestic firm share squared	-45.712^{**}
	(19.799)
Domestic firm share cubed	18.598^{**}
	(7.719)
Observations	285
R^2	0.978
Adjusted R^2	0.976
Note:	*p<0.1; **p<0.05; ***p<0.01

D Data sources

D.1 Calibration targets

- **Revenue distribution of firms by size.** This refers to the share of firms of different size (measured by employment) in total revenue. The source is OECD (2020). Domestic and foreign-owned firms are combined. The size categories are 1-9, 10-19, 20-49, 50-249, 250+ employees. Data are averaged for 2013-2017.

- **Profit per employee of foreign firms relative to domestic firms.** Profits per employee is calculated separately for domestic and foreign-owned firms as the ratio of the gross operating surplus (in million EUR) to the number of persons employed. Then the value for foreign-owned firms is divided by the value for domestic firms. The source is Eurostat (2020). Data are averaged for 2013-2017.

- **Share of domestic firms' revenues in total firm revenues.** This is calculated as turnover (or gross premiums written) by domestic firms divided by the same figure for domestic and foreign-owned firms combined. The source is Eurostat (2020). Data are averaged for 2013-2017.

D.2 Observable parameters

- **Domestic firm share (μ).** This refers to the number of domestic enterprises divided by the total number of enterprises. The source is Eurostat (2020). The exception is Poland, which does not report these numbers in the same way as the other countries (see Section 15.1 of the metadata of the data source). For Poland, therefore, the average of the other three countries is used. Data are averaged for 2013-2017.

- **Profit reinvestment rate of foreign-owned firms (ρ).** On the debit side of primary income account, direct investment income is split into two components by the IMF: reinvested earnings, and dividends and withdrawals. The reinvestment rate is estimated as the share of reinvested earnings in total direct investment income (on the debit side). The source is IMF (2020). Data are averaged for 2013-2017.

- **Domestic employment share (δ).** This refers to the number of persons employed by domestic enterprises divided by the total number of persons employed. The source is Eurostat (2020). Data are averaged for 2013-2017.

- **Mark-up (σ).** Following Cavalleri et al. (2019), this is estimated as gross output divided by the sum of intermediate input costs and employee compensation. The source is the EU-KLEMS database (Stehrer et al., 2019). Data are averaged for 2013-2017.

- **Employment distribution of domestic and foreign firms by size (g_i^d, g_i^f).** This refers to the share of firms of different size (measured by employment) in total employment. This is calculated separately for domestic and foreign firms. The source for Hungary and Slovakia are the respective national

statistical agencies (KSH and SUSR). For the Czech Republic and Poland, the same data for domestic and foreign firms combined is obtained from OECD (2020), and is split between domestic and foreign firms based on the Hungarian and Slovak data. The size categories are 1-9, 10-19, 20-49, 50-249, 250+ employees. Data are averaged for 2018.