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**Working Paper**

## Real Exchange Rates and the Earnings of Immigrants

CESifo Working Paper, No. 10625

**Provided in Cooperation with:**

Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

*Suggested Citation:* Dustmann, Christian; Ku, Hyejin; Surovtseva, Tanya (2023) : Real Exchange Rates and the Earnings of Immigrants, CESifo Working Paper, No. 10625, Center for Economic Studies and ifo Institute (CESifo), Munich

This Version is available at:

<https://hdl.handle.net/10419/279376>

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# Real Exchange Rates and the Earnings of Immigrants

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## **Impressum:**

CESifo Working Papers

ISSN 2364-1428 (electronic version)

Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH

The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute

Poschingerstr. 5, 81679 Munich, Germany

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Editor: Clemens Fuest

<https://www.cesifo.org/en/wp>

An electronic version of the paper may be downloaded

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# Real Exchange Rates and the Earnings of Immigrants

## Abstract

We relate origin-destination real price differences to immigrants' reservation wages and their career trajectories, exploiting administrative data from Germany and the 2004 enlargement of the European Union. We find that immigrants who enter Germany when a unit of earnings from Germany allows for larger consumption at home settle for lower entry wages, but subsequently catch up to those arriving with less favourable exchange rates, through transition to better-paying occupations and firms. Similar patterns hold in the US data. Our analysis offers one explanation for the widespread phenomenon of immigrants' downgrading, with new implications for immigrant cohort effects and assimilation profiles.

JEL-Codes: J240, J310, J610, O150, O240.

Keywords: real exchange rate, reservation wage, immigrant downgrading, earnings assimilation.

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We acknowledge funding from the DFG grant DU 1024/1-2. Dustmann acknowledges funding from the ERC Advanced Grant 833861.

# 1. Introduction

Upon arrival in the host country, new immigrants often accept jobs or wages that are below their observed qualifications. Although the phenomenon of immigrant downgrading is well established in the literature (see e.g. Eckstein and Weiss 2004; Dustmann et al. 2013), less is known about the drivers of such behaviour. In this paper, we propose real price differences (or real exchange rates) between the host and source countries as one plausible driver of immigrants' reservation wages and provide concrete empirical evidence for that.

Our argument stems from the observation that real price levels tend to be higher in rich countries than in poor ones (Balassa 1964; Samuelson 1964) and labour migration typically occurs from poorer to richer regions. Consider the case of Poland and Germany as an example. The real exchange rate (RER) between Germany and Poland can be expressed as:

$$RER = \frac{P^*}{P} \times e, \quad (1)$$

where  $P^*$  and  $P$  denote the price levels for a reference basket of goods and services in Germany (in Euros) and in Poland (in Zlotys), respectively, while  $e$  denotes the nominal exchange rate between the two currencies (Zlotys per Euro). Suppose that the basket costs 30 Euros in Germany, and at the prevailing nominal exchange rate, 30 Euros can buy 150 Zlotys in the currency market. For purchasing power parity (PPP), the same basket should cost 150 Zlotys in Poland, consistent with  $RER = 1$ . Suppose, however, that it actually costs 100 Zlotys (instead of 150 Zlotys) in Poland. That means 30 Euros earned in Germany can buy 1.5 times as much when spent in Poland, leading to  $RER = 1.5$ .<sup>1</sup>

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<sup>1</sup> There are a multitude of reasons why real price ratios between countries may deviate from PPP, including transportation and information costs, price and wage rigidities, and imperfect competition. See Dornbusch (1987) and Rogoff (1996) for a discussion.

If migrations are temporary and/or if immigrants (intend to) spend part of their earnings in their region of origin—either through transfers to family members or through consumption and investment upon return (see e.g. Yang 2008; Dustmann and Mestres 2010)—then their *effective* real wage derived from a given pay will be higher to the extent that the real price level in the origin is lower than that in the destination. All else equal, therefore, immigrants from low price regions/periods are likely to have lower reservation wages than those from high price regions/periods, which may be reflected in their observed entry wages.<sup>2</sup>

To test this RER-reservation wage hypothesis, ideally, we would like a situation in which potential migrants face minimal administrative barriers such as employer-specific work permits or visas that require job offers meeting a pre-specified wage threshold, since such restrictions would make it difficult for immigrants to act on their reservation wages.<sup>3</sup> To approximate that situation, we take advantage of the accession of eight Central and Eastern European countries (the A8) to the European Union (EU) in 2004, which greatly facilitated the access of A8 citizens to the labour markets of other EU countries.<sup>4</sup> Our analysis is based on micro-level longitudinal administrative data from Germany (Social Security records in specific) that allows us to track immigrants over time from their first employment spell, and investigate the evolution of their wages in subsequent years with detailed information on their firms and occupations. In particular, focusing on A8 immigrants arriving in Germany over the period 2004-2012, we study the effect of time-of-arrival real exchange rate (RER) on their

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<sup>2</sup> The conceptual framework we have in mind views the real wage one would receive at home in the absence of migration as a new immigrant's outside option, which in turn determines her reservation wage. This person will accept a wage offer from the host country as long as it exceeds her reservation wage. When the prevailing RER is high (low), the reservation wage (expressed in nominal wage in the host country) is low (high), which will then be reflected in the observed entry wages.

<sup>3</sup> In the case of immigrants entering without a visa, employment eligibility verification requirements (see e.g. Ayromloo et al. 2020) can similarly limit the scope for (ineligible) immigrants' acting on their reservation wages, at least in the formal sector.

<sup>4</sup> A8 countries comprise Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.

entry wages and subsequent career trajectories in the German labour market, conditioning on country-of-origin fixed effects and cohort fixed effects (hence exploiting within-country and across-cohort variations).

We find that immigrants' entry wages are indeed affected by the real exchange rate prevailing at the time of arrival. In particular, we estimate a wage elasticity of -0.3, implying that a 10 percent higher real exchange rate (about 1 SD of log RER) between the host and source countries leads to a 3 percent lower accepted wage in the first employment spell. However, the relation between the time-of-arrival RER and cohort-specific labour market outcomes becomes weaker over time and dissipates by the third year after arrival, suggesting a catch up of those who arrive at high RERs (and accept lower entry wages) to those arriving with low RERs (and accept higher entry wages), convergence achieved through firm changes and occupational upgrading and not by compositional changes due to selective outmigration (see Dustmann and Görlach 2016 for a discussion).

Overall, we establish that geographic real price differences between where immigrants work vs. where they spend (part of) their earnings may influence the *reservation wages* of newly arrived immigrants, taking advantage of high quality longitudinal administrative data.<sup>5</sup> Our analysis thus provides concrete evidence that some immigrants may indeed have lower reservation wages than other comparable workers, a premise that is commonly invoked in the literature and is gaining ground in recent analyses of immigration in non-competitive settings such as Malchow-Møller et al. (2012), Naidu et al. (2016), Amior (2017), Amior and Manning (2020), and Wang (2021). Understanding the factors driving reservation wages is crucially

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<sup>5</sup> Using a similar argument, Albert and Monras (2022) build a quantitative spatial equilibrium model in which immigrants who are more likely to spend their US earnings in their home country choose high price (and high nominal wage) cities over low price (and low nominal wage) cities within the US, with consequences for the aggregate productivity of the US economy. In contrast, our focus is on the effect of time-of-arrival RER for the reservation and entry wages of different immigrant cohorts and their earnings dynamics over time in the host country.

important as immigrants' willingness to work for less has consequences not only for their entry wages and assimilation profiles (see e.g. Chiswick 1978; LaLonde and Topel 1992; Bratsberg et al. 2002; Barth et al. 2004; Lubotsky 2007, 2011; Gathmann and Keller 2018; Albert et al. 2020; Dostie et al. 2020; Arellano-Bover and San 2020; Barsbai et al. 2022) but also for assessing the labour market impacts of immigration (see e.g. Altonji and Card 1991; Card 2001; Borjas 2003; Glitz 2012; Manacorda et al. 2012; Ottaviano and Peri 2012; Llull 2018; Prantl and Spitz-Oener 2020; Tabellini 2020).

In addition, our analysis also offers a new insight for interpreting the well-known immigrant cohort effects in the literature. In his influential study, Borjas (1985) (also see Borjas 1995 and 2015) argues that in cross-sectional analysis, changes in entry wages of later arriving cohorts can lead to biased estimates of immigrants' assimilation profiles. Borjas goes on to provide evidence for a decline in the "quality" of newly admitted immigrants to the US (measured in terms of entry wages) over time, suggesting the changing cohort composition from mainly Europeans to Latin Americans after the Immigration and Nationality Act of 1965 as a possible explanation. Our analysis adds a different perspective to the interpretation of the observed decline in entry wages. In particular, using US census data, we show that the declining entry wages documented in Borjas (1985, 1995) may in part be driven by the higher purchasing power of the US dollar applicable for later arriving cohorts (who originate predominantly from lower price countries).<sup>6</sup>

Further, by focusing on the real exchange rate (RER) as a factor determining the reservation and entry wages of new immigrants, we also add to the literature exploiting RER variations to explain a variety of immigrant outcomes in the host country. A common

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<sup>6</sup> See Section 5 for a detailed discussion.



proposition in this literature is that to the extent that immigrants spend (part of) their earnings in their country of origin, their behaviour should be responsive to the prevailing real price differences between the host and source regions. The outcomes so far examined in the literature include return migration and remittances among Philippine migrants overseas (Yang 2006, 2008), long-run development in the migrant-origin communities within the Philippines (Khanna et al. 2020), location choices of immigrants across US cities (Albert and Monras 2022), and labour supply (i.e. hours worked) of immigrants in the US (Nekoei 2013) and in Australia (Nguyen and Duncan 2017). We add to this literature by focusing on the impact of *time-of-arrival* RER on immigrants' *entry wages* and their career profiles. In particular, we find that cohorts arriving when the RER is more favourable (i.e. high) settle for lower entry wages than other cohorts, though over time the wages of high RER arrivals converge to that of low RER arrivals. In a related work, Nekoei (2013) shows that a rise in the *contemporaneous* (as opposed to time-of-arrival) RER between the US and their home countries leads to a reduction in the *hours worked* by US immigrants. While the two studies have in common that immigrants' labour market behaviour is responsive to the purchasing power that their foreign earnings would have in their home country, the focus of the present study is on the reservation and entry wages of newly arrived immigrants whereas Nekoei (2013) focuses on the labour supply of incumbent immigrants (with substantial years of tenure, on average 17 years).

## **2. Background, Data and Sample Description**

### **2.1 The 2004 EU enlargement and migration flows**

On May 1, 2004, eight Central and Eastern European countries (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia), also referred to as the A8, and two

Mediterranean countries (Malta and Cyprus) joined the EU, thus constituting the largest single enlargement of the European Union, both in terms of number of countries and people. While citizens of new accession countries could immediately move and live freely in any of the EU member states, a transitional period of up to seven years was agreed upon during which time countries could restrict access to their labour markets for citizens of the new member states.

The majority of the old EU-15 countries applied some restrictions on access to their labour markets, with the exception of the UK, Ireland and Sweden. Germany delayed elimination of labour market restrictions for A8 workers until May 1, 2011. However, despite these restrictions, Germany nevertheless experienced a large increase in migrant inflows from the new EU member states after their accession in 2004.<sup>7</sup> For instance, the share of foreigners migrating to Germany who were Polish citizens increased from about 12 percent in 2003 to 20 percent in 2004. Between 2000 and 2003, an average of 80,000 Poles migrated to Germany each year, while between 2004 and 2007 this number was 141,000, constituting a 75 percent increase in the four years after Poland joined the EU (OECD 2011). Migration flows from other A8 countries increased similarly, e.g. inflows from Hungary, the second largest country in the A8 group after Poland, increased by 20 percent. Indeed, migration flows from A8 countries to Germany increased faster even than those to countries like the UK that applied no restrictions on labour mobility from the new accession countries.<sup>8</sup> While Germany did not officially open

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<sup>7</sup> Even within the transitional period arrangement, nationals from new member states had preferential access to the labour market of the EU15 as compared to third country nationals. In Germany, for instance, a new type of work permit has been created to respond to this new situation, and more than 11,000 of these permits were issued to nationals of A8 countries in 2004 (OECD 2006, p. 108). For detailed regulations affecting the labour market access of A8 nationals, see pp. 118-119 in Holland et al. (2011).

<sup>8</sup> The inflow of Poles to the UK in 2004 and 2005 amounted to 16,000 and 49,000 respectively, considerably lower than the inflows registered to Germany, where 125,000 and 148,000 Poles arrived in 2004 and 2005 respectively (OECD 2011). Here, statistics for Germany represent foreigners holding a residence permit and intending to stay in the country for at least one week. Statistics for the UK show non-British citizens admitted to the UK.

its labour market to A8 immigrants, the ease with which work permits could be obtained therefore led to a situation that came to resemble closely free mobility of labour.

## 2.2 Data

For our empirical analyses, we use several data sources: individual-level data from German Social Security records, country-level macroeconomic variables, and data from the American Community Survey (ACS) and the US census. We describe the various data sources below.

**Labour market biographies in Germany.** We use the “Weakly anonymous Version of the Sample of Integrated Labour Market Biographies (SIAB) – Version 7514 v1” from the Research Data Centre of the Federal Employment Agency (BA) at the Institute for Employment Research (IAB). Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access. Detailed documentation of the SIAB Version 7514 is available in Antoni et al. (2016).<sup>9</sup> The SIAB is a 2 percent random sample drawn from the universe of employment biographies of workers who were liable to German Social Security at any point between 1975 and 2014. The data contain detailed information on the labour market outcomes of individuals such as occupation and gross (daily) wages reported by the employer. It also contains some rudimentary information on the demographic characteristics of workers including age, gender, and education. Most importantly, we also observe nationality. This, in conjunction with the longitudinal nature of the data, allows us to identify workers with foreign

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<sup>9</sup> Version 7514 has subsequently been updated and the latest version available is SIAB 7521 (see Graf et al. 2023; Schmucker et al. 2023).

nationality as they appear for the first time in the German labour market. In the SIAB data, an individual may have multiple employment spells within a year (or even hold multiple jobs concurrently). We focus on the main employment spell each year, which we define as the spell with the longest duration. In the case of ties, we use the spell that appears chronologically first. Our analysis focuses on immigrants from the four largest A8 accession countries: Poland, Hungary, Czech Republic and Slovakia, who enter Germany in the post-EU enlargement period between 2004 and 2012 and are observed in the German labour market data.<sup>10,11</sup>

**Real exchange rate (RER).** We augment the individual employment data with aggregate yearly data on real exchange rates for each of the origin countries that we consider. We construct the RER according to (1), where  $P^*/P$ , commonly referred to as “purchasing power parity conversion factor” and  $e$ , the nominal exchange rate, are both obtained from the World Bank’s World Development Indicators (WDI) database.<sup>12</sup> Panel (a) of Figure 1 illustrates the evolution of the real exchange rate between Germany and Poland, Hungary, Czech Republic and Slovakia between 2004 and 2012.<sup>13</sup> If these countries and Germany were at purchasing power parity, the RER should be equal to unity. In reality, however, the prevailing RER is always greater than 1 (mean RER = 1.67), meaning that the real price levels in these countries are lower than that in Germany. The figure also illustrates that the RERs exhibit considerable

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<sup>10</sup> We only use country-cohort cells that include at least 20 individuals in the 2% sample. This requirement is not met for other (smaller) A8 countries.

<sup>11</sup> The SIAB data runs until 2014. Therefore, we focus on 2004 to 2012 arrival cohorts to enable us to follow every cohort for three years after arrival.

<sup>12</sup> The database can be accessed at: <https://data.worldbank.org/indicator>. For European countries (including those used in our analysis), OECD-Eurostat (<https://ec.europa.eu/eurostat/web/purchasing-power-parities/overview>) collects their own data and produces the PPP conversion factors for each year, which are then provided to the World Bank.

<sup>13</sup> Slovakia adopted the Euro in 2009 and hence the nominal exchange rate between Slovakia and Germany is unity from 2009 onwards. However, a common currency does not preclude variations in RER since the relative prices of Slovakia and Germany still vary over time.

changes over time (SD of RER = 0.16) with substantial differences between origin countries. Panel (b) of Figure 1 shows data on each country's real GDP per capita relative to that in Germany (again obtained from the World Development Indicators).

**Data for US analysis.** To investigate whether our findings for Germany carry over to other settings, in particular the US, we supplement our analysis of immigrants in Germany with that in the US, using the 2005 to 2017 waves of the American Community Survey (ACS) obtained from IPUMS (Ruggles et al. 2017).<sup>14</sup> We restrict our sample to individuals aged 16 to 65 in full-time employment, who arrived in the US between 2004 and 2014 and are in their initial 3 years since migration. We exclude individuals in self-employment and those in the armed forces. We also drop migrants from small countries with country-cohort cells containing fewer than 20 observed immigrants, leaving 53 different countries of origin in our sample. Appendix Table A1 provides the descriptive statistics for the US sample.

**Data for analysis of immigrant cohort effects.** In the parts of our analysis where we revisit Borjas' (1985, 1995, and 2015) examination of immigrant cohort effects in the US (see Section 5), we draw on data from the US census for the years 1970, 1980, 1990 and 2000, as well as the 2009-2011 waves of the ACS—which for simplicity and following Borjas (2015) we denote as the 2010 census—provided by IPUMS (Ruggles et al. 2017).<sup>15</sup> Following Borjas (2015), we restrict our sample to employed men aged 25 to 64, excluding those in self-employment or in

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<sup>14</sup> The ACS contains information about income and employment, but the income data refers to individual wage and salary income in the year prior to the survey, therefore the information in the 2005 to 2017 waves of the survey corresponds to the years 2004 to 2016. Furthermore, because the respondents' wage income refers to the wages in the previous year, we exclude those who arrived in the year of the survey.

<sup>15</sup> For this part of the analysis, we require data on the real exchange rate that goes back to the 1960s and 1970s, which is not available from the World Development Indicators. We therefore use data from the Penn World Table (Feenstra et al. 2015).

the armed forces. We focus on natives and *recent* immigrants who arrived in the US during the 5 years prior to the census, excluding naturalized US citizens.<sup>16</sup> The sample size is 7,969,464, of which 149,398 are immigrants. The description of the sample of natives and immigrants is provided in Table A2.

### 2.3 Sample and descriptive statistics

For our main analysis, we restrict attention to the 2004 to 2012 entry cohorts who enter the German labour market as full-time employees (which is the case for 85 percent of workers) and who are between 16 and 65 years old at the start of their first employment spell.<sup>17</sup> We follow these cohorts for up to three years post-entry. Our main sample consists of 16,361 full-time employment spells covering 8,085 unique individuals. For part of the analysis, we restrict our attention to “stayers”, i.e. individuals who stay in Germany for at least 3 years after their entry to the German labour market, to keep the composition constant across spells. The stayers’ sample includes 4,323 unique individuals covering 11,491 employment spells.<sup>18</sup>

Table 1 presents some descriptive statistics for our sample. Column 1 reports characteristics of the full sample whereas column 2 focuses on stayers. Due to the nature of the data (i.e. employment records reported to the social security administration by employers) and the fact that the individuals are not German natives, education data are missing for many workers in our sample. Of those for whom we have information on education, 29 percent are

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<sup>16</sup> For census waves up until 2000, arrival cohorts are reported in 5-year intervals (i.e. whether a respondent arrived within the 5 years prior to the year of census). Hence, census year 1970 includes 1965-1970 arrival cohorts, census year 1980 includes 1975-1980 arrival cohorts, etc.

<sup>17</sup> The SIAB data report daily wages and these are not reliable for part-time employees, hence we focus on full-time employees here.

<sup>18</sup> We can also employ an alternative definition of stayers where an individual is required to be full-time employed in every year. Our results are robust to the stricter definition of stayers.

low skilled (defined as no post-secondary education or apprenticeship), 56 percent are medium skilled (defined as some training or apprenticeship after secondary education), and 15 percent have some college education. The sample of stayers, in comparison, has slightly higher educational attainments. The average real exchange rate (RER) at arrival is 1.77 and it is the same across the two samples. Likewise, the average GDP per capita of the origin country relative to Germany in the year of arrival is identical for the two groups at 0.53.

### 3. Empirical Strategy

Our key hypothesis is that as long as immigrants (intend to) spend a non-zero share of their foreign earnings back in the home country, those who arrive at a higher RER should on average be observed accepting lower wages in their first job in the host country. However, over time, the initially low wages of high RER arrivals should catch up to the wage levels of lower RER arrivals, as workers encounter new wage offers each period and high RER arrivals (given their low starting point) should be more likely to accept any new offer than the low RER arrivals. In contrast, if the initial difference in accepted wages between the high and low RER arrivals reflected their *fixed* or *innate* differences such as productivity, then the initial difference should persist over time. This is a testable hypothesis to which we return later.

In the data, if high RER arrivals are observed to accept low wages due to their willingness to work for less (i.e. lower reservation wages), then this is precisely what we want to detect. Importantly, this effect should not be confused with the standard selection issue where high RER arrivals may receive low wages due to their possibly lower skill or productivity levels. When examining entry wages, we therefore control for the standard determinants of wages such as age, gender, and education, as well as country FE and year FE.

Moreover, when examining the effect of RER on the wage growth, we also include *individual* FE, thereby accounting for all (observable and unobservable) differences between high versus low RER arrivals in terms of their fixed or innate labour market traits.<sup>19</sup>

We start by examining the relationship between immigrants' time-of-arrival (or initial) RER and their first accepted wages. In particular, based on workers in their initial spell of employment, we estimate the following equation:

$$\ln w_{ijt} = \gamma_1 \ln Q_{jk(i)} + \gamma_2 \ln Y_{jk(i)} + \phi_j + \psi_t + \mathbf{X}_{ijt} \beta + e_{ijt}, \quad (2)$$

where  $\ln w_{ijt}$  is the log wage that individual  $i$  from country  $j$  receives in Germany in year  $t$ . Denoting by  $k$  the year of arrival (cohort), we can assign each individual  $i$  to a unique country-by-cohort bin  $(jk)$  and thereby to  $Q_{jk(i)}$ , the *time-of-arrival* real exchange rate (RER) applicable for migrant  $i$ .<sup>20</sup> The higher  $Q_{jk(i)}$ , the greater is the purchasing power of one unit of German earnings when it is spent in country  $j$  (in year  $k$ ).

The key parameter of interest in this regression is  $\gamma_1$ , the effect of the initial or time-of-arrival RER on entry wages in Germany. As (2) controls for country-of-origin FE ( $\phi_j$ ) and calendar year FE ( $\psi_t$ ), we exploit variation in RER among individuals from the same countries of origin but arriving in different years. The year FE account for labour market conditions in Germany that commonly affect all immigrants regardless of their countries of origin. To address concerns that the effect of fluctuations in the real exchange rate may be confounded with that of fluctuations in the income level of the home country relative to Germany, we also include the log of  $Y_{jk(i)}$ , the real GDP per capita of country  $j$  relative to that of Germany in the

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<sup>19</sup> We also show that, conditional on country and year FE, cohorts arriving at different RER levels are balanced in their observed characteristics, see section 4.2.

<sup>20</sup> Since we are currently only looking at wages in the initial employment spell for each cohort,  $k = t$  in this context. Later, when we follow the same cohorts over time,  $k \neq t$  for years 2 and 3.



year of migrant  $i$ 's arrival.<sup>21</sup> Further, we include a vector of individual characteristics  $\mathbf{X}_{ijt}$ , which contains gender, a quadratic in age, and dummies indicating four different education categories (with “missing” being one of the categories). For identification, we are thus exploiting the remaining variation in country-cohort real exchange rates, conditional on origin country FE, year FE, log GDP differences between Germany and individual-specific labour market characteristics.

The specification in (2) measures the effect of RER on the accepted wages of immigrants in Germany in the year of arrival. However, in subsequent periods we would expect the wages of those who arrive at a high RER to grow faster than that of those who arrive at a lower RER, if the low entry wages of the high RER cohorts are indeed due to their initial downgrading rather than their innate labour market traits. These dynamics not only speak directly to the mechanisms through which the time-of-arrival RER impacts on immigrants' initial occupational downgrading and subsequent upgrading but may also provide an explanation as to why data on existing *stocks* of immigrants (as opposed to new immigrants in their initial employment spells) obscures measurable variation in reservation wages related to RER.

To examine the differential dynamics of wage adjustments by immigrants who arrived at different initial RER levels, we include observations of immigrants in the three years after migration (i.e. periods 1, 2, and 3), and estimate the following equation:

$$\ln w_{ijt} = \sum_{\tau=1}^3 \lambda_1^{\tau} \ln Q_{jk(i)} \times T_{\tau(it)} + \sum_{\tau=1}^3 \lambda_2^{\tau} \ln Y_{jk(i)} \times T_{\tau(it)} + \rho_{\tau(it)} + \xi_{jt} + \mathbf{X}_{ijt} \beta + v_{ijt}, \quad (3)$$

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<sup>21</sup> For robustness, we also control for additional macro variables such as origin country-cohort-specific unemployment rate, employment rate, and labour force participation rate, which makes little difference to our main results (see Section 4.3).

where  $jk(i)$  again refers to person  $i$ 's country of origin and year of arrival (cohort), and  $T_{\tau(it)}$  indicates whether an individual  $i$  in year  $t$  is in the  $\tau$ -th year in her migration history, i.e.  $\tau = t - k + 1$ . We condition on years-since-migration (YSM) FE,  $\rho_{\tau(it)}$ , and interact the dummies indicating YSM ( $T_{\tau(it)}$ ) with both  $\ln Q_{jk(i)}$  and  $\ln Y_{jk(i)}$ , so that  $\lambda_1^\tau$  captures the  $\tau$ -specific effect of the time-of-arrival RER and  $\lambda_2^\tau$  that for time-of-arrival real GDP per capita (relative to Germany). If those who arrived at a high RER (and thus accepted lower paying jobs) indeed subsequently catch up in wages to those who arrive at a lower RER, we should expect  $\lambda_1^1$  to be negative, but  $\lambda_1^2$  and  $\lambda_1^3$  to become less negative and potentially even approach zero.

In addition, we also condition on country-by-year FE,  $\xi_{jt}$ , thereby eliminating all country-of-origin specific shocks that are also calendar year specific, which have a common effect on immigrants from the same country of origin who may have different migration histories.<sup>22</sup> In particular, the effects of *contemporaneous* (as opposed to *time-of-arrival*) RER or GDP per capita are accounted for by  $\xi_{jt}$ . Moreover, the country-by-year FE also absorb possible impacts of the prevailing stock or inflow of immigrants from the same country of origin. Our tight identification strategy therefore relies on within-country and across-cohort variation in the time-of-arrival RER while conditioning on the effects of all common shocks that vary at the country-by-year level (captured in  $\xi_{jt}$ ).

Finally, in our most demanding specifications, we estimate:

$$\ln w_{ijt} = \sum_{\tau=2}^3 \delta_1^\tau \ln Q_{jk(i)} \times T_{\tau(it)} + \sum_{\tau=2}^3 \delta_2^\tau \ln Y_{jk(i)} \times T_{\tau(it)} + \rho_{\tau(it)} + \alpha_i + \xi_{jt} + \mathbf{X}_{ijt} \beta + u_{ijt}, \quad (4)$$

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<sup>22</sup> Thanks to the fact that each cohort arriving between 2004 and 2012 is followed for three years, in every calendar year (except for 2004 and 2014), we have at least two cohorts who originate from the same country but are in different YSM bins, which allows us to identify  $\xi_{jt}$ .

where  $\alpha_i$  denotes individual fixed effects. Notice that here each worker's time-of-arrival RER and GDP ( $Q_{jk(i)}$  and  $Y_{jk(i)}$ ) are absorbed into  $\alpha_i$ . In this specification, therefore, we fully account for all possible unobserved differences between immigrants arriving with high versus low RER (as well as the associated GDP levels) and ask whether the within-person wage growth of higher RER arrivals is indeed faster, such that the initial wage gap between high and low RER arrivals (detected in (2) and (3)) becomes narrower in subsequent years after migration. Note that, by conditioning on individual FE, this specification eliminates any potentially remaining unobserved selectivity of immigrants arriving in different years with different RER. We estimate these regressions on the full sample, and on the stayers only sample to account for any selective return migration or other attrition.

## 4. Real Exchange Rate, Entry Wages and Wage Dynamics

### 4.1 Entry wages

Estimates of the elasticity of wages in the initial spell with respect to the RER upon arrival (as in equation (2)) are displayed in the first three columns of Table 2, based on workers in their first year of migration only. While column 1 conditions only on demographic controls, column 2 adds country FE and year FE. Column 3 additionally controls for time-of-arrival real GDP per capita relative to Germany. Estimates in column 3 suggest a wage elasticity of -0.3 in the year of arrival, implying that a 10 percent higher real exchange rate at arrival (about 1 SD of log RER in the sample) leads to a 3.13 percent lower accepted wage in the first employment spell in the host country. This squares up with the magnitude of wage response we should expect for RER variations of this size, given that the share of net household earnings

immigrants expect to consume back in the home country (in terms of savings and remittances) is about 16-18 percent (see Appendix B for a detailed discussion).<sup>23</sup>

In column 4 of Table 2, we also include workers who are in their 2<sup>nd</sup> or 3<sup>rd</sup> year after migration, and re-estimate equation (2), conditioning on country FE and year FE as well as year-since-migration FE. Column 4 thus shows the effect of time-of-arrival RER on the *average* wages during the first three years in the host country. In column 5, we further include country-by-year FE (like in equation (3)), using only variation in the *time-of-arrival* RER applicable to different cohorts from the same origin country for identification, while eliminating any country-by-year specific common shocks such as the *contemporaneous* RER. This addresses potential concerns that a higher contemporaneous RER may induce more migration, leading to competition effects among immigrants from the same country of origin and lowering wages along the lines of Mishra and Spilimbergo (2011) and Albert et al. (2020), or that the size of the immigrant community of co-nationals may help in improving wages as in Munshi (2003) and Glitz (2017). Any such variation in inflows is absorbed by the country-by-year FE, as are variations in the stock of immigrants from the same country of origin, and movement in the contemporaneous RER. Estimates show that a higher real exchange rate at arrival leads to lower average wages of individuals over their first three years, with an elasticity of -0.24, smaller than that for the first year only, suggesting some catch up in wages in years 2 and 3 after arrival, which is what we turn to in section 4.3.

So far, we have used the RER prevailing in year  $k$  as the *time-of-arrival* RER for cohorts arriving in year  $k$ . For robustness, we also examine the role of lagged RERs, in

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<sup>23</sup> We obtain these figures from the German Socio-Economic Panel (GSOEP), focusing on immigrants from the same countries of origin and for the same periods as considered in our main analysis.

particular the RER prevailing in years  $k - 1$  and  $k - 2$ , respectively. As shown in Table A3, entry wages of cohorts  $k$  indeed respond to the RER of year  $k$ , and not the lagged RERs.

## 4.2 Comments on selection and inflows

The results above are consistent with the interpretation that immigrants arriving with high RER accept lower wages than others because of their lower reservation wages. However, if those arriving during high RER periods have worse labour market traits than others, then this may bias our estimates. To address this concern, we examine whether immigrants arriving at high vs. low RER differ in their labour market characteristics, by regressing the time-of-arrival RER on the individual's observed labour market characteristics such as gender, age and education. As shown in Table A4, once we condition on country FE and year FE, cohorts arriving at different RER levels are balanced in their observed characteristics. The coefficients on gender, age, and different education categories are very small and not statistically significant. Moreover, the p-values on the test of their joint significance are large, with the smallest p-value being equal to 0.64. Thus, the composition of new immigrants seems unrelated to the RER.

A remaining concern is that the high RER cohorts may also be different than the low RER cohorts in unobservable ways. We address this through the inclusion of individual FE, taking advantage of the fact that our administrative data allows us to follow the same individuals over time (see section 4.3).

Relatedly, we next examine whether more immigrants arrive during high RER periods than during low RER periods. As Table A5 shows, conditional on country FE and year FE, there is a negative and significant association between the relative GDP per capita and the size of inflows from a given country of origin, in regressions both unweighted, and weighted by each country's population size in the 2001 census. However, the effects of RER on inflows is

imprecisely estimated and very small, with an elasticity of inflows with respect to RER between 0.4 and 0.6, far smaller (in absolute terms) than the elasticity of inflows with respect to GDP, which is around 4. The low sensitivity of the migration flow to the RER is not surprising given that the wage (and income) differential between Germany and the source countries is order of magnitude larger than the variation in RER. For instance, among occupations commonly held by immigrants in Germany, wages paid in 2004 are roughly twice as high as in Poland, which must dwarf any effect of the RER on the decision to migrate (Table A6). Nonetheless, for inframarginal migrants, the prevailing RER can still influence their reservation and hence accepted wages, which is the focus of the present study.

To account for the potential competition effect, we also directly control for the inflow or stock of co-nationals. In Table A7, column 1 replicates our main coefficient (column 3 from Table 2). In column 2, we include the inflow of immigrants from the same country of origin to Germany. Columns 3 and 4 control for the inflow and stock, respectively, of immigrants from the same country of origin *in the same district* as the individual at hand. All effects of time-of-arrival RER on wages remain invariant to these additional controls.

### 4.3 Wage adjustments

We next explore wage adjustments over time since migration, based on regressions specified in (3) which conditions on country-by-year FE,  $\xi_{jt}$ , thereby eliminating all country-of-origin specific shocks that are also calendar year specific, including the effects of contemporaneous (as opposed to time-of-arrival) RER. Panel A of Table 3 reports results for the full sample, while Panel B uses only individuals who stay in Germany for at least 3 years (stayers). Estimates in column 1 show an interesting pattern: while the RER effect for the first year is

larger than the three-year average (cf. column 5 in Table 2), it decreases in the second year by nearly 50 percent and disappears by year three. This suggests that immigrants arriving with a high RER, while initially settling for lower wages, catch up to those arriving with a low RER in subsequent periods. This relationship is further confirmed by estimates of equation (4) reported in column 2, where we additionally condition on individual FE and therefore account for (observable and unobservable) differences between high vs. low RER arrivals. In particular, column 2 focuses on the *within-individual* changes in the effect of time-of-arrival RER on the wages in the second and third years after arrival, relative to those in the initial year. These changes are very similar to those implied by the regressions in column 1 which does not condition on individual FE (0.126 vs. 0.167 and 0.263 vs. 0.257). This adds further evidence that the low entry wages of the high RER cohorts are not driven by their low innate productivity. Overall, the results in columns 1 and 2 of Table 3 together suggest that those who arrive at high RER initially settle for lower wages (due to their lower reservation wages), but over time their wages catch up to the wages of those who arrive at low RER.<sup>24</sup>

To ensure that the results on wage growth are not driven by compositional changes in the sample over time (due to selective return migration), we re-estimate the specifications in Panel A but using only the sample of stayers, i.e. individuals who remain in Germany for at least 3 years. The estimates are presented in Panel B. Despite the smaller sample size, the pattern of parameter estimates is remarkably similar to that in Panel A.<sup>25</sup>

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<sup>24</sup> This convergence contrasts with the persistent negative effects on earnings often found in the job loss/displacement literature, following the seminal paper by Jacobson et al. (1993). In that literature, the persistence stems mainly from reductions in employment, as transitioning from nonemployment to employment is more difficult (especially when combined with adverse local labour market conditions). In our context, we compare two workers who both start off from employment but with different initial wages (due to differential reservation wages, rather than different productivity). For these workers, subsequent adjustments are likely to be less challenging than for workers starting from nonemployment. Moreover, the (high RER-driven) low reservation wages in our context are specific to certain origin country-arrival cohort cells while all immigrants are subject to the same labour market conditions in Germany.

<sup>25</sup> We also examine whether the selection into the “stayer” status itself may be correlated with the time-of-arrival

Moreover, our main findings in Table 3 are robust to the inclusion of additional variables at the origin country-year of arrival level (beyond GDP per capita relative to Germany) that may co-vary with RER (Table A8). Column 1 of Table A8 replicates column 1 of Table 3. In columns 2-4, we additionally include (origin) country-cohort specific unemployment rate, employment rate, and labour force participation rate, respectively. As shown, adding these additional controls make little difference to our main results. Panel B presents the corresponding analysis based on the stayers sample.

Next, we investigate whether the wage responses to RER differs by demographic groups (Table 4). The first two columns in Panel A suggest that the wage response to RER is concentrated among men, while being smaller and statistically insignificant among women.<sup>26</sup> In terms of age groups, we find the same pattern among younger and older workers. Given the large share of individuals with missing education information, column 5 excludes those for whom this information is not recorded. The estimates in column 6 are based on a sample in which observations with missing education information are retained, but those individuals with college education are excluded. The results in columns 5 and 6 suggested that the RER effect on entry wages is stronger for “higher skilled” (i.e. those with college or non-missing education) immigrants. Very similar patterns are also found for the sample of stayers (Panel B).

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RER. In particular, when regressing “stayer” on the time-of-arrival RER while conditioning on country FE and year FE, we do not find any significant relation.

<sup>26</sup> Based on the 2011-2016 waves of the German Socio-Economic Panel (GSOEP), we find that among immigrants from Poland, the Czech Republic, Slovakia and Hungary, males have a 6-7 percentage point higher likelihood of reporting to have a child or spouse abroad than females, in line with the typical migration pattern, where the husband arrives first, and the wife follows (Table A9). This may partly explain the gender difference in the responsiveness of entry wages to the RER in this context. However, this gender difference may not be generalizable to other contexts since in the US analysis (section 4.5), we do not find strong heterogeneity by gender.



#### 4.4 Mechanisms of wage adjustments

Estimates in Table 3 show that immigrants arriving in Germany at a high RER initially settle for lower wages than those arriving at a low RER, but that their wages converge in subsequent years. We now examine what drives this convergence, by investigating firm and occupational mobility of immigrant workers in the 2<sup>nd</sup> or 3<sup>rd</sup> year after migration. To isolate the patterns of mobility without convolution with compositional changes, we focus on the sample of stayers for this analysis. In particular, we estimate a variant of equation (3), where the dependent variable is a dummy indicating a worker's mobility status along various dimensions. Estimates are presented in Table 5. Defining "job change" as a change in firm and/or occupation (as compared to the previous year), results in column 1 show that those who arrive at a higher RER (and thus accept on average a lower wage) exhibit overall more job mobility than those who arrive at a lower RER. Breaking these job changes down into their various components, columns 2 and 3 show that high RER arrivals are not only more likely to change firms but are also more likely to move to a better paying firm than their initial employer. Those arriving with a 10 percent higher RER (about 1 SD of log RER in the sample) have a 2.8 percentage point higher probability of moving to a better paying firm in both year two and three after their arrival, which amounts to 20 percent (0.028/0.14) of the mean probability for moves of this type. Thus, mobility across firms contributes to explaining the wage catch up we illustrate in Table 3.

We also examine the role of occupational mobility and upgrading in the wage trajectories of immigrants. To this end, we rank three-digit occupations by their average wages (after accounting for calendar year FE), and then construct an indicator variable that equals one if an individual has changed from a lower to a higher paying occupation in the previous year. Estimates in column 4 show that high RER arrivals are significantly more likely than low RER

arrivals to change occupations in the second year after arrival. Moreover, they are also more likely to move to occupations that pay higher wages than their initial occupation, with those arriving at 10 percent higher RER having a 2.2 percentage point (or 28 percent of the mean) higher probability of changing to a better paying occupation in year 2 (as shown in column 5). Results in columns 6 and 7 suggest that most of the occupational upgrading occurs when individuals change firms, although there is some evidence of within-firm occupational upgrading in the second year after arrival. Thus, changing to better paying firms and occupations seem an important mechanism that explains the catching up of high RER arrivals to the wages of low RER arrivals.

#### **4.5 Evidence for the US**

Our analysis has thus far focused on Eastern European immigrants in Germany, allowing us to use longitudinal administrative data to precisely determine immigrants' first spells in the German labour market as well as follow individuals over time. To investigate whether the pattern we find in the German data also hold elsewhere, we conduct a similar analysis for the US, drawing on data from the American Community Survey (ACS).<sup>27</sup>

Results in Table 6 are based on regressions as in equation (3), where RER and real GDP per capita are all relative to the US. We first report estimates for the full sample (columns 1 and 2). After that, to bring this analysis closer to the setting we have in the German analysis, we also report results based on a sub-sample of countries where the average RER (over the period considered in the analysis) is greater than 1 (columns 3 and 4). The first column reports

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<sup>27</sup> Unlike our data on Germany, the ACS data does not allow us to follow the same workers over time. Therefore, when studying the dynamic effect of the time-of-arrival RER on immigrant wages over time, we cannot eliminate composition effects arising due to attrition or selective out-migration, or account for unobserved compositional differences in migration cohorts.

the average effect of the time-of-arrival RER on log wages during the first three years in the US, similar to our estimates in column 5 of Table 2, while column 2 allows the effect of (time-of-arrival) RER to vary over time after arrival. The elasticity of wages over the first three years with respect to the time-of-arrival RER is -0.096, smaller than the corresponding elasticity for Germany. However, the variation in RER relevant for immigrants in the US is greater than that for immigrants in Germany. In particular, the estimates in column 1 imply that a one SD increase in the log RER (0.45) leads to a 4.3 percent reduction in the wage level accepted by immigrants in their first three years after migration to the US (Cf. 2.4 percent reduction for immigrants in Germany, column 5 of Table 2). Column 2 shows that, when allowing for the effect of the initial RER to vary across the three years, point estimates are slightly larger in the first year after migration but decline by year 3.

In columns 3 and 4, we focus on the subsample of immigrants from countries with a lower price level than the US, which constitutes about 88 percent of the sample on which estimates in the first two columns are based. For this sample, the effect of the RER on initial wages is larger, with an elasticity of wages over the first three years with respect to the time-of-arrival RER being equal to -0.125, and the elasticity for the first year alone being -0.167. Moreover, the estimate for year three is only half the size of the year 1 estimate, suggesting a narrowing in the initial wage gap by the third year.

Overall, our findings for the US are qualitatively in line with those for Germany, suggesting that the time-of-arrival RER matters in determining new immigrants' reservation wages and thereby their observed wages in their first employment spells. Moreover, there is some evidence that these differentials tend to shrink over time in the US as well, although these results need to be interpreted with care, as we are not able to control for changes in composition and selective outmigration with the ACS data.

## 5. Interpretation of Immigrant Cohort Effects

One implication of our findings is that immigrants from countries in which the real price is lower (relative to the host country) will on average accept lower entry wages than immigrants from high price countries. Therefore, if the composition—in terms of countries of origin—of entry cohorts changes over time, with an increasing proportion of new arrivals coming from countries with relatively low real price levels, then average entry wages of immigrants should decrease over time, which will be picked up as cohort effects when estimating immigrants' wage equations.

Following this line of argument, we add a new perspective to the debate surrounding some of the most influential studies in the literature on immigrant assimilation. In his response to Chiswick's (1978) paper on the assimilation of immigrants, Borjas (1985) shows that the entry wages of immigrants arriving in the US declined between the 1960s/1970s and the 1980s/1990s (see also Borjas 1995, 2015). He attributes this to a decline in the “quality” of immigrant cohorts arriving in the US following the Immigration and Naturalization Act of 1965 that abolished the quota system based on national origin, shifting the composition of new arrivals from mainly European countries and Canada to South America and Asia.

However, this compositional change also led to changes in the RER between origin countries and the US. Figure 2, where we plot the mean RERs applicable for different arrival cohorts, illustrates a sharp increase in the RER from the 1970 to the 1990 censuses, and a small decrease in the subsequent decades. Hence, the decline in immigrants' entry wages for cohorts arriving in the 1980s and 1990s as illustrated in Borjas (1985, 1995) may in part be driven by the higher purchasing power of the US dollar applicable for these cohorts (who originate predominantly from lower price countries) and their correspondingly lower reservation wages. To investigate this conjecture, we plot in Figure 3 the residual entry wages (after controlling

for demographic characteristics) of immigrants relative to natives in the 1970-2010 censuses against the RER prevailing upon their entry. In line with our analysis above, the figure suggests that immigrants arriving when the RER between the US and their country of origin is high earn lower entry wages upon their arrival, even after controlling for key socio-demographic characteristics.

Next, we present, in Table 7, estimates of immigrant cohort effects based on the 1970-2010 censuses and simple regression models following Borjas (1985). Specifically, we pool immigrants and natives, and report immigrant cohort effects relative to the 1965-1970 arrival cohorts (i.e. those from the 1970 census).<sup>28</sup> All regressions include census year FE (common to both immigrants and natives). Demographic controls include years of schooling (education), a quadratic in potential labour market experience (i.e.  $\text{age} - \text{education} - 6$ ), a disability indicator, and marital status, whose effects are all allowed to differ between immigrants and natives. Columns 1 and 2, measuring the change in cohort effects between the 1970 and subsequent arrival cohorts, illustrate a strong deterioration in entry wages for those arriving in 1980 and 1990. After controlling for demographic characteristics (column 2), entry wages for the 1980 and 1990 immigrant cohorts are 11 percent lower than for the 1970 cohort. The difference in cohort effects declines (and nearly disappears) for arrival cohorts 2000 and 2010 after controlling for demographic characteristics. This pattern broadly follows the evolution of the average RER applicable for the different arrival cohorts (Figure 2), which increases sharply for the 1980 and 1990 cohorts in comparison to the 1970 cohort while declining thereafter.

Once we account for the RER (columns 3 and 4), the decline in immigrant wages of each subsequent cohort with respect to the 1970 cohort is far less pronounced. We visualize

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<sup>28</sup> As we explain above, for census waves up until 2000, arrival cohorts are reported in 5-year intervals (i.e. whether a respondent arrived within the 5 years prior to the year of census), so that census year 1970 includes 1965-1970 arrival cohorts, census year 1980 includes 1975-1980 arrival cohorts, etc.

these effects in Figure 4, where we plot the cohort effects from both columns 2 (without RER) and 3 (with RER) of Table 7. The graphs illustrate that the increase in the conditional entry wage gaps between natives and immigrants in 1975-1980 arrivals (relative to 1965-1970 arrivals) becomes more nuanced (-0.107 to -0.072) once we condition on the RER, and similarly for the 1985-1990 arrivals.

Overall, this analysis suggests that the observed decline in the entry wages of the 1980 and 1990 cohorts as documented in the influential studies of Borjas (1985, 1995) may at least in part be driven by these cohorts' *behavioural responses* (i.e. reservation wages) to the favourable RER applicable for them, and not be entirely due to their lower *innate quality* (i.e. fixed labour market traits). These findings do not change the fundamental insight of Borjas' (1985, 1995) work, but they provide an additional new angle to the *interpretation* of the well-known immigrant cohort effects.

## 6. Conclusions

The premise that some immigrants may have lower reservation wages than comparable natives or other immigrants is commonly invoked in analyses of immigration yet there is scant evidence on that. To fill this gap, we propose the real price differences between the host and source regions as one possible driver of their reservation wages and find evidence consistent with the hypothesis. In particular, exploiting the accession of eight Central and Eastern European countries (A8) to the EU in 2004 together with longitudinal administrative data from Germany, we find an elasticity of entry wages with respect to the real exchange rate (RER) of about -0.3 in the year of arrival, meaning that a 10 percent increase in the RER (roughly 1 SD of log RER in the sample) leads to a decrease in the accepted wages of around 3 percent in the

first year in Germany. In subsequent periods, however, wages of high RER arrivals catch up to that of their low RER counterparts. Our findings thus suggest an important source of immigrant downgrading (Eckstein and Weiss 2004; Dustmann et al. 2013), with implications for policy debates over such issues as immigrants' undercutting of native wages (Edo and Rapoport 2019) and immigration restrictions as active labour market policy for natives (Clemens et al. 2018).

Further, our analysis also adds a new perspective for interpreting immigrant cohort effects. Using US census data, we show that the declining cohort quality documented in Borjas (1985, 1995)'s influential studies may reflect, at least in part, the *behavioural responses* of later arrival cohorts to the prevailing real price differences between the US and their home countries, rather than their *innate* labour market characteristics alone. While not affecting the key insights of Borjas, our results add an additional interpretation of the observed decline in entry wages, with further implications for immigrant wage growth in the first years after arrival.

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Table 1: Descriptive statistics

	<i>All</i> (1)	<i>Stayers</i> (2)
Log daily wage	3.90 (0.46)	3.96 (0.46)
Age	34.10 (10.34)	34.34 (10.11)
Female	0.33	0.34
Education:		
Low	0.14	0.13
Middle	0.27	0.32
High	0.07	0.09
Missing	0.52	0.45
Real exchange rate (RER) between Germany and origin country	1.77 (0.14)	1.77 (0.14)
Real GDP per capita of origin country relative to Germany	0.53 (0.05)	0.53 (0.05)
Obs.	16,361	11,491
Unique persons	8,085	4,323

Notes: Mean is reported with standard deviation in parentheses. Sample includes full-time employees aged 16 to 65, entering the German labor market between 2004 and 2012. "Stayers" are individuals with a total migration duration of at least 3 years. Skill level in the table refers to the maximum educational attainment observed in the data. Data sources: Sample of Integrated Labor Market Biographies (SIAB) provided by the German Federal Employment Agency (IAB). Data on real exchange rates and real GDP per capita relative to Germany come from the 2011 round of the World Bank's World Development Indicators database.

Table 2: Real exchange rates and the entry wages of immigrants

	Log daily wage				
	(1)	(2)	(3)	(4)	(5)
Log RER: initial	-0.431** (0.187)	-0.301* (0.164)	-0.313* (0.176)	-0.273*** (0.089)	-0.241** (0.091)
Log GDP pc: initial			0.563*** (0.180)	0.449*** (0.123)	0.281 (0.198)
Demographic controls	Y	Y	Y	Y	Y
Country FE		Y	Y	Y	
Year FE		Y	Y	Y	
YSM FE				Y	Y
Country*Year FE					Y
R2	0.12	0.15	0.16	0.22	0.22
Number of unique individuals	8,085	8,085	8,085	8,085	8,085
Obs.	8,085	8,085	8,085	16,361	16,361

Notes: Sample includes individuals in the first year since migration in columns 1 through 3, and those in year 1, 2 or 3 since migration in column 4. YSM is a year-since-migration indicator variable. Demographic controls include a gender indicator, a quadratic in age, and a dummy for each education category, with missing education as one of the categories. Standard errors clustered by country-cohort in parentheses. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01

Table 3: Real exchange rates and wage dynamics over time

	Log daily wage			
	<i>A. All</i>		<i>B. Stayers</i>	
	(1)	(2)	(3)	(4)
YSM 1 * Log RER: initial	-0.339*** (0.087)		-0.335*** (0.097)	
YSM 2 * Log RER: initial	-0.172* (0.101)	0.126* (0.072)	-0.260** (0.100)	0.220*** (0.078)
YSM 3 * Log RER: initial	0.082 (0.148)	0.263* (0.143)	-0.022 (0.141)	0.411*** (0.149)
Demographic controls	Y	Y	Y	Y
Country*Year FE	Y	Y	Y	Y
YSM FE	Y	Y	Y	Y
Log GDP pc: initial*YSM FE	Y	Y	Y	Y
Individual FE		Y		Y
R2	0.22	0.91	0.24	0.89
Number individuals	8,085	8,085	4,323	4,323
Obs.	16,361	16,361	11,491	11,491

Notes: Sample includes individuals in year 1, 2, or 3 since migration. Columns 3 and 4 restrict the sample to individuals with a migration duration of at least 3 years. YSM is a year-since-migration indicator variable. Demographic controls include a gender indicator, a quadratic in age, and a dummy for each education category, with missing education as one of the categories. Standard errors clustered by country-cohort in parentheses. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01

Table 4: Heterogeneity and robustness

	Log daily wage					
	Male	Female	Age≤35	Age>35	No missing educ.	No college educ.
	(1)	(2)	(3)	(4)	(5)	(6)
<i>A. All</i>						
YSM 1 * Log RER: initial	-0.526*** (0.090)	-0.048 (0.183)	-0.374*** (0.116)	-0.418* (0.210)	-0.603*** (0.162)	-0.328*** (0.061)
YSM 2 * Log RER: initial	-0.218** (0.088)	-0.035 (0.185)	-0.173 (0.134)	-0.251 (0.171)	-0.183 (0.143)	-0.192*** (0.066)
YSM 3 * Log RER: initial	0.200 (0.158)	-0.081 (0.224)	0.010 (0.157)	0.160 (0.196)	0.122 (0.188)	0.092 (0.102)
Mean of D.V.	3.95	3.81	3.90	3.91	3.84	3.86
R2	0.19	0.24	0.24	0.19	0.12	0.13
Number individuals	5,417	2,668	5,093	3,217	4,588	7,616
Obs.	10,989	5,372	9,974	6,387	8,536	15,160
<i>B. Stayers</i>						
YSM 1 * Log RER: initial	-0.512*** (0.106)	-0.074 (0.212)	-0.476*** (0.125)	-0.285 (0.244)	-0.564*** (0.163)	-0.275*** (0.073)
YSM 2 * Log RER: initial	-0.277*** (0.084)	-0.153 (0.182)	-0.291* (0.146)	-0.330 (0.208)	-0.256* (0.144)	-0.268*** (0.083)
YSM 3 * Log RER: initial	0.174 (0.167)	-0.236 (0.221)	-0.146 (0.200)	0.086 (0.248)	0.016 (0.144)	-0.011 (0.099)
Mean of D.V.	4.01	3.85	3.96	3.95	3.90	3.91
R2	0.20	0.26	0.26	0.21	0.13	0.14
Number individuals	2,802	1,521	2,733	1,590	1,949	3,934
Obs.	7,599	3,892	6,934	4,557	5,200	10,422
Log GDP pc: initial*YSM FE	Y	Y	Y	Y	Y	Y
YSM FE	Y	Y	Y	Y	Y	Y
Country*Year FE	Y	Y	Y	Y	Y	Y
Demographic controls	Y	Y	Y	Y	Y	Y

Notes: Sample includes individuals in year 1, 2, or 3 since migration. In panel B, the sample is restricted to those with total migration duration of at least 3 years. YSM is a year-since-migration indicator variable. Demographic controls include a gender indicator, a quadratic in age, and a dummy for each education category, with missing education as one of the categories. Standard errors clustered by country-cohort in parentheses. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01

Table 5: Mechanisms of wage adjustments

D.V.	Job change	Firm change	Move to a better paying firm	Change occupation	Occ. upgrading	Occ. upgrading & firm change	Occ. upgrading within firm
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
YSM 2 * Log RER: initial	0.310*** (0.072)	0.227** (0.084)	0.288*** (0.066)	0.143* (0.074)	0.223*** (0.058)	0.139** (0.053)	0.084** (0.037)
YSM 3 * Log RER: initial	0.156 (0.098)	0.146 (0.109)	0.281*** (0.096)	0.068 (0.078)	0.194** (0.077)	0.128* (0.070)	0.066 (0.053)
Mean of D.V.	0.25	0.22	0.14	0.16	0.08	0.07	0.01
Number individuals	3,900	3,900	3,797	3,742	3,742	3,742	3,742
Obs.	7,168	7,168	6,956	6,528	6,528	6,528	6,528
Log GDP pc: initial*YSM FE	Y	Y	Y	Y	Y	Y	Y
YSM FE	Y	Y	Y	Y	Y	Y	Y
Country*Year FE	Y	Y	Y	Y	Y	Y	Y

Notes: Sample of stayers; includes individuals in year 2 or 3 since arrival to Germany. The sample is restricted to those with a migration duration of at least 3 years. All regressions include the following demographic controls: gender, quadratic in age, and dummy for each education category with missing education as one of the categories. Standard errors clustered by country-cohort in parentheses. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table 6: Real exchange rates and accepted wages among immigrants in the US

	Log hourly wage			
	All Countries		Countries with RER>1	
	(1)	(2)	(3)	(4)
Log RER: initial	-0.096*		-0.125**	
	(0.055)		(0.060)	
YSM 1 * Log RER: initial		-0.110**		-0.167***
		(0.055)		(0.057)
YSM 2 * Log RER: initial		-0.100*		-0.124**
		(0.055)		(0.058)
YSM 3 * Log RER: initial		-0.083		-0.084
		(0.058)		(0.062)
Demographic controls	Y	Y	Y	Y
Country*Year FE	Y	Y	Y	Y
YSM FE	Y	Y	Y	Y
Log GDP pc: initial	Y		Y	
Log GDP pc: initial*YSM FE		Y		Y
R2	0.31	0.31	0.27	0.27
Obs.	81,957	81,957	72,326	72,326
Std.dev. Log RER	0.45	0.45	0.35	0.35
Mean of D.V.	2.31	2.31	2.24	2.24

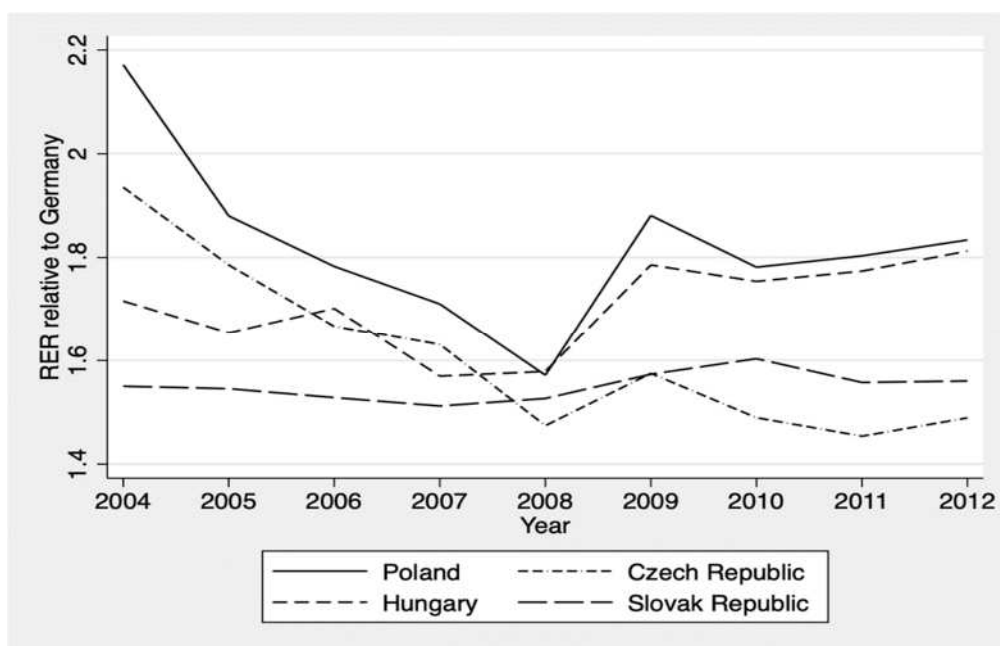
Notes: Sample consists of immigrants arriving to the US between 2004 and 2014. We restrict the sample to all immigrants aged 16-65 in full-time employment in year 1, 2 or 3 in the US. In columns 3-4 we focus on those from countries with lower price levels than the US. We drop immigrants from small countries with country-cohort cells containing fewer than 20 observed immigrants. Demographic controls include a gender indicator, a quadratic in age, and years of education. Standard errors clustered by country-cohort in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 7: Cohort effects among immigrants in US censuses 1970-2010

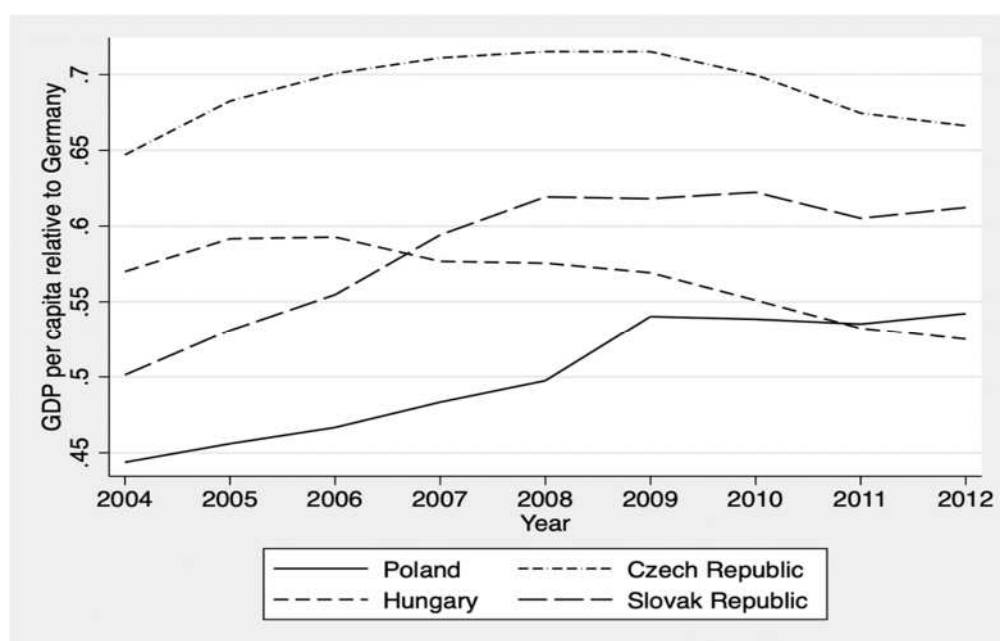
	Log weekly wage			
	(1)	(2)	(3)	(4)
log(RER)			-0.298***	-0.232***
			(0.101)	(0.081)
Immigrant * census year 1980	-0.171***	-0.107***	-0.072**	-0.065*
	(0.043)	(0.026)	(0.033)	(0.034)
Immigrant * census year 1990	-0.224***	-0.111***	-0.032	-0.032
	(0.072)	(0.039)	(0.044)	(0.045)
Immigrant * census year 2000	-0.163	-0.008	0.056	0.058
	(0.106)	(0.054)	(0.072)	(0.073)
Immigrant * census year 2010	-0.172*	-0.058	0.004	0.004
	(0.090)	(0.054)	(0.076)	(0.073)
Census year FE	Y	Y	Y	Y
Demographic controls		Y	Y	Y
Log GDP pc				Y
R2	0.007	0.190	0.191	0.191
Obs.	7,969,464	7,969,464	7,968,719	7,968,719

Notes: Reference category is census year 1970. For each census year, we include immigrants who arrived in the US in the last five years such that census year 1970 includes 1965-1970 arrival cohorts, census year 1980 includes 1975-1980 arrival cohorts, etc. We also include US natives from each census. Demographic controls include a quadratic in labor market experience, education, marital status and disability status. Controls are interacted with an immigrant indicator. Standard errors clustered by country in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Figure 1: Real exchange rates (RER) and GDP per capita relative to Germany



(a) RER relative to Germany

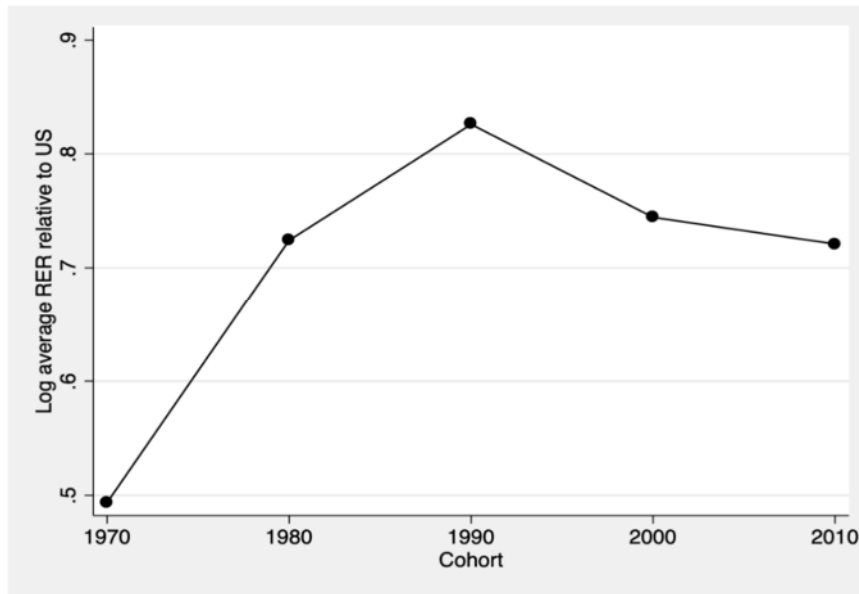


(b) GDP per capita relative to Germany

Notes: Real exchange rates (RER) between Germany and the origin country, and real GDP per capita of each country relative to Germany are plotted. Data sources: The World Bank International Comparison Program (ICP) 2011 round.

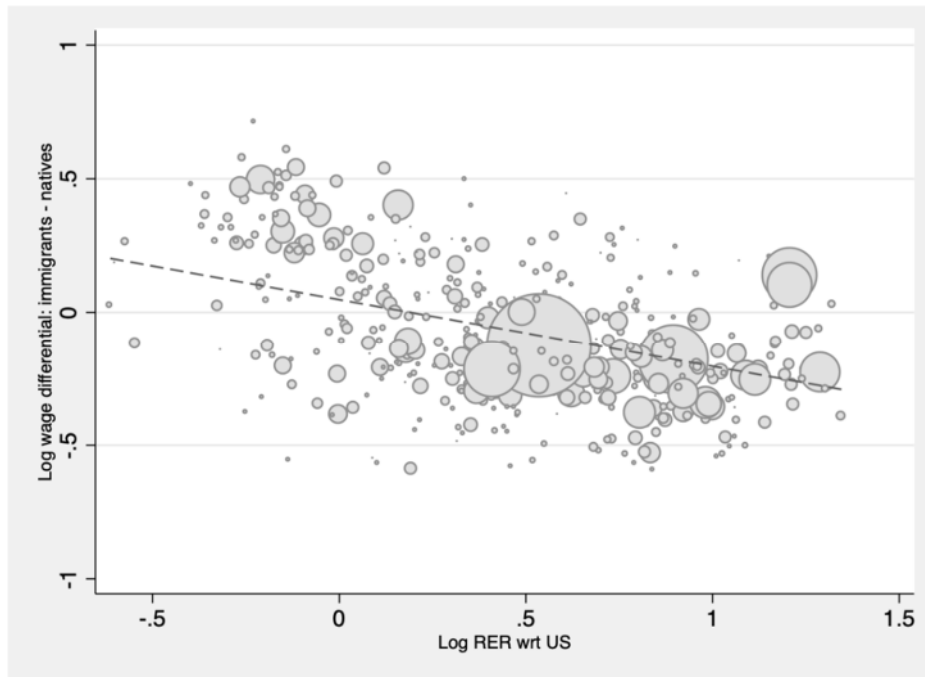


Figure 2: Average RER, different arrival cohorts of immigrants in the US data



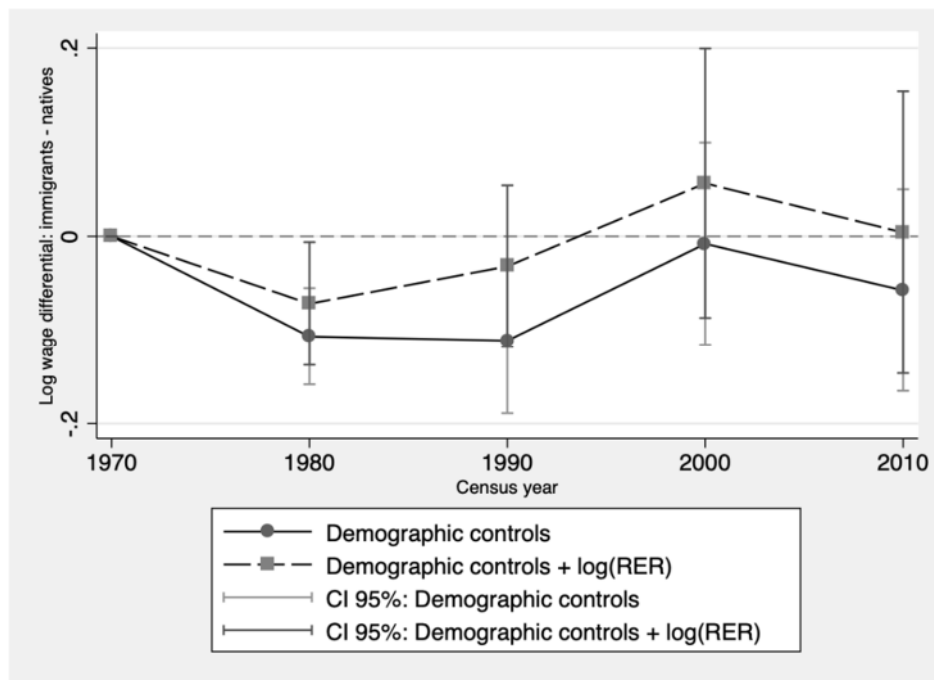
Notes: RER data comes from the Penn World Tables. The weights are computed using 1970 to 2000 waves of the US Population Census and 2009 to 2011 waves of the American Community Survey. Cohort refers to immigrants arriving in the 5 years prior to each census year. Average RER is computed by first taking the average over the arrival years for each country of origin and then taking the average across countries of origin for each census year.

Figure 3: Residual wage and real exchange rate, 1965-2010 arrival cohorts



Notes: The figure represents 452 country-by-cohort combinations. The underlying sample consists of men aged 25-64, observed in 1970-2000 census years and the 2009-2011 waves of the American Community Survey. The wage differential is calculated between immigrants who arrived in the 5 years prior to each census year and native workers after controlling for a quadratic in labor market experience, education, marital status and disability status, all interacted with an immigrant indicator. The regression coefficient (standard error) is -0.251 (0.080).

Figure 4: Cohort effects, immigrants in the US



Notes: The underlying sample consists of men aged 25-64, observed in 1970-2000 census years and 2009-2011 American Community Survey waves. The wage differential is calculated between immigrants who arrived in the 5 years prior to each census year and native workers after controlling for a quadratic in labor market experience, education, marital status and disability status, all interacted with an immigrant indicator. The dashed line also includes log RER as an additional control.

## Appendix A: Additional Tables and Figures

Table A1: Descriptive statistics, US sample

	All Countries (1)	Countries with RER>1 (2)
Log hourly wage	2.31 (0.79)	2.24 (0.76)
Age	32.94 (9.97)	32.62 (10.01)
Female	0.34	0.34
Years of Education	12.93 (4.41)	12.55 (4.48)
Real exchange rate (RER) between the US and origin country	2.16 (0.93)	2.34 (0.85)
Real GDP per capita of origin country relative to the US	0.30 (0.23)	0.23 (0.15)
Number of countries	53	43
Obs.	81,957	72,326

Notes: Mean is reported with standard deviation in parentheses. We restrict the sample to individuals aged 16-65 in full-time employment who have migrated to the US less than 3 years ago. We exclude the self-employed and those in armed forces. We focus on country (of origin)-year cells with at least 20 immigrants. In column 2, we further restrict the sample to immigrants from countries with lower price levels than the US. Data sources: 2005-2017 waves of the American Community Survey from IPUMS.

Table A2: Sample for analysis of cohort effects in the US

	Immigrants (1)	Natives (2)
Log weekly wage	6.17 (0.83)	6.56 (0.71)
Age	35.36 (8.90)	41.73 (10.85)
Married	0.56 (0.50)	0.71 (0.45)
Years of education	12.17 (4.95)	13.18 (2.77)
Real exchange rate (RER) r.t. US	2.15 (1.21)	
Real GDP per capita r.t. US	0.27 (0.22)	
Obs.	149,398	7,820,066

Notes: Mean is reported with standard deviation in parentheses. Sample includes employed men aged 25 to 65. Sample includes immigrant entry cohorts 1965-1970, 1975-1980, 1985-1990, 1995-2000, and 2005-2010. Data sources: US census 1970, 1980, 1990 and 2000, and 2009-2011 waves of the American Community Survey provided by IPUMS. Real exchange rates and real GDP per capita relative to the US come from the Penn World Table.

Table A3: Role of lagged RER

	Log daily wage			
	(1)	(2)	(3)	(4)
Log RER: initial	-0.241** (0.091)	-0.245** (0.098)	-0.241*** (0.084)	-0.244** (0.093)
Log RER: lag 1		0.024 (0.079)		0.016 (0.080)
Log RER: lag 2			-0.039 (0.097)	-0.037 (0.099)
Number individuals	8,085	8,086	8,087	8,088
Obs	16,361	16,362	16,363	16,364
Demographic controls	Y	Y	Y	Y
Country*Year FE	Y	Y	Y	Y
YSM FE	Y	Y	Y	Y
Log GDP pc: initial	Y	Y	Y	Y

Notes: Column 1 replicates column 5 of Table 2, where we assign the RER prevailing in year  $t$  as the relevant RER for cohorts arriving in  $t$ . In columns 2 and 3, we additionally include the lagged RER from years  $t-1$  and  $t-2$ , respectively, while column 4 includes both. Sample includes individuals in the first three years since migration. YSM is a year-since-migration indicator variable. Demographic controls include a gender indicator, a quadratic in age, and a dummy for each education category, with missing education as one of the categories. Standard errors clustered by country-cohort in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table A4: Time-of-arrival RER and labor market characteristics of individuals

	Log RER			
	A. All		B. Stayers	
	(1)	(2)	(3)	(4)
Female	0.0007 (0.0006)	0.0007 (0.0005)	0.0008 (0.0011)	0.0008 (0.0011)
Age≤35	-0.0004 (0.0006)	-0.0005 (0.0006)	-0.0002 (0.0008)	-0.0001 (0.0007)
Low skilled	0.0013 (0.0009)	0.0014 (0.0009)	0.0006 (0.0009)	0.0006 (0.0009)
High skilled	0.0011 (0.0019)	0.0010 (0.0016)	-0.0011 (0.0020)	-0.0011 (0.0017)
Missing education	0.0003 (0.0006)	0.0004 (0.0006)	-0.0007 (0.0007)	-0.0007 (0.0008)
F-stat	0.69	0.60	0.46	0.47
P-value	0.637	0.702	0.800	0.799
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Log GDP		Y		Y
R2	0.89	0.89	0.89	0.89
Obs.	8,085	8,085	4,323	4,323

Notes: Sample includes individuals in the year of their arrival to Germany. In columns 3 and 4, the sample is restricted to individuals with migration duration of at least 3 years. Standard errors clustered by country-cohort in parentheses. F-statistic and p-value refers to the testing of the joint significance of gender, age, and education variables reported in the regressions. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table A5: Real exchange rates and immigrant inflows

	Log inflow of immigrants			
	(1)	(2)	(3)	(4)
Log RER	0.461 (1.238)	0.622 (0.672)	0.527 (1.278)	0.472 (0.705)
Log GDP pc		-4.741*** (0.590)		-4.424*** (0.575)
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
R2	0.964	0.991	0.974	0.993
Obs.	36	36	36	36

Notes: The outcome variable is a number of workers from Poland, Hungary, Czech Republic and Slovak Republic for the period 2004-2012 in their initial year in Germany in the SIAB 2% sample. Columns 3 and 4 are weighted by the population size of each country in the 2001 census. Robust standard errors in parentheses. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01



Table A6: Average wages by select occupations in Germany and Poland in 2004

Occupation	Wage Germany	Wage Poland	Relative wage (Pol/Ger)
Land workers	1491.6	787.15	0.53
Gardeners, garden workers	1776	1046.74	0.59
Cooks	1656.9	918.16	0.55
Waiters, stewards and other attendants	1438.5	847.46	0.59
Office specialist	2657.1	1183.22	0.45
Stores, transport workers	2188.2	1120.15	0.51
Salespersons	1863.3	874.75	0.47
Motor vehicle drivers	2136	1283.67	0.60
Landlords, agents, auctioneers	2513.7	937.75	0.37
Other housekeeping attendants	1338	781.45	0.58
Nurses, midwives	2609.4	1112.55	0.43
Builders	1943.1	961.28	0.49
Household cleaners	1285.8	952.63	0.74
Electrical fitters, mechanics	2594.7	1342.39	0.52
Data processing specialists	3795.3	1205.68	0.32
Packagers, goods receivers, despatchers	2028.3	904.79	0.45
Metal workers	2467.2	1281.74	0.52

Notes: Gross monthly earnings of native workers for select occupations in Germany and Poland are reported for the year 2004. The last column shows the relative wages of Poland to that in Germany. The wage data come from Sample of Integrated Labor Market Biographies (SIAB) for Germany and the Labor Force Survey (LFS) for Poland. For Germany, the monthly wage is imputed by multiplying a daily wage by 30. For Poland, the gross wage is imputed from the net wage and the corresponding tax structure.

Table A7: Controlling for the inflow or stock of co-nationals

	Log daily wage			
	(1)	(2)	(3)	(4)
Log RER: initial	-0.313*	-0.289*	-0.316*	-0.316*
	(0.176)	(0.167)	(0.177)	(0.177)
Log inflow: same, Germany		-0.059		
		(0.051)		
Log inflow: same, district			-0.001	
			(0.007)	
Log stock: same, district				-0.001
				(0.006)
Demographic controls	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Log GDP pc: initial	Y	Y	Y	Y
Obs.	8,085	8,085	8,085	8,085

Note: Sample includes individuals in the first year since migration. Demographic controls include gender indicator, quadratic in age, and dummy for each education category with missing education as one of the categories. Column 1 replicates the estimates from column 3 of Table 2. Column 2 controls for the inflow of immigrants arriving to Germany from the same country of origin in each year. Columns 3 and 4 include the inflows and stock, respectively, of immigrants from the same country of origin in the same district in each year. Standard errors clustered by country-cohort in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table A8: Real exchange rates and wage dynamics over time: with additional controls

	Log daily wage			
	(1)	(2)	(3)	(4)
<i>A. All</i>				
YSM 1 * Log RER: initial	-0.339*** (0.087)	-0.426*** (0.140)	-0.465*** (0.119)	-0.293** (0.112)
YSM 2 * Log RER: initial	-0.172* (0.101)	-0.265** (0.121)	-0.233** (0.103)	-0.156 (0.108)
YSM 3 * Log RER: initial	0.082 (0.148)	0.017 (0.164)	0.046 (0.143)	0.105 (0.160)
R2	0.22	0.22	0.22	0.22
Number individuals	8,085	8,085	8,085	8,085
Obs.	16,361	16,361	16,361	16,361
<i>B. Stayers</i>				
YSM 1 * Log RER: initial	-0.335*** (0.097)	-0.553*** (0.149)	-0.546*** (0.116)	-0.326** (0.128)
YSM 2 * Log RER: initial	-0.260** (0.100)	-0.434*** (0.129)	-0.371*** (0.094)	-0.267** (0.118)
YSM 3 * Log RER: initial	-0.022 (0.141)	-0.131 (0.146)	-0.073 (0.128)	-0.028 (0.147)
R2	0.24	0.24	0.24	0.24
Number individuals	4,323	4,323	4,323	4,323
Obs.	11,491	11,491	11,491	11,491
Demographic controls	Y	Y	Y	Y
Country*Year FE	Y	Y	Y	Y
YSM FE	Y	Y	Y	Y
Log GDP pc: initial*YSM FE	Y	Y	Y	Y
Unempl.: initial*YSM FE		Y		
Empl.: initial*YSM FE			Y	
LFP: initial*YSM FE				Y

Notes: Sample includes individuals in year 1, 2, or 3 since migration. In panel B, the sample is restricted to those with total migration duration of at least 3 years. YSM is a year-since-migration indicator variable. Demographic controls include a gender indicator, a quadratic in age, and a dummy for each education category, with missing education as one of the categories. In column 2, we control for the unemployment rate in the country of origin prevalent at arrival interacted with years-since-migration fixed effect. In column 3, we control for the employment rate in the origin country at arrival interacted with the year-since-migration fixed effect. In column 4, we control for the labor force participation rate in the origin country at arrival interacted with the year-since-migration fixed effect. Standard errors clustered by country-cohort in parentheses. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01

Table A9: Share of respondents who report having either a child or a spouse abroad

	Male	Female	Difference
	(1)	(2)	(3)
<i>A: All</i>			
Family lives abroad	0.0932	0.0277	0.0655 (0.0120)
Obs.	590	866	
<i>B: Entry cohorts 2004-2012</i>			
Family lives abroad	0.1059	0.0287	0.0772 (0.0249)
Obs.	170	209	

Notes: Sample includes immigrants from Poland, Czech Republic, Slovakia and Hungary in the German Socio-Economic Panel, 2011-2016 waves. This table reports the share of male and female respondents who report having either a child or a spouse abroad, and the difference between gender. Panel A includes all respondents while panel B restricts the sample to individuals who arrived in Germany between 2004 and 2012. Standard error of the difference is reported in parentheses in column 3.

## Appendix B: Putting the Estimated Wage Elasticity in Perspective

According to our calculation based on the German Socio-Economic Panel (waves 2011 to 2016 including immigrant supplement), immigrants from A8 countries who arrived in Germany between 2004 and 2012 saved or remitted about 16-18 percent of their monthly net income. This means that the effective consumption that immigrants can derive from a wage  $w$  is roughly equal to:

$$0.83w + 0.17w \times RER.$$

Consider a 10% increase in the RER. Then, the effective consumption achievable from the same wage  $w$  would increase to:

$$0.83w + 0.17w \times 1.1RER.$$

Denote by  $w'$  the wage level required to maintain the same level of consumption as before under the higher RER such that

$$0.83w' + 0.17w' \times 1.1RER = 0.83w + 0.17w \times RER$$

or

$$\frac{w'}{w} = \frac{0.83 + 0.17 \times RER}{0.83 + 0.17 \times 1.1RER}. \quad (B1)$$

Evaluating (B1) at the mean RER between Germany and the origin countries for the years considered in our analysis, i.e. 1.77, we obtain

$$\frac{w'}{w} - 1 = -0.0259,$$

which means that for a 10% increase in RER, the wage can decrease by 2.6% in order to keep the effective consumption level constant. This is similar to what we estimate in our analysis (Table 2).