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Foreign ownership and gender differences in pay: causal evidence from a sample of Polish workers

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Abstract *The study attempts to estimate the causal relationship between foreign company ownership and wages that is driven by ownership per se, and not by observable or unobservable worker and firm characteristics. We employ proprietary data from surveys conducted by Sedlak & Sedlak, a major Polish HR consulting firm, with our pooled cross-section data set comprising over 300,000 men and 250,000 women working in the Polish labor market between 2013 and 2017. The foreign-firm wage premium is estimated by several techniques, ranging from ordinary least squares and two-stage least squares to a recently developed frequentist RX-2SLS econometric procedure that relaxes IV assumptions via the exclusion restriction. Our major findings are: (1) regardless of gender, Polish workers employed by majority foreign capital firms earn a significant wage premium; and (2) the foreign-firm wage premium is substantially larger for women, suggesting that the wage policies used by foreign-owned firms in Poland have an equalizing effect on the gender wage gap.*

Keywords foreign-firm wage premium, Poland, causal effect, plausibly exogenous, local-to-zero Bayesian estimator, modified two-stage least squares procedure

1. Introduction

For the 30 years since the fall of communism, Poland has pursued policies to make it one of the top destinations for foreign investors in the Central and East European (CEE) region and, more generally, the whole of Europe. The annual inflow of foreign direct investment (FDI) in Poland grew from $3.7 billion in 1995 to a record high of $24.8 billion in 2021, amounting to 18.0% of all FDI inflows in the EU and 11.3% of all FDI inflows in Europe. In 2021, Poland was ranked #17 among the 20 largest FDI host economies in the world, the only one of the post-communist countries on that list (UNCTAD, 2022). Poland has proved to be an attractive location for FDI due to its large population, strategic geopolitical position, European Union membership, transparent regulatory system, economic stability, and the incentive schemes attractive to businesses. Moreover, there are two more important reasons why foreign companies are expanding their activities in Poland. First, Poland has lower wages in comparison to the European average yet offers good access to an educated, skilled, productive and multilingual workforce. Second, there is a cultural affinity with many Western European countries, with a nearby time-zone for European businesses (see, e.g., Bogdan et al., 2015; Chidlow et al., 2009; Cieślik, 2020a, 2020b, 2021; Teixeira and Dias, 2013). At the end of 2021, employment in entities with foreign capital in Poland reached 2.1 million, a 2.3% increase compared to 2020 (GUS, 2022).

A large literature provides substantial evidence in favor of a quantitatively important positive correlation between employment in foreign-owned firms and individual wages. This finding generally holds true even after controlling for individual and company characteristics. An econometric concern is that a causal interpretation of the positive correlation between wages and the type of ownership depends on a critical question: How much of the positive foreign firm wage effect results from foreign investors selecting the best areas for greenfield investments and/or the best companies for acquisitions? For foreign acquisitions, a very fruitful approach to addressing this critical question is to use panel data on firms or linked employer-employee panel data to examine whether wages change after a domestic company has been taken over by foreign owners (see, e.g., Earle et al., 2018; Egger et al., 2020; Orefice et al., 2021).

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Looking only at takeovers, however, cannot address the effects of greenfield investments that account for the vast majority of foreign-owned enterprises in Poland. Cumulatively, during 2005-2020 18,968 new entities with foreign capital were registered, out of which 82.7% were greenfield companies and 17.3% were M&A (GUS, 2006-2021). Indeed, even with detailed fixed effects for firms and workers, Earle et al. (2018) observe that this approach cannot fully control for biases resulting from measurement error or unobserved time-varying variables that are correlated with wages and foreign firm status. The few attempts to use an instrumental variable approach to identify the causal effect of foreign firms on wages have often raised questions related to the validity of the chosen instruments. Namely, it is difficult to ensure that an instrument does not have an undesired direct effect on wages as well as the desired indirect effect (through determining the ownership status of the firm).

In this paper, we employ a novel econometric strategy that relies on long-standing regional variations in Poland as *plausibly* exogenous instrumental variables. Our instruments determine the likelihood that a worker in Poland is employed at a majority foreign-owned firm, whether it be a greenfield investment or an acquisition. By using proprietary data with observations on over 300,000 men and 250,000 women surveyed from 2013 to 2017, we estimate the causal effect of foreign firms on the wages of workers in Poland. In addition to the typical measures of human capital attainment, our data include potential control variables on proficiency in English and other foreign languages. We also extend the literature by focusing our attention on gender differences in the causal effect on wages of employment at a foreign-owned firm.

Poland presents us with an interesting case study for this question, since there is evidence of a significant female wage disadvantage that seems to reflect traditional gender norms in the human resource policies of Polish firms. Although it is true that raw (unconditional) gender wage gap estimates show little inequality in comparison with other EU member countries, recent studies show that the gender wage gap in Poland is well above the EU norm once consideration is given to individual worker characteristics. Both Christofides et al. (2013), who employ the Statistics on Income and Living Conditions data for 2007, and Boll and Lagemann (2018), who employ the Structure of Earnings Survey data for 2014, show that the explained male-female wage gap in Poland is negative. This indicates that women would be earning more than men if wages were based solely on measurable personal and job characteristics. In addition, their estimates of the unexplained male-female wage gap (which is often attributed to gender discrimination) are much higher than unexplained gaps for most countries in Western Europe. Gerber (2011) argues that in the period after 1997 Poland diverged from the EU by pursuing labor market and family policies that “re-traditionalized” gender norms. In stark contrast, EU policy objectives focused on pursuing gender equality in labor market outcomes.

The remaining part of the paper is structured as follows. Section 2 briefly summarizes the theoretical and empirical literature, focusing attention on the relatively small number of studies examining foreign ownership and gender differences in pay in Central and Eastern Europe. Sections 3 and 4 discuss our data and research design, respectively; and Section 5 presents the empirical results of our analyses and discusses our findings. Section 6 then concludes the paper.

2. A Review of the Relevant Literature

2.1 Theoretical background

In highly competitive labor markets, there is no reason to expect that firms with foreign capital would offer better salary or working conditions for workers having the same characteristics as their local counterparts. However, the presence of certain market imperfections may provide foreign-owned firms with an incentive to offer better pay through efficiency wages than Polish firms to individuals with similar characteristics in similar positions. Three types of theories explain the phenomenon of a wage premium in foreign-owned companies: the theories of heterogeneous workers, heterogeneous learning, and heterogeneous firms (Malchow-Møller et al., 2013).

According to Dunning’s eclectic paradigm, firms investing abroad rely on important ownership, location, and internalization advantages. Those ownership advantages include production and management know-how, innovative capacity, advanced technology, non-codifiable knowledge, organizational systems, and distribution networks. Local workers in foreign-owned firms become familiar with firm-specific advantages through experience and training, and have the potential to disseminate this knowledge if they switch employers or start their own business (see, e.g., Balsvik, 2011; Fosfuri et al., 2001; Görg and Strobl, 2005; Görg et al., 2007; Maré et al., 2021; Pesola, 2011; Poole, 2013). To prevent such spillovers, foreign-owned firms have an incentive to pay higher wages to reduce labor turnover.

Additionally, foreign-controlled companies may be willing to pay higher wages to motivate employees and promote greater work effort if monitoring costs are high or it is difficult to manage industrial relations in the context of different cultural and legal environments. Higher wages compensate the workforce in their subsidiaries for lower support by the headquarters (Egger et

al., 2018, Egger and Jahn, 2020; Gumpert, 2018). Likewise, foreign-owned firms may also pay higher wages because of global rent sharing and the fair-wage preferences of employees (Budd et al., 2005; Egger and Kreickemeier, 2013; Martins and Yang, 2015). For instance, Hjort et al. (2020) demonstrate that the level and structure of wages across narrowly defined occupational categories at the foreign affiliates of multinational enterprises (MNEs), especially those in Western Europe, are anchored to comparable positions at the MNE's headquarters.

The "efficiency wage" arguments have recently been questioned by the political economy framework of wage setting, claiming that the increase of foreign ownership in the local economy changes the process of wage bargaining between a trade union and a firm (see, for example, Naylor and Santoni, 2003; Radulescu and Robson, 2008; Vijaya and Kaltani, 2007; Zhao, 1995, 1998). According to these theories, foreign direct investment (FDI) may lead to lower bargaining power for labor in foreign-owned firms and, hence, may reduce the negotiated wage. Another important prediction stemming from bargaining theory is the differential impact of FDI on male and female wages. Vijaya and Kaltani (2007, pp. 87–88) point out that:

> increasing foreign presence need not necessarily have a uniform impact on men and women. While the increasing mobility of capital lowers both male and female bargaining power, it can have a greater impact on women's bargaining power since their options in the market economy are traditionally limited. On the other hand, the potentially greater opportunities for skill advancements presented by FDI are more likely to be offered to men, given the perception of their greater productivity vis-à-vis women. This pattern can therefore lead to a differential impact on male and female wages.

2.2 Empirical findings for developed and developing countries

Most empirical studies have analyzed the direct impact of foreign ownership on employee wages in developed and developing countries outside of the CEE region. The results in these papers vary by countries studied and sample period, level of aggregation, definitions of variables, and econometric methodologies (see the survey by Hale and Xu, 2020). However, even after controlling for numerous individual and firm characteristics and endogeneity, the general conclusion is that foreign-owned firms pay better than domestic firms. Estimates of the foreign-ownership wage premium vary widely, with the foreign-domestic wage gap often found to be more pronounced in developing countries but nearly negligible in the most developed economies. The positive direct wage results associated with FDI, in addition to potential gains from technological and managerial spillovers, provide evidence to support developing country policy efforts to promote FDI. An additional question for the evaluation of such policies concerns the impact of FDI on domestic wage inequality, in particular the gender wage differential. Review papers by Aguayo-Tellez (2011) and Braunstein (2006) conclude that FDI, and trade liberalization policies in general, have positive effects on the employment opportunities and wages of women as well as men. However, there is little evidence that this translates into greater gender equality. Indeed, mixed results on this question can be seen in recent papers that have compared the direct wage effect of working in a foreign-owned firm for men and women (Braunstein and Brenner, 2007; Fukase, 2013; Ono and Odaki, 2011).

2.3 Empirical findings for post-communist Central and Eastern European countries

There is a wide range of estimates of the foreign-domestic wage differential in post-communist Central and Eastern European countries. Earlier studies typically used firm-level or industry-level data; more recently, the availability of different surveys has allowed researchers to consider worker characteristics along with firm and industry controls. The studies also differ in their applied methods and estimation techniques. One group of studies compared wages between foreign-owned and domestically owned firms, while another group of studies compared wages of workers before and after a foreign merger or acquisition of a domestic company. The estimation techniques range from OLS to fixed effects or difference-in-difference models. For instance, Magda and Sałach (2021) and Broniatowska and Strawiński (2021) analyzed the foreign-ownership wage premium in Poland; Csengődi et al. (2008), Earle and Telegdy (2008), Earle et al. (2018), Köllő et al. (2021) in Hungary; Eriksson and Pytlikova (2011) in the Czech Republic; Delevic and Kennell (2022) in Serbia; Jude (2012) in Romania; Zulfiu-Alili (2014) in North Macedonia; Vahter and Masso (2019) in Estonia; Brown et al. (2010), Kurtović et al. (2021) and Onaran and Stockhammer (2008) considered several countries in their analyses. The majority of studies report a substantial raw foreign-domestic wage gap which in some cases exceeded 100%. Overall, positive direct wage effects of foreign ownership appear considerably larger for enterprises located in low-wage Central and Eastern European countries as compared to developed economies (Oberhofer et al., 2012).

On the other hand, there is limited evidence on gender differences in foreign firm wage effects in post-communist Central and Eastern European countries. We were able to find only a handful of such studies. Zulfiu-Alili (2014) examined gender differences in foreign firm wage effects in Macedonia. Data were from the People-Centred Analyses (PCA) survey in 2008

comprising about 3,000 observations. Employment at a foreign firm significantly raised the wages earned by men (0.375 log points, or 46%, using OLS and 0.564 log points, or 76%, using the Heckman two-step procedure)[1], but the wage effect for women was not significantly different from zero.

In addition to their comprehensive examination of overall foreign firm wage effects in Hungary, Earle et al. (2018) also examine interactive effects between employment at a foreign-owned firm and various worker characteristics. Their results show that both genders received substantial wage gains after the foreign acquisition. In the full sample with firm fixed effects, the estimated gains for men were 0.189 log points (or 21%) and 0.160 log points (or 17%) for women. In the full sample with worker-firm matched effects, both men and women had wages that were 6% (i.e., 0.055-0.059 log points) higher than similar workers in domestically owned enterprises.

Vahter and Masso (2019) combined three major data sets for Estonia to develop employer/employee linked data for a cross-section with detailed individual controls for year 2011 and panel data that allows for individual fixed effects for 2006–2012. They estimated foreign firm wage effects by employing propensity score matching to identify a control group of domestic firms. In their 2011 cross section, men working for foreign firms earned wages that were 13–15% (i.e., 0.119-0.139 log points) higher than their counterparts at domestic firms; for women, the findings were 5% (i.e., 0.046-0.053 log points). For the 2006–2012 panel with individual fixed effects, foreign-firm wage premia were 8% (i.e., 0.079 log points) for men and 2% (i.e., 0.016 log points) for women. Analyses for samples segregated by occupation revealed the same pattern of substantially larger foreign-firm wage effects for men, thereby leading to a wider gender wage gap in these establishments.

Finally, Magda and Sałach (2021) examined gender wage gaps in domestic and foreign-owned firms in Poland. They employed data from the Structure of Wages and Salaries by Occupation survey conducted by the Polish Central Statistical Office in 2014. In terms of actual hourly wages, male (female) workers in foreign-owned companies earned on average 76% (47%) more than their counterparts in domestically owned firms. Controlling for different worker and firm characteristics reduced this gap to 26–34% (i.e., 0.232-0.293 log points) for men and 16–23% (i.e., 0.145-0.208 log points) for women; however, for some specifications the wage gap between foreign-owned and domestic firms increased to 95% (i.e., 0.668 log points) for men and 84% (i.e., 0.613 log points) for women. The results reported in this paper concur that such large effects are plausible.

Two findings are particularly relevant for our study. In their decomposition of the foreign firm wage premium in Poland, Broniatowska and Strawiński (2021) show that over 60% of the premium remains unexplained after accounting for measurable characteristics of workers and of firm, industry, and region of employment. In a similar vein, Magda and Sałach (2021) present decompositions of the gender wage gap within foreign-owned and domestic establishments in Poland. These show that the firm effect on wages substantially lowers the gender gap within foreign firms and increases the gender gap within domestic firms. Both of these findings point to an important role for firm-specific wage policies in determining the substantial foreign firm wage premium evident in the Polish labor market.

3. Data

For this paper, we use data provided for scientific purposes by Sedlak & Sedlak company (S&S), the oldest Polish HR advisory company, operating in Poland since 1990. The firm supports its compensation consulting services by implementing salary surveys of firms and individuals via CAWI (Computer Assisted Web Interviewing) surveys by Internet users. Our data are from their Polish General Salary Survey (in Polish: Ogólnopolskie Badanie Wynagrodzeń, OBW) which is the biggest nongovernmental salary survey in Poland. The survey is conducted all year long with data presented as annual databases consisting of information provided by respondents from Jan. 1st until Dec. 31st each year. Recruitment of respondents to this survey is mostly through advertising on the company's web page but also through email campaigns and text links provided to S&S by external partner companies. Indeed, each year there are over 100,000 people who participate in the survey. To ensure data quality and reliability, S&S uses a number of procedures, both quantitative and qualitative, in the data cleaning procedure.

1 In the economics literature, the wage equation is typically estimated in a semilogarithmic form in which the dependent variable is the natural logarithm of the variable of interest (i.e., wage). As was pointed out initially by Halvorsen and Palmquist (1980), if such models include a zero-one dummy variable, the proper representation of the percentage impact of this variable on the dependent variable is $[(\exp(\text{coefficient}) - 1) * 100\%]$, and there is a well-established literature on the appropriate estimation of this impact. However, it is still not uncommon to interpret the estimated coefficient on the dummy variable as the percentage change in the dependent variable (i.e., coefficient *100%) resulting from a unit change in the dummy variable. This interpretation may be approximately correct over a very small range of the estimated coefficients (about from -0.2 to +0.2), and it is decidedly incorrect outside that small range (Thornton and Innes, 1989). To avoid any confusion, in this study we report both – the estimated coefficients in log points as well as the percentage impact of the respective dummy variables on wage.

Among these is analysis of behavior on the web page, including time devoted to completing the survey, and outlier examination. We combine survey responses for five years from 2013 to 2017. After excluding employers and self-employed individuals, our sample consists of 327,311 men hired full-time from age 18 to 64 and 249,197 women from age 18 to 59 (the upper age limits correspond to the usual retirement ages for men and women). For each respondent there are a large number of variables measuring personal attributes (gender, age, education, foreign language proficiency, total work experience), workplace attributes (sector of employment, firm ownership, department, wage, and job search strategy) and local labor market conditions. For our purposes, a critical variable is each respondent's identification of their employer as either a firm with majority Polish ownership or majority foreign ownership. In our sample, 118,894 men, 36.3% of all men, and 74,201 women, 29.8% of all women, identified themselves as employed by majority foreign-owned enterprises. This is consistent with Magda and Sałach (2021) and Broniatowska and Strawiński (2021) who used data from the Structure of Wages and Salaries by Occupation surveys conducted by the Polish Central Statistical Office in 2014 and 2016. In the samples of more than 202,000 male employees and more than 140,000 female employees used by Magda and Sałach (2021), about 35% worked in foreign-owned firms. In the sample of more than 395,000 employees used by Broniatowska and Strawiński (2021), 34% worked in foreign-owned firms.
Table 1 shows data on the mean characteristics of workers at Polish and foreign firms along with average real monthly earnings, including bonuses, before taxes (in Polish zlotys). Clearly, there are differences in the composition of the workforce depending on ownership type. On average, foreign firms in our sample employ younger, better-educated, and more foreign-language proficient male workers than their Polish-owned counterparts (with nominal earnings deflated by the harmonized consumer price index, with 2015 = 100). There is a substantial raw wage advantage to those employed by foreign firms; average monthly real earnings in our sample are higher by 2,568 zlotys, or 50.6%, for men and by 2,237 zlotys, or 56.1%, for women. This is lower than the 76% for male Polish workers but higher than 47% for female Polish workers in 2014 reported by Magda and Sałach (2021), and within the range of 34–56% reported by Broniatowska and Strawiński (2021) for the whole sample of Polish male and female employees in 2016. The larger foreign-firm wage advantage for women in our study translates into a slightly smaller male-female wage ratio in foreign firms (1.23 vs. 1.27).

Table 1. Characteristics of workers by gender and type of employer

Variable	Men				Women			
	Foreign firms		Domestic firms		Foreign firms		Domestic firms	
	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev
Real total monthly earnings (Zlotys)	7644.0	6626.5	5075.8	4371.3	6223.5	5235.2	3986.6	3067.2
Log (real total monthly earnings)	8.715	0.637	8.342	0.564	8.538	0.585	8.144	0.491
Age (years)	33.8	8.2	35.2	10.0	32.8	7.4	35.1	9.3
Secondary school (%)	2.3	14.9	3.3	17.8	2.4	15.4	5.0	21.8
Post-secondary school/no degree (%)	18.7	39.0	24.6	43.0	11.1	31.4	15.1	35.8
Undergrad degree (%)	16.9	37.5	16.0	36.7	13.9	34.6	14.1	34.8
Incomplete Master's degree (%)	3.9	19.4	3.5	18.3	3.6	18.7	2.8	16.5
Master's degree (%)	24.6	43.1	22.7	41.9	51.9	50.0	48.9	50.0
Master's in engineering (%)	29.7	45.7	22.6	41.8	15.6	36.3	12.0	32.5
Postgraduate training (%)	15.9	36.6	14.0	34.7	25.2	43.4	23.8	42.6
MBA (%)	2.3	14.9	1.1	10.3	1.6	12.7	0.6	7.8
Good or very good knowledge of English (%)	72.4	44.7	54.2	49.8	75.6	42.9	52.7	49.9
Number of other foreign languages known at the good or very good levels*	0.197	0.449	0.185	0.434	0.299	0.533	0.237	0.477
Independent job search (%)	53.7	49.9	52.9	49.9	56.1	49.6	54.6	49.8
Job search through employment bureau (%)	0.9	9.6	3.2	17.5	1.4	11.7	5.5	22.9
Internal job recruitment (%)	22.7	41.9	28.3	45.0	21.2	40.8	26.1	43.9
Job promotion (%)	6.9	25.3	1.8	13.4	6.3	24.4	1.5	12.2
Instrumental variables (IV):								
Ahpar (%)	27.7	44.7	30.9	46.2	24.3	42.9	26.9	44.4

Variable	Men				Women			
	Foreign firms		Domestic firms		Foreign firms		Domestic firms	
	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev
Gerpar (%)	17.1	37.7	18.9	39.1	16.4	37.0	19.1	39.3
Gerww2 (%)	21.2	40.9	17.8	38.2	19.3	39.4	19.2	39.4
Observations	118,894		208,417		74,201		174,996	

Notes: Males were born years 1949–1999 and range in age from 18 to 64 at the time of the survey; females were born years 1954–1999 and range in age from 18 to 59 at the time of the survey. The reference educational group consists of those with secondary, basic vocational, lower secondary, or basic educational credentials. Not summarized in this table are 22 industry and 26 department dummy variables. * The 'NgoodOth' variable (corresponding to the number of other languages the employee knows, besides English) is coded from 0 to 4, inclusive, and hence cannot be put into percentage terms.

4. Research Design

A number of papers—for example, Broniatowska and Strawiński (2021)—use matching methods to identify domestic firms that are similar to foreign-owned enterprises in their data. However, as demonstrated by Angrist and Pischke (2009, pp. 69–86), matching algorithms and OLS share the *exact* same assumptions for causal inference since they are each control strategies. In fact, regression can be viewed as a type of weighted matching estimator. In what follows, we employ three long-standing Polish regional classifications as control variables in OLS regression, or as instrumental variables in traditional 2SLS estimation.

4.1 History leads to strong instruments

Poland has an interesting history, full of turbulence and changes of rule. From 1795 until the end of World War I (WWI) in 1918, Poland was not even a country. Instead, what we now call Poland was partitioned into three major areas: the area controlled by Prussia to the west, Russia to the east, and Austria to the south (see Figure 1 in Churski et al., 2021). For more than one hundred years, the former Polish territories were governed by considerably different political, economic, and educational regimes as well as legal institutions, customs, and norms (see, e.g., Davies, 2001; Prażmowska, 2010, 2017). After World War II (WWII), the map of Poland was again altered drastically as territory along its eastern border, the Kresy region, was transferred to the Soviet Union. Formerly German regions along its western border became part of Poland. This shift in borders was accompanied by a massive, forced relocation of Poles from east to west and the expulsion of German residents from the new Polish territory.

It has been shown that the contemporary spatial variability of socioeconomic development, including FDI, in Poland is "significantly affected by historical conditions, especially those resulting from the partition of Poland between three powers (Russia, Prussia and Austria)" (Churski et al., 2021; also see Figure 4 therein). We hence use the historical episodes of the partitions of Poland as natural experiments to identify regional differences in FDI in present-day Poland. In our empirical work, we define three regional dummies to measure the impact of historical divisions within Poland: *Ahpar* identifies provinces with whole or majority regions of territory absorbed into the Austro-Hungarian Empire from the partitions to the end of WWI; *Gerpar* identifies provinces with whole territories or majorities of territory absorbed into Prussia/Germany from the partitions at the end of WWI; and *Gerww2* identifies provinces with whole territories or majorities of territory that were part of Germany up until the end of WWII. These longstanding historical dividing lines have greatly impacted the economic development of the various regions of Poland, and have resulted in strong cultural patterns across the country. In fact, because of their deep historical nature, the regional dummy variables are prime candidates to serve as instrumental variables in our 2SLS estimations below.

We also use these regional classifications as *both* control variables and as instrumental variables in our newly proposed frequentist RX-2SLS method that replicates the point estimates from the quasi-Bayesian local-to-zero (LTZ) method of van Kippersluis and Reitveld (2018), denoted as KR-LTZ thereafter in this paper. Using a given variable as both a control and as an instrument is possible because we have additional information that allows us to relax the exclusion restriction for IV estimation. In fact, we show in the Appendix that KR-LTZ is indeed frequentist in nature since it does not actually rely upon the Bayesian framework. This equivalence is quite evident, since we can easily duplicate the KR-LTZ point estimates by modifying the traditional 2SLS estimator. One of the main advantages of using our RX-2SLS estimator instead of KR-LTZ is that various specification tests—such as the Hausman (1978) test of exogeneity—are readily available, and unlike the KR-LTZ procedure, RX-2SLS provides immediate access to conventional standard errors.

Multiple studies support the view that history matters and that historically distant events form, mold, and shape today's political,

institutional, social, and economic landscape. In some instances, the long shadows of history can extend over the centuries. Recent research indeed points to several areas in which the partitions of Poland have had longlasting effects in the country: political outcomes or institutions (Charnysh, 2015; Grosfeld and Zhuravskaya, 2015; Jańczak, 2015; Vogler, 2019; Zarycki, 2015), trust and corruption (Becker and Woessmann, 2011; Becker et al., 2016), economic development and economic inequalities (Churski et al., 2021; Wysokińska, 2015), entrepreneurship (Fritsch et al., 2019), fiscal policy (Kantorowicz, 2022), education (Backhaus, 2019; Becker et al., 2020; Bukowski, 2019; Herbst, 2006, 2021; Herbst and Rivkin, 2013; Kościńska, 2022).

For instance, Grosfeld and Zhuravskaya (2013a,b; 2015) find evidence for significant partition border differences in data on the intensity of religious beliefs and democratic ideals. They show that "the northwest of the country, which roughly resembles the former Prussian territories, largely supports Civic Platform (PO), the main liberal party, while the southwest, which formerly belonged to the Russian and Habsburg empires, votes for the more religious conservative party, Law and Justice (PiS)" (Grosfeld and Zhuravskaya, 2013a; also see Economist, 2018). Additionally, they demonstrate that the density of railroad infrastructure is higher in the Prussian region (see Figure 2 in Churski et al., 2021). Vogler (2019) shows that some differences in the organization and efficiency of bureaucracies in Poland are due to imperial legacies: the Austrian and Prussian regions observe better performance of bureaucracies—in terms of their competitive recruitment of staff and cost-effectiveness—than the Russian region. Becker et al. (2016) find that historical affiliation with the Austrian Habsburg Empire increases current trust and reduces corruption in courts and police.

Churski et al. (2021) confirm that contemporary socioeconomic spatial diversification in Poland is still visibly conditioned by the country's history, especially by the social and economic consequences of the partition of Poland (see Figures 2–4 in Churski et al., 2021). Wysokińska (2015) also shows that the municipalities in the Prussian region are more prosperous than those in the Russian region. Fritsch et al. (2019) find that persistence of entrepreneurship is stronger in the regions that were part of Germany before WWII. Bukowski (2019) examines evidence for long run discontinuities in educational achievement along the partition borders using 2005–2011 data on Polish student test scores. He finds a significant positive effect (equal to a 0.6 standard deviation increase in test scores) on the Austrian side of the partition border between Austria and Russia, but no difference along the partition border between Prussia and Russia. This positive effect persists in the face of several robustness checks. He attributes the difference in this important measure of human capital to Austria's more liberal policies regarding education in the Polish language and history, and the consequent effect of these policies on social norms. There is also evidence of substantial differences in human capital accumulation associated with the post-WWII change in Poland's borders and the subsequent population relocation. Becker et al. (2020) present evidence of a significant increase in years of schooling and the propensity to finish secondary or tertiary education among present-day students descended from those relocated from the eastern Kresy region to the western areas transferred from Germany to Poland. Surveys suggest that the experience of forced relocation shifted preferences toward investment in mobile human capital assets and that this preference shift has persisted for over three generations.

4.2 Model

Formally, our model is:

$$lnW_i = \alpha F_i + \beta X_i + \gamma IV_i + \varepsilon_i \quad (1)$$

$$F_i = \theta IV_i + \lambda X_i + \xi_i \quad (2)$$

where W_i is total monthly earnings for individuals i = 1, 2,…, N; foreign ownership is indicated by F_i (with 0 indicating "domestic ownership"); X_i is vector of exogenous variables that control for age, education, language proficiency, and in some specifications, industry and department; IV_i is a vector of regional instrumental variables that may also be employed as control variables; and ε_i and ξ_i are the error terms.

We will employ four estimation strategies depending on four alternative modeling assumptions about the disturbances in Equation (1). The four assumptions that we invoke, in turn, are as follows:

Assumption 1: $E(\varepsilon_i|F_i, X_i) = 0$; $\gamma = 0$; since Cov(ε_i, ξ_i) = 0, we can use OLS.

Assumption 2: $E(\varepsilon_i|F_i, X_i, IV_i) = 0$; γ may not equal to zero, but Cov(ε_i, ξ_i) = 0.

Assumption 3: Cov(ε_i, ξ_i) ≠ 0; $\gamma = 0$; this is the usual assumption for 2SLS estimation.

Assumption 4: Cov(ε_i, ξ_i) ≠ 0; γ may not equal to zero, but α = 0 for a sub-sample of individuals.

The assumptions are ordered most-to-least restrictive. Importantly, interregional migration within Poland is unusually low when compared with other European countries. The result is that regional labor-market disparities in wages and employment are quite persistent. In other words, because of limited movement across regions, there is a potential that strong regional differences in wages will persist into the near future—with these direct regional effects then captured by allowing $\gamma \neq 0$. This is why we consider assumptions 2 and 4 to be of special interest.

As discussed by Magda and Salach (2021), limited movement among workers may very well lead domestic firms to keep wages low. Moreover, depending on the degree of competition among firms, this may very well be true in some regions more than others. In fact, the acceptance of low wages may be an especially acute problem for Polish women, who may be more reluctant to change location than men due to family considerations. With fewer family-friendly and childcare accommodations in regions where there are strong convictions that a woman's place is in the home, there is downward pressure on wages for women with children who might need less responsibility at work.

Even highly educated women will face low pay if regional traditions enforce an inertia that limits a completely flexible approach to work-life balance. While regional differences in women's pay will likely be less an issue at a foreign firm (with a tendency towards equal pay, equal promotion, and a flexible work-life balance), there is no incentive for a foreign firm to increase wages far above that established by domestic firms in their geographic region. Since this observation is especially germane for employees unlikely to move in search of higher wages, we might expect that $\gamma \neq 0$ for women even if $\gamma = 0$ for men.

For our first and second set of regressions, we assume the exogeneity restriction $\text{Cov}(\varepsilon_i, \xi_i) = 0$ and employ OLS estimation. For our third set of regressions, we relax the assumption that $\text{Cov}(\varepsilon_i, \xi_i) = 0$, but keep the exclusion restriction, $\gamma = 0$. We can thus employ traditional 2SLS estimation. Note that even though we allow for the possibility of omitted ability and firm effects, we do *not* allow our regional controls to have a direct influence on wages. Rather, as is typical in IV estimation, the instruments enter the equation only indirectly through the right-hand-side endogenous variable.

As an analogy, think about a simultaneous equations model for the demand and supply of wheat. We typically assume that the supply of wheat depends on weather conditions, but not so for the demand for wheat. A variable that measures weather conditions can then be employed as an instrument to identify the demand curve. Indeed, for traditional 2SLS estimation it is necessary for the demand curve to be invariant to changes in the weather (i.e., $\gamma = 0$) since otherwise we encounter an identification problem. By comparison, for other types of modeling situations where endogeneity is an issue, even if $\gamma \neq 0$ identification is still possible if $\alpha = 0$ for a subset of the observations.

For our modeling situation, we suspect that γ may not equal zero, yet we do have a subset of firms where $\alpha = 0$. These are the state-owned firms where foreign ownership is not possible. From these public firms, we can thus estimate γ since F is not included in the wage equation for this subsample of observations. It is this intuition that drives the KR-LTZ technique from van Kippersluis and Reitveld (2018), and our own RX-2SLS technique introduced in the Appendix. The surprising fact is that these two techniques, the first Bayesian in nature and the second frequentist, yield *identical* estimates of the foreign-firm effect. Again, we do not enforce the exclusion restriction for RX-SLS estimation to allow for long-standing regional differences that directly influence wages.

5. Empirical Results

Table 2 presents our empirical results. In each regression, we include a fair number of exogenous variables to control for the individual characteristics of workers (see Table 1), and we always employ robust standard errors. Moreover, to address functional form issues, we include interactions of our various attributes with age. For instance, not only do we include a dummy variable indicating whether the employee has good knowledge of the English language, but we also include the interaction of this variable with age since this variable is highly significant for both men and women. Similarly, we included interaction terms between the educational variables and age, as well as between the job search variables and age.

Table 2. (Log) monthly-earning returns to foreign-firm employment

Specifications	Men		Women	
	Without industry and department controls	With industry and department controls	Without industry and department controls	With industry and department controls
Panel A: OLS estimation without using the IV variables as controls				
Foreign ownership	0.2315*** (0.0019)	0.2252*** (0.0019)	0.2621*** (0.0022)	0.2315*** (0.0023)
Observations	279,094	279,081	192,061	192,048
Panel B: OLS estimation with using the IV variables as controls				
Foreign ownership	0.2302*** (0.0019)	0.2231*** (0.0019)	0.2581*** (0.0022)	0.2256*** (0.0022)
Observations	279,094	279,081	192,061	192,048
Panel C: Traditional 2SLS estimation				
Foreign ownership	0.5398*** (0.0299)	0.7161*** (0.0314)	1.3936*** (0.0575)	1.5407*** (0.0557)
Hausman test	117.96***	309.33***	957.97***	1,589.47***
Observations	279,094	279,081	192,061	192,048
Panel D: RX-2SLS estimation				
Foreign ownership	0.3557*** (0.0721)	0.1253* (0.0688)	0.6020*** (0.0717)	0.6534*** (0.0634)
Hausman test	3.04*	2.02	23.85***	48.00***
Observations	327,311	327,296	249,197	249,182

Notes: The dependent variable is inflation-adjusted log monthly earnings, and *Foreign ownership* is instrumented by three regional dummy variables. Males were born years 1949–1999 and range in age from 18 to 64 at the time of the survey; females were born years 1954–1999 and range in age from 18 to 59 at the time of the survey. The Hausman test for exogeneity is constructed as the Wald test for whether the residuals from the first-stage regression have a zero coefficient when augmented to the structural model for log monthly earnings (estimated by OLS for the purpose of the Hausman test). Robust standard errors are reported in parentheses. Statistical significance at 10 percent is indicated by *, at 5 percent by **, and at 1 percent by ***. The super-sample employed for RX-2SLS estimation (Panel D) includes a sector of firms where foreign ownership is precluded. The full set of estimates is available from the authors upon request.

5.1 OLS estimation without using the IV variables as controls

We start with estimating α in Equation (1) by OLS with the restriction that $\gamma = 0$ under Assumption 1 that $E(\varepsilon_i|F_i, X_i) = 0$. The idea here is that $E(\varepsilon_i|F_i)$ may not equal zero, yet the inclusion of X_i on the right-hand-side is sufficient to proxy any omitted variables that may otherwise render the least-squares estimate of α inconsistent. For instance, if F_i is correlated with ε_i because those with higher innate ability tend to work at foreign-owned firms, then it is possible that individual characteristics measured by X_i (such as educational attainment) are sufficient to capture these ability factors. The estimated coefficient in Panel A of Table 2 is 0.2315 log points, suggesting that male full-time employees working at a foreign-owned firm earn about 26.0% more than those working at a domestic firm. As expected, the inclusion of industry and department controls reduces the estimated coefficient to 0.2252 log points, but the wage premium drops by less than 1% to 25.3%. For women, the estimates of the foreign-ownership wage premium are higher: 0.2621 log points (or 30.0%) without industry and department controls and 0.2315 log points (or 26.0%) with these controls.

5.2 OLS estimation with using the IV variables as controls

We proceed with estimating α in Equation (1) by OLS without the restriction that $\gamma = 0$ and under Assumption 2 that $E(\varepsilon_i|F_i, X_i, IV_i) = 0$. The idea here is that regional characteristics may have a direct effect on wages if job mobility is inhibited by historical geographical preferences. This appears especially true in Poland with its strong dissection of cultures caused in part by fractious invasions and differing territorial traditions based on either farming or factories. Aside from econometric efficiency issues, including IV_i in Equation (1) is important only if its exclusion substantially changes the OLS estimate of α.

The wage equation in Panel B of Table 2 includes the set of IV variables that account for potential direct effects of regional differences *Ahpar*, *Gerpar*, and *Gerww2*. The results from Panel B suggest that male (female) full-time employees working at a foreign-owned firm earn about 25.0–25.9% (25.3–29.4%) more than those working at a domestic firm. A comparison of Panels A and B reveals no major differences in the point estimates of the effect of foreign ownership, regardless of whether we include the regional IV variables and/or the industry and department dummy variables as controls. We also observe that the estimates in both Panels A and B point to occupational crowding since the differences between men and women all but disappear once we account for industry and department. However, while suggesting a small gender difference, these results are not particularly striking.

5.3 Traditional 2SLS estimation

Since the OLS estimates may be biased due to omitted ability and firm effects, we are interested in the 2SLS estimates reported in Panel C of Table 2. Here, our Assumption 3 is that $\gamma = 0$, yet F_i is correlated with ε_i even after conditioning on ability as captured by X_i. How does this situation arise? Suppose that there are certain firm characteristics that make a domestic firm especially attractive for acquisition by a foreign firm. For example, suppose that a profitable domestic firm employs highly productive workers at all levels of ability and, because of their productivity, pays high wages to them. A foreign firm then acquires the domestic firm because of its positive attributes, but otherwise makes only cosmetic changes to the operations of the enterprise. In this case, the attribution of the "foreign-firm" effect to the high wages of productive workers is misleading since it is the managerial talent of the domestic firm that has attracted foreign investment.

To circumvent the above problems, we employ 2SLS estimation. Our instruments, the historical regional dummies, are assumed to be strongly correlated with F_i but uncorrelated with ε_i conditional on X_i. Of course, by adopting this estimation strategy, we do not rule out the possibility that acquiring foreign firms do raise the wages and also the productivity of the domestic workers. If so, then $\alpha > 0$. Finally, as there is no reason to suspect that natural, innate ability is correlated with our instruments, then 2SLS will address the problem of unobserved innate ability that is not otherwise captured by our control variables (such as, for example, education).

The 2SLS results are reported in Panel C of Table 2. Regardless of whether we include the industry and department controls, the Hausman (1978) test easily rejects the null hypothesis that foreign ownership is exogenous, and the recent test developed by Montiel Olea and Pfluger (2013) easily rejects the null of weak instruments. The estimated coefficients are quite different from those in Panels A and B. They are large: 0.5398 and 0.7161 log points for men and 1.3936 and 1.5407 log points for women. Since we found that the regional IV variables had demonstrable *direct* effects in our estimations associated with Panels B and D (not reported in Table 2 due to space considerations), the 2SLS estimates are highly likely biased upward.

5.4 RX-2SLS estimation

We finally estimate α using the RX-2SLS method, where the RX signifies that we are *relaxing* the *exclusion* restriction. Under our Assumption 4, we need to employ 2SLS estimation for the reasons given in Section 5.3, but—as given in Section 5.2—it is quite possible that $\gamma \neq 0$. Here, F_i is endogenous because of (say) unobserved firm effects, yet our instruments, IV_i, have a direct effect on wages. While traditional 2SLS estimation fails here, it is still possible to estimate α by relaxing the exclusion restriction via the method detailed in the Appendix.

What is required for this analysis is a special subsample where the regional instruments have arguably no effect on the foreign-ownership dummy variable. Fortunately, for our Polish workers we have such a subsample, because survey respondents identify themselves as working for (1) private sector for-profit firms, (2) nonprofit firms and non-governmental organizations, or (3) economic entities that are either state-owned or the property of local governments. Importantly, there are no majority foreign-owned enterprises among the firms in the third category. For the subsample of workers at such government-owned firms, any measured regional effect must be direct since there cannot be an indirect effect through foreign ownership. Pooling together the subsamples of those workers in private for-profit and nonprofit firms (who might work for a foreign-owned firm) with those who are in government-owned firms (where no majority foreign-owned firms exist) allows us to identify the direct effect while also using the regional dummies as instrumental variables.

The RX-SLS estimates are reported in Panel D of Table 2. They take into consideration both the potential endogeneity of foreign ownership, as well as the direct effects of the regional IV variables. Like traditional 2SLS, the test by Montiel Olea and Pfluger (2013) easily rejects the null hypothesis of weak instruments.

The RX-SLS estimates reported in Panel D suggest that the effect of foreign ownership differs greatly by gender. For men, the estimated coefficients are 0.3557 and 0.1253 log points, albeit the latter is only marginally significant, and suggest a foreign-ownership wage premium of 42.7% and 13.3%. However, after controlling for both industry and department, the Hausman (1978) test for men fails to reject the null hypothesis of exogeneity. Moreover, even without such controls, the Hausman test rejects at only 10% significance. Considering these formal tests, our preferred (and most conservative) estimate of the foreign-ownership effect on male wages is the OLS estimate of about 25–26%, from Panel B. The empirical evidence is quite different for women. Regardless of whether we include the industry and department controls, the Hausman test easily rejects the null hypothesis that foreign ownership is exogenous. Based on RX-2SLS and depending on whether we include industry and department controls, the estimated coefficients for women are 0.6020 and 0.6534 log points, implying that women working at a foreign-owned firm earn 82.6–92.2% more than those working at a domestic firm.

While this estimated effect for women (and even for men) may seem large, it is not unusual. For instance, Zulfiu-Alili (2014) examined foreign-firm wage effects for men and women using the PCA survey data in 2008 in Macedonia. For men, the

estimated foreign-ownership wage premium is 0.375 log points (or 45.5%) using OLS and 0.564 log points (or 75.8%) using the Heckman two-step procedure. For Poland, Magda and Sałach (2021) used data from the Structure of Wages and Salaries by Occupation survey conducted by the Polish Central Statistical Office in 2014. They ran different specifications of the wage equation on the whole sample of both men and women. The estimated coefficient on the foreign ownership dummy is 0.293 log points (or 34.0%) in Model 1 including individual-level, job-level, and firm-level characteristics; 0.232 log points (or 26.1%) in Model 2 which adds co-worker characteristics; 0.668 log points (or 95.0%) in Model 3 which uses firm fixed effects instead of firm-level and co-worker characteristics; and 0.666 log points (or 94.6%) in Model 4 which runs Model 3 on the common support. Also, such a high wage premium for both men and women may be explained, at least in part, by the fact that greenfield investments were the dominant mode by which foreign companies have entered the Polish market. Compared with foreign takeovers, greenfields have historically tended to pay the highest wage premium (Heyman *et al*., 2007). Finally, it is worth noting that a very large fraction of the respondents to the S&S online survey have at least some tertiary education. This needs to be considered in comparing our results with those reported in other papers. While we control for education level in the regressions reported above, our results largely reflect the impact of employment at a foreign-owned firm on the wages of skilled workers.

Furthermore, our estimated foreign-ownership wage premium for women is reasonable if foreign firms tend to acquire domestic firms that are profitable but pay especially low wages to women. Based on the above equity and efficiency arguments, it appears that the acquiring firm finds compelling reasons to increase the wages of both genders, but especially the wages of Polish women. Consider, for instance, the recent survey article by Blau and Kahn (2017, p. 827) who show that women tend to be concentrated in firms that pay lower wages regardless of occupation.

We suggest that the much stronger foreign-firm wage effects for women than for men in our study stem from the interaction of two distinct factors. The first factor is the application of gender-equity pay policies used by foreign-owned firms in their home countries. If women in the home country are paid higher relative wages than the typical equally-skilled Polish woman, there is a tendency to raise the pay of women in the Polish affiliate to match its organizational pay scale in the home country. The biggest flows of FDI into Poland are from EU countries with high gender equity objectives, which would influence the wage-setting practices of their subsidiaries in Poland (Halvarsson et al., 2022; Stolzenburg et al., 2020; and Zimmerman, 2022).

The second factor is a competitive effect whereby foreign firms locating in Poland are attracted by the low wages for women relative to equally skilled men. Wages of women are bid upwards in order to hire the most qualified among them. Hijzen et al. (2013)—among others—argue that foreign-owned companies may be willing to pay more to identify, attract, retain and motivate highly qualified individuals. They also provide evidence for the claim that foreign-owned firms are indeed able to attract highly qualified employees from their domestic counterparts through higher wages. In addition, female employees may have cognitive skills better suited to the technology transferred by foreign owners (Stolzenburg et al., 2020) and interpersonal skills relevant for working in an international organization (Halvarsson et al., 2023) that boosts the relative demand for women employees by foreign-owned firms.

6. Conclusions

In this paper, we have tried to estimate the causal relationship between foreign ownership and wages that is driven by ownership per se, and not by observable or unobservable worker and firm characteristics. We employ data from surveys conducted by a major Polish HR consulting firm, with our pooled cross-section data set comprising over 300,000 men and 250,000 women working in the Polish labor market during 2013–2017. The foreign-firm wage premium is estimated by a number of techniques, ranging from ordinary least squares and two-stage least squares to a recently developed frequentist RX-2SLS econometric procedure that relaxes IV assumptions via the exclusion restriction. Our analysis leads us to two conclusions. First, regardless of gender, Polish workers employed by majority foreign-owned firms earn a significant wage premium relative to their counterparts in other Polish firms. Our OLS results suggest that on average men (women) earn approximately 25–26% (26–30%) more in foreign firms. Second, our RX-2SLS estimation strategy that relaxes the exclusion restriction for 2SLS estimation shows an even stronger effect for women, suggesting that the wage policies of foreign-owned firms in Poland have an equalizing effect on the gender wage gap.

We are encouraged that our findings compare favorably with those reported by Magda and Salach (2021). From Model 1 in their Table 6 (the model closest to our OLS estimation in Panel A of Table 2, with industry controls), they find an estimated foreign-firm coefficient of 0.293 for men and 0.208 for women. From Table 2, we find an estimated coefficient of 0.225 for men and 0.232 for women. These estimates are quite similar when we consider the differences between the SWSO data they use and the data from Sedlak and Sedlak that we employ. In addition, the two studies specify quite different control variables

and, while we estimate regressions separately for men and women, Magda and Sałach use pooled data with female indicator variables for their estimates. By comparison, our IV estimates substantially differ from the OLS estimates.

Despite being more educated, respondents to the S&S survey tend to be younger, and hence less experienced. They will be less likely to be in top or mid-level management than those in the SWSO survey. For men in 2014, the (raw-data) foreign-wage gap is 76% in the SWSO survey, but only 45% in the S&S survey. For women the foreign-firm wage gap is about the same regardless of the survey, about 47% for both SWSO and S&S. This does not mean, however, that the represented populations are the same. In fact, the percentage of females at foreign firms is noticeably higher in the SWSO survey; for S&S (SWSO), the fraction of females at domestic firms is 0.39 (0.40), while at foreign firms the fraction is 0.37 (0.43). Moreover, the respondents to the S&S survey tend to have less work experience; the experience for individuals at domestic firms is about 11(16) years, and at foreign firms about 10 (13) years. Finally, the respondents to the S&S survey tend to be more educated; the fraction of those with tertiary education at domestic firms is 0.72 (0.24), while at foreign firms the fraction is 0.82 (0.39). Nonetheless, having deleted the less educated from the S&S sample, we found that our empirical conclusions were the same. The OLS estimates were close to those from Magda and Salach (2022), and the RX-2SLS estimate for men was not significant for the model with department and industry dummies. This suggests that the nature of our sample (that leans toward the more educated) is not the driver of our main results.

A limitation to our study is that we do not observe individual characteristics of our respondents, such as whether they have children at home. Moreover, although we do not account for self-selection into the job market, an important consideration for women, our 2SLS estimation technique should ameliorate this problem even though this is not true for OLS. Finally, since we do not have firm fixed effects, we cannot delve into interesting decompositions that would be available to us with the SWSO data. Unfortunately, due to privacy concerns, this limitation will likely persist with the S&S survey.

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Appendix: KR-LTZ and RX-2SLS Estimation

In econometric applications, instrumental variables (IV) estimation is one of the most used tools to obtain causal estimates. The estimation procedure, however, relies on having a set of valid instruments. Bound and Jaeger (2000) were among the first to raise awareness that – if possible – one should first perform an auxiliary regression to informally test the exclusion restriction. What is required for this analysis is a subsample where the proposed instruments have arguably no effect on the treatment variable (where, for our purposes, the treatment variable is the dummy *F*, i.e., *Foreign Ownership*). In particular, we need to have a subsample where foreign ownership is precluded.

Recently, van Kippersluis and Rietveld (2018) reason that if the direct effect can be measured in the "precluded" subsample, then it is also possible to use this information in the quasi-Bayesian plausibly exogenous method proposed by Conley et al. (2012). In the case of local-to-zero (LTZ) estimation, denoted as KR-LTZ in this paper, one specifies a prior distribution for the direct effect and then combines this prior distribution with other sample information to estimate the treatment effect. Considering that the direct effect can be estimated, however, leads immediately to a frequentist identification strategy. It is unnecessary to employ Bayesian reasoning. Indeed, our modified 2SLS estimator (RX-2SLS) discussed below relaxes the exclusion restriction (hence the RX) and allows estimation of the treatment effect by using information from both the "precluded" subsample and the "non-precluded" subsample.

Observe first that the direct effect of the instruments can be estimated by running OLS on the "precluded" subsample, as follows:

$$ln(W) = \delta X + \gamma IV + \varepsilon \quad \text{(A1)}$$

where we have dropped the observational subscript for notational convenience; X is set of individual characteristics, and IV consists of three regional dummy variables. Since δ may be different from β in Equation (1) presented in the main text, there is considerable allowance for parameter heterogeneity between the "precluded" and "non-precluded" subsamples. Observe too that F does not appear in Equation (A1), and this is what allows us to identify the direct effect.

After estimating Equation (A1) by OLS, van Kippersluis and Reitveld (2018) set a Normal prior for γ with mean γ_{OLS} and a variance Ω_γ that is rather subjective but can be data-dependent. Regardless of how Ω_γ is set, however, LTZ estimation is readily available through the plausexog command in STATA; see Clarke (2017) and Clarke and Matta (2018). A limitation of the plausexog routine is that it allows but one instrumental variable, whereas we have three of them in our application. By comparison, there are no such limitations for our proposed RX-2SLS estimator.

For RX-2SLS estimation, we first combine the observations from the "precluded" and "non-precluded" subsamples to form a super-sample of employees who work at firms that are allowed to have foreign ownership, plus those who are employees of firms that are precluded from foreign ownership. Define the dummy variable P to indicate that an employee is from the "precluded" subsample; and zero otherwise. Next, using the super-sample, run 2SLS estimation with $ln\ (W)$ as the dependent variable, $(1-P)*IV$ as the vector of instruments, and F, X, IV, and $X*P$ on the right-hand-side. The endogenous variable, F, will necessarily equal zero in the "precluded" subsample, and though not a requirement, we assume that the vector X contains an intercept term.

The RX-2SLS point estimate for α (that is, the coefficient on F in Equation (1) in the main text) is *identical* to that obtained from KR-LTZ based on the quasi-Bayesian method of Conley et al. (2012). So, even though the idea from van Kippersluis and Reitveld (2018) is quite good, there is actually no need to invoke Bayesian reasoning. Moreover, having switched to 2SLS estimation, it is no longer necessary to restrict ourselves to one instrument via the plausexog statistical routine. All of the usual regression diagnostics are readily available in many computer packages, including STATA, and the standard error for the RX-2SLS estimate of α is immediately obtained from the computer output. For instance, we are particularly interested in the Hausman (1978) test for exogeneity for both traditional 2SLS and RX-2SLS estimation.

To help our reader better understand the intuition behind both KR-LTZ and RX-2SLS, we present a highly stylized example. Consider the system of Equation (1) and Equation (2) from the main text, but without any exogenous cofounders or an intercept term:

$$ln(W) = \alpha F + \gamma IV + \varepsilon \quad \text{(A2)}$$

$$F = \theta IV + \xi \quad \text{(A3)}$$

Furthermore, assume for simplicity that IV is a scalar so that there is but one instrumental variable. Substituting the first-stage equation (A3) into structural equation (A2), we obtain the following:

$$ln(W) = (\alpha + \gamma/\theta)\theta IV + (\varepsilon + \alpha\xi) \quad \text{(A4)}$$

Equation (A4) demonstrates the consequences of the exclusion violation since traditional 2SLS will estimate $\alpha + \gamma/\theta$ instead of α.

Subtracting a consistent estimate of γ/θ from the traditional 2SLS estimate remedies the problem. By the properties of probability limits, γ/θ will be consistently estimated by employing a consistent estimator of γ divided by a consistent estimator of θ. Moreover, well known is the fact that OLS applied to the first-stage equation at (A3) produces a consistent estimator of θ, while for the subsample that precludes foreign ownership ($\alpha = 0$), OLS applied to Equation (A5) below produces a consistent estimator of γ:

$$\ln(W) = \gamma IV + \varepsilon \quad \text{(A5)}$$

This is the intuition behind the KR-LTZ estimation method. The KR-LTZ estimate of α corrects the inconsistency, so that $\alpha_{KR-LTZ} = \alpha_{2SLS} - (\gamma_{OLS}/\theta_{OLS})$.

Even for the more general case where we include exogenous confounders, RX-2SLS replicates both α_{KR-LTZ} and γ_{OLS}. For RX-2SLS estimation, it is important to include $X * P$ on the right-hand-side to allow for the parameter heterogeneity associated with Equation (A1). Furthermore, just to be clear, the close association between KR-LTZ and RX-2SLS remains regardless of the number of instrumental variables. Yet the advantage of using RX-2SLS lies in its ease of implementation and close ties with traditional 2SLS.