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THE EFFECT OF SKILLED EMIGRATION ON REAL EXCHANGE RATES THROUGH THE WAGE CHANNEL

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Abstract

Building on an analytical model, we provide cross-country empirical evidence that net skilled emigration appreciates bilateral real exchange rates through the wage channel in source countries. Chains of causality in the presence of the Law of One Price run through the “spending effect” and the “resource allocation effect,” analogous to the remittance-based Dutch disease effect. A pricing-to-market model allows pass-through for both traded and nontraded prices when the Law of One Price is violated. The skilled emigration elasticity of real exchange rate is estimated to be in the range of between .6 and .8, with internal prices playing a dominant role. Alternative model specifications show robust outcomes.

Keywords: emigration, exchange rate, the Dutch disease

JEL Classification: F22, F31

Contents

1. INTRODUCTION

A growing body of literature on the impact of emigration on source countries' wages suggests a positive effect (Mishra 2007; Aydemir and Borjas 2007; Bouton, Paul, and Tiongson 2010). The magnitude differs across schooling groups, and the most significant increase has been for the high-skilled stayers with 12 to 15 years of education, owing to a higher emigration rate from this group (Mishra and Topalova 2007). The positive wage effect of emigration also opens many important indirect general equilibrium questions. Could an increase in average wages pass through relative prices of nontraded goods and in turn affect real exchange rate movements? While studies show that the elasticity of domestic wages to real exchange rate ranges from .15 to .40 depending on the level of barriers to labor mobility (Mishra and Spilimbergo 2011), little is known on the reverse causality of this channel. This study examines whether the net skilled emigration affects bilateral real exchange rates in source countries through the wage channel.

As theory suggests, a reduction in the supply of labor because of out-migration is likely to increase the wages of those workers staying home. Studies provide empirical evidence both at the individual and regional or sector-specific wages. At an individual level, Mishra (2007), using the supply shifts in education-experience groups (Borjas 2003), finds that a 10% increase in emigration, on average, increases wages in Mexico by almost 4%. Other studies find similar evidence; Aydemir and Borjas (2007) on Mexico, Bouton, Paul, and Tiongson (2010) on Moldova, Elsner (2010) on Ireland, and Gagnon (2011) on Honduras all estimate wage elasticities of emigration between 1 to 4%.[1] Empirical findings on sector-specific wages are similar. Lucas (1987, 2005) finds that emigration of mine workers to South Africa has raised wages in Malawi and Mozambique. Similarly, Hanson (2006) finds that the average hourly earnings in regions with high emigration rates increased by 6 to 9%, compared to regions with low emigration rates in Mexico. We call this "labor supply shock" channel.

Moreover, Marjit and Kar (2005) argue that the return to capital could decline as a result of skilled emigration in a particular sector, and this could subsequently raise the wages in other (non-migrating) sectors. This implies that an acute emigration shock in the nontraded sector might drive wages up in a traded sector. We call this the "return to capital" channel of emigration. We postulate that skilled emigration produces an upward thrust on sector-specific (traded and nontraded) national average wages through both the "labor supply shock" channel and the "return to capital" channel. However, the relative effect on wages across traded and nontraded sectors depend on the relative strength of these pass-through channels.

With regards to the standard literature analyzing factors behind movements in real exchange rates, Engel's (1999) influential work showed that the traded goods component drives about 90% of the fluctuations in the US bilateral real exchange rates. Burstein, Eichenbaum, and Rebelo (2006) refute such findings on the grounds that the price of traded goods was measured using unsuitable proxies. In a comprehensive study of 1,225 country pairs over the period 1989–2005, Betts and Kehoe (2008) find that real exchange rate fluctuations tend to co-move much more strongly with internal prices when there are more intense trade relationships. Again, Ouyang and Rajan (2013), considering a panel of 51 economies over the period 1990–2010, find that internal relative prices contribute only 30 to 40% variation in real exchange rates. While

[1] Notable exceptions are Docquier, Özden, and Peri (2014) and Pryymachenko, Fregert and Andersson (2013), who fail to provide such evidence on OECD and EU countries, respectively.

such ambiguity persists, the questionable existence of the Law of One Price (LOOP) has also received much attention. If LOOP holds (Harrod-Balassa-Samuelson hypothesis), Canzoneri, Cumby, and Diba (1997) show that if the productivity of traded goods relative to nontraded goods grows faster at home rather than abroad, then the home country should experience a real exchange rate (RER) appreciation. Macdonald and Ricci (2005) find that the distribution sector plays a similar role in RER appreciation. However, studies (Heston, Rouwenhorst, and Wessels 1995; Eaton and Kortum 2001) also show that international deviations from the LOOP for traded and nontraded goods are of nearly the same magnitude. Closest to ours in spirit, an article by Alessandria and Kaboski (2011) deserves mention. Building on a pricing-to-market model based on cross-country productivity differences and search frictions, this study shows that international differences in wages account for almost 63% of the violation from absolute purchasing power parity.

Using a simple theoretical framework, we model two channels through which the effect of skilled emigration shock gets transmitted onto real exchange rates. The first channel is the relative price of traded to nontraded goods (or internal prices). In light of the Harrod-Balassa-Samuelson model, we argue that a higher wage resulting from skilled emigration in both sectors may induce “the spending effect” analogous to what we find in the remittance-based Dutch disease effect (Barajas et al. 2010). Assuming that there is no leisure-consumption trade-off, this enables households to spend extra on both traded and nontraded goods. If LOOP holds, then there is no change in prices of traded goods (price takers), but prices of nontraded goods go up as the domestic economy determine them. Since the relative prices move in favor of nontraded goods, this erodes the competitiveness of traded sectors, a phenomenon known as “resource allocation effect.” Both effects lead to a real exchange rate appreciation.

However, in this study, we allow for the failure of LOOP. The second channel borrows a pricing-to-market model based on international productivity differences and searches frictions similar to Alessandria and Kaboski (2011). The authors demonstrate the role of local wages in the price-setting behavior of firms. Unlike with the first channel, the pricing-to-market model allows pass-through for both external (relative prices of traded goods) and internal (relative price of traded to nontraded) prices assuming possible violations of LOOP. Assuming that an increase in net skilled emigration in the source country increases relative wages, and therefore prices, in favor of the home country, this makes traded goods in the home country less competitive compared to the foreign country and leads to an appreciation of real exchange rates. We postulate that these two mechanisms jointly appreciate real exchange rates, and the relative contribution of external and internal prices depends on the extent of the failure of LOOP and relative wage elasticity of skilled emigration across traded and nontraded goods sectors.

Building on this, we test the hypothesis of whether skilled emigration appreciates bilateral real exchange rates. We consider bilateral real exchange rates and its two price components as dependent variables. To identify the effect of skilled emigration on real exchange rates we use cross-country-pair variation in net skilled emigration. Variation in the net skilled emigration explains the net mean wage differences across country pairs, which in turn explains movements in bilateral RER. Two price components of RER, namely the external and internal prices, identify the price mechanism in explaining the movements in RER. We use the political quality index and the lagged growth rate of real GDP per capita in the source country as instruments to address a possible endogeneity bias between net skilled emigration and real exchange rates. Baseline outcomes indicate an appreciation of real exchange rates resulting from skilled emigration. The skilled emigration elasticity of real exchange rate is estimated to be in the range of between .6 and .8, with internal prices playing a stronger role in the external prices. The outcomes are robust across alternative model specifications. For developed-source countries, the pass-through external prices component is stronger, whereas for the developing-source country sample the internal price component makes a stronger contribution. Empirical findings on RER appreciation are robust across different levels of skilled emigration and alternative model specifications. Also, we also provide empirical evidence on the positive effect of skilled emigration on wages in the skilled migrant-sending countries.

To our knowledge, this is the first study that provides evidence of an appreciation of real exchange rates resulting from skilled emigration through the wage channel. Our paper can be linked to existing literature in the following ways. First, this study extends the remittance-based Dutch disease theory. We offer an alternative and a more robust explanation of the exchange rate movements related to international labor mobility.[2] Second, this paper makes an indirect contribution to our understanding of the factors behind movements in real exchange rates. Our study does not explain the volatility in real exchange rates; however, it provides empirical evidence on the relative contribution of external and internal prices when real exchange rates appreciate. Finally, this study aims to contribute to the growing literature on the economics of international migration. In a recent paper, Clemens, Özden, and Rapoport (2014) provide evidence of significant growth in migration research, especially in the areas related to the direct and indirect effects of human capital movement. Taking advantage of the availability of novel datasets, especially on cross-border migration by skill-groups (Artuç et al. 2015), this study extends our knowledge base on the indirect general equilibrium effects of the mobility of human capital in source countries.

We plan the rest of the section in the following manner. In section 2, we forward a simple motivational model. In section 3, we discuss data, summary statistics, econometric strategy, and the main empirical findings. Section 4 summarizes some robustness test outcomes, which is followed by concluding remarks in section 5.

2. A SIMPLE MOTIVATIONAL MODEL

We use a general analytical framework similar to Macdonald and Ricci (2005), where they examine the role of the distributional sector in explaining the movements in real exchange rates. This study focuses on bilateral real exchange rate movements. As a result, we consider two open economies (countries 1 and 2), and two sectors of production, traded goods, and nontraded goods. The model assumes constant returns to labor in both sectors, and identical Cobb-Douglas preferences in traded and nontraded goods for both economies. We denote skilled emigration as a share of total emigration from country 1 to 2 as M_{12} and in a similar way from country 2 to 1 is denoted as M_{21}. The net skilled emigration from country 1 to 2 is $\overline{M_{12}} = M_{12} - M_{21}$.

Based on the literature, we define the “labor supply shock” channel as when a reduction in the supply of labor because of out-migration is likely to increase the wages of those workers staying home. A large growing body of the literature estimates wage elasticities of emigration to be between 1 to 4% from a 10% increase in emigration

[2] With the steady growth of remittances over the past few decades (Spatafora and Aggarwal 2005), some studies examine the possibility of a remittance-based Dutch disease effect. It is argued that the inflow of remittances analogous to the discovery of new resources relative to the size of the recipient economy could appreciate real exchange rates (Corden and Neary 1982). While some studies (Amuedo-Dorantes and Pozo 2004; Lartey, Federico, and Acosta 2012; Hassan and Holmes 2013) provide supportive empirical evidence to this phenomenon, other studies caution against a hasty conclusion (Rajan and Subramanian 2005; Barajas et al. 2010).

(Mishra 2007; Mishra and Topalova 2007; Borjas 2003; Aydemir and Borjas 2007; Bouton, Paul, and Tiongson 2010; Elsner 2010; Gagnon 2011). On the other hand, the return to capital could decline as a result of skilled emigration in a particular sector, and this could subsequently raise the wages in other (non-migrating) sectors (Marjit and Kar 2005). For example, an emigration shock in the nontraded sector might drive wages up in a traded sector; we define this channel as the "return to capital." We postulate that skilled emigration produces an upward thrust on sector-specific (traded and nontraded) national average wages through both the "labor supply shock" channel and the "return to capital" channel. The net effect of skilled emigration on wages across traded and nontraded sectors depends on the relative strength of these pass-through channels, and we discuss the implications of them on movements in real exchange rates later in this section. We define wage ratios in traded and nontraded sectors as a function of net skilled emigration, as follows:

$$\frac{W_{T1}}{W_{T2}} = \theta_T \overline{M_{12}} \text{ and } \frac{W_{N1}}{W_{N2}} = \theta_N \overline{M_{12}} \quad (1)$$

Where $\frac{W_{T1}}{W_{T2}}$ is the wage ratio in the traded sector between country 1 and 2, θ_T is the wage elasticity of skilled emigration in traded goods sector. Similar notations for nontraded goods; only replacing *T* by *N*.

Alessandria and Kaboski (2011) develop a pricing-to-market model based on international productivity differences and search frictions, where they demonstrate the role of local wages in the price-setting behavior of firms. In light of this model, we write the prices in the traded good sector for country 1 and 2 as

$$P_{T1} = \varphi_T W_{T1}^{\beta} W_{T2}^{1-\beta} \text{ and } P_{T2} = \varphi_T W_{T2}^{\beta} W_{T1}^{1-\beta}.$$

Thus, based on a pricing-to-market model, traded sector prices are a function of wages in both countries and an identical mark-up φ_T for both countries, which represents other costs associated with the distribution sector (Macdonald and Ricci 2005), productivity differences (Canzoneri, Cumby, and Diba 1997), etc. Similarly, for nontraded sectors, we write the prices as a function of wages in the home country only and some mark-up costs

$$P_{N1} = \varphi_{N1} W_{N1} \text{ and } P_{N2} = \varphi_{N2} W_{N2}.$$

After some algebraic calculations, the prices ratios in the traded sector and nontraded sectors can be written, respectively, as

$$\frac{P_{T1}}{P_{T2}} = \left(\frac{W_{T1}}{W_{T2}}\right)^{1-2\beta} \text{ and } \frac{P_{N1}}{P_{N2}} = \left(\frac{\varphi_{N2}}{\varphi_{N1}}\right)\left(\frac{W_{N1}}{W_{N2}}\right).$$

Replacing the wage ratio with net skilled emigration from equation (1), we rewrite price ratios as

$$\frac{P_{T2}}{P_{T1}} = (\theta_T \overline{M_{12}})^{1-2\beta} \text{ and } \frac{P_{N2}}{P_{N1}} = \left(\frac{\varphi_{N2}}{\varphi_{N1}}\right)\left(\frac{1}{\theta_N \overline{M_{12}}}\right) \quad (2)$$

Thus, price ratios in both traded and nontraded sectors are written as a function of skilled emigration rates from each sector, respectively. Now, we turn to the real exchange rate. Assuming P_1 denotes the domestic price level, while P_2 denotes the foreign price level, the real exchange rate (RER) can be expressed as:

$$RER = E\,\frac{P_2}{P_1}$$

Since both countries have identical Cobb-Douglas preferences, the aggregate price level for both can be written as $P_i = P_{Ni}^{\alpha} P_{Ti}^{1-\alpha}, i = 1, 2$. Substituting the expressions of aggregate prices, we get the real exchange rate as a function of traded and nontraded prices:

$RER = E\frac{P_{N2}^{\alpha} P_{T2}^{1-\alpha}}{P_{N1}^{\alpha} P_{T1}^{1-\alpha}}$, or this can be written as

$$RER = (E\frac{P_{T2}}{P_{T1}})\,(\frac{P_{N2}}{P_{N1}})^{\alpha}\,(\frac{P_{T2}}{P_{T1}})^{-\alpha}$$

Taking log both sides, the expression becomes

$$ln\,(RER) = \ln\,(E\frac{P_{T2}}{P_{T1}}) + \alpha ln(\frac{P_{N2}}{P_{N1}}) - \alpha ln(\frac{P_{T2}}{P_{T1}}) \quad (3)$$

Equation (1) decomposes bilateral real exchange rates *(RER)* of country 1 concerning country prices in country 2 into two price components. The first price component is the ratio of traded prices (or external prices, we denote it as RER^{XT}) and the last two factors constitute the ratio nontraded to traded prices (or internal prices, we denote it as RER^{IN}). This is the familiar equation of the Balassa-Samuelson hypothesis (Balassa 1964; Samuelson 1964). We replace the price ratios in equation (3) by skilled emigration shares from equation 2, and the bilateral RER becomes a function of net skilled emigration rates.

$$\ln(RER) = ln(E) + (1-2\beta)\ln(\theta_T\overline{M_{12}}) + \alpha\ln\left(\frac{\varphi_{N2}}{\varphi_{N1}}\right) - \alpha\ln(\theta_N\overline{M_{12}}) \\ -\alpha(1-2\beta)ln(\theta_T\overline{M_{12}}) \quad (4)$$

Equation (4) shows RER as a function of net skilled emigration rates. This can also be further simplified into

$$rer = rer^{XT} + rer^{IN}$$

where

$$rer = \ln\,(RER)$$

$rer^{XT} = ln(E) + (1-2\beta)\ln(\theta_T\overline{M_{12}})$ and

$$rer^{IN} = \alpha\ln(\frac{\varphi_{N2}}{\varphi_{N1}}) - \alpha\ln(\theta_N\overline{M_{12}}) - \alpha(1-2\beta)ln(\theta_T\overline{M_{12}}).$$

Both the real exchange rate and its price components, external and internal, are shown as a function of net skilled emigration. We first consider the case when prices of traded goods are comparable across countries. In the presence of the LOOP, $EP_{T2}/P_{T1} = 1$ and most of the variation in real exchange rates is explained by the productivity differences in different sectors through the internal prices. A higher wage in both traded and nontraded sectors resulting from skilled emigration sectors may induce "the spending effect" analogous to what we find in the remittance-based Dutch disease effect (Barajas et al. 2010). Assuming that there is no leisure-consumption trade-off, this enables households to spend extra on both traded and nontraded goods. For a small open economy (Krugman 1989), if the LOOP holds, then there is no change in prices of traded goods (price takers), but prices of nontraded goods go up as they are determined in the domestic economy. Since the relative prices move in favor of nontraded goods, this erodes the competitiveness of traded sectors, a phenomenon known as "resource allocation effect." Both of these effects lead to a real exchange rate appreciation.[3]

Despite its long pedigree, the ambiguity related to the existence of the Law of One Price (LOOP) persists (Engel 1999; Burstein, Eichenbaum, and Rebelo 2006; Betts and Kehoe 2008; Ouyang and Rajan 2013). Heston, Rouwenhorst, and Wessels (1995) and Eaton and Kortum (2001) show that international deviations from the LOOP for traded and nontraded goods are of nearly the same magnitude. In a related study, Alessandria and Kaboski (2011), building on a pricing-to-market model based on international productivity differences and search frictions, shows that international differences in wages account for almost 63% of the violation from absolute purchasing power parity. We allow for deviations from LOOP by considering a pricing-to-market model based on international productivity differences and search frictions emphasizing the role of local wages. It allows pass-through for both external (relative prices of traded goods) and internal (relative price of traded to nontraded) prices. Assuming that an increase in net skilled emigration in favor of country 1 increases relative wages and therefore prices in favor of country 1, this makes the relative prices of traded goods lower for country 1, thus EP_{T2}/P_{T1} is lower with a relatively high increase in P_{T1}. As a result, the traded sector in country 1 becomes less competitive compared to country 2 and in turn, leads to an appreciation of bilateral real exchange rate for country 1.

To sum up, the main purpose of our theoretical model is to showcase channels through which skilled emigration are linked to movements in RER. Following the existing literature, we argue that skilled emigration provides a positive thrust to wages mainly through the "labor supply shock" channel and also through the "return to capital" channel. We then apply the notion of the "spending effect," which allows households to spend extra on both traded and nontraded goods following a higher wage in both traded and nontraded sectors. Assuming that international deviations from the LOOP for traded and nontraded goods are of nearly the same magnitude, then a combination of the "resource reallocation effect" and the "spending effect" determines the movements in RER and its price components. The contribution of external and internal prices to movements in RER is determined by the relative strength of the "resource reallocation effect" and the "spending effect."

[3] If LOOP holds (Harrod-Balassa-Samuelson hypothesis), Canzoneri, Cumby, and Diba (1997) show that if the productivity of traded relative to nontraded goods grows faster at home rather than abroad, then the home country should experience an RER appreciation.

3. DATA AND EMPIRICAL FINDINGS

3.1 Data and Descriptive Evidence

We use a sample of 67 sample economies for this study (listed in Appendix 1). We calculate real exchange rates based on available data on price indices. While the CPI is used to compute the bilateral real exchange rate, PPI proxy for the price index for traded goods.[4] We rescaled all the price indices for the base year of 1990. All the CPI, PPI, and nominal exchange rate data are taken from the IMF *International Financial Statistics* (*IFS*) database. Furthermore, we calculate both internal and external prices of the bilateral real exchange rate and use them as the dependent variables.[5] The skilled emigration ratio is defined as the share of emigration stock with college education level over the total emigration stock. The bilateral emigration data is taken from Artuç et al. (2015).[6] The bilateral skilled emigration data is available only for two time periods (i.e., 1990 and 2000). As a result, we consider a panel regression with two time periods. Data on the rest of the variables are taken from the *World Development Indicators* (*WDI*) database.

Table 1: Skilled Emigration Ratio
(% of Total Emigration among Sample Countries)

	1990	**2000**	**Growth Rate** (%)
All 67 Sample Countries	23.4	31.38	34
Developed Countries	32.8	40.47	23
To Developed Countries	33.44	41.38	24
To Developing Countries	24.05	30.39	26
Developing Countries	17.21	26.55	54
To Developed Countries	26.21	31.64	21
To Developing Countries	7.45	18.19	144
OECD Countries	32.53	40.45	24
To OECD Countries	33.16	41.37	25
To Non-OECD Countries	24.53	31.51	28
Non-OECD Countries	18.05	27.14	50
To OECD Countries	29.61	33.94	15
To Non-OECD Countries	8.51	18.54	118

Data Source: Authors' calculation based on Artuç et al. (2015) data on bilateral skilled emigration.

[4] Since no consensus exists about which price index is appropriate for traded goods, we follow the best practices. Betts and Kehoe (2006, 2008) argue that sectoral gross output deflators may be preferred over CPI-based retail prices as it measures the output value of the production side and excludes the non-traded marketing and final consumption services that tend to be included in the CPI component data. Due to unavailability of the data on sectoral gross output deflators, their other recommendation is to use the PPI.

[5] Please refer to Appendix 2 for the decomposition of the real exchange rate.

[6] The bilateral emigration data is measured as a stock of emigrants for 1990 and 2000. Since yearly data on skilled-emigration flow is not available, it is difficult to ascertain the level of emigration for a particular period, except for the flow between 1990 and 2000, which is merely the difference between the 1990 and 2000 figures. For a detailed description of the emigration data, see Artuç et al. (2015).

Table 1 provides descriptive evidence on the level and growth of the skilled emigration ratio in the period from 1990 to 2000 across regions. The skilled emigration ratio is estimated as a percentage of total emigration. For the full sample of 67 countries, the average skilled emigration ratio is estimated to be 23.4% and 33.4%, in 1990 and 2000, respectively. The growth of averagely skilled emigration during this period is estimated to be about 34%. A comparison across regions reveals different migration trends. While skilled emigration ratios are high in developed and OECD countries, these figures are mostly driven by migration within the developed or OECD group of countries. The average skilled emigration ratio from developed to developing countries is significantly lower than that of developing to developed countries. However, we find evidence of catching up, as the growth rate of average skilled emigration ratio is recorded as highest (almost 144%) for developing countries, especially for south-south migration corridors. Overall, the average growth of skilled emigration is upward during the period of our analysis and could be a potential factor behind the movements in exchange rates. Appendix 1 provides information at the country level for 67 countries studied in this paper.

3.2 Empirical Model and Identification Strategy

To examine the impacts of skilled emigration on real exchange rate movement, we use a baseline regression model similar to equation (4) in the theoretical section, as follows:

$$rer_{ijt} = \beta_0 + \beta_1(netSkill_{ijt}) + \beta_2(dTradeopen_{ijt}) + \beta_3(dRGDPPC_{ijt}) + \beta_4(dKAopen_{ijt}) + \beta_5(dr_{ijt}) + \beta_6(dGovtgdp_{ijt}) + \beta_7(dTOT_{ijt}) + \beta_8 D_{2000} + e_{ijt} \quad (5)$$

Where the dependent variable, rer_{ijt}, is the natural log of the bilateral real exchange rate between country *i* and country *j*. A rise of real exchange rate indicates real exchange rate appreciation for country *i*. The set of explanatory variables are as follows:

- $netSkill_{ijt} = ln\left(\frac{Skill\ emigration_{ijt} - Skill\ emigration_{jit}}{Total\ Emigration_{ijt} + Total\ Emigration_{jit}}\right)$ is the natural log of net skilled emigration from source country i to destination country j (we divide the net skilled emigration gap by the corresponding total emigration to normalize the variable);[7]
- $dTradeopen_{ijt} = \ln\left(\frac{Export_{ijt} + Import_{jit}}{GDP_{it}}\right) - \ln\left(\frac{Export_{jit} + Import_{ijt}}{GDP_{jt}}\right)$ is the relative trade openness between country i and country j;
- $dRGDPPC_{ijt} = \ln(RGDPPC_{it}) - \ln(RGDPPC_{jt})$ measures relative real GDP per capita between country i and country j;
- $dKAopen_{ijt} = KAopen_{it} - KAopen_{jt}$ measures relative capital account openness between country i and country j. The Chinn and Ito capital account openness index is used to proxy the level of capital account openness.
- $dr_{ijt} = r_{it} - r_{jt}$ measures real interest rate difference between country i and country j;

[7] Ideally, for each country-pair there should be a positive and a negative (of the same magnitude) net skilled emigration gap. We consider only the positive net skilled emigration differences in our selection of unique country pairs since we use the logarithm of this variable in the regression.

- $dGovtgdp_{ijt} = ln\left(\frac{Govt_{it}}{GDP_{it}}\right) - ln\left(\frac{Govt_{jt}}{GDP_{jt}}\right)$ is the relative government spending between country i and country j;
- $dTOT_{ijt} = \ln(TOT_{it}) - \ln(TOT_{jt})$ is the relative terms of trade between country i and country j;
- D_{2000} = Year fixed effect. Since our data is a two-year panel, this is the dummy for the year 2000.

To identify the effect of skilled emigration on real exchange rates, we use cross-country-pair variation in net skilled emigration. In the absence of data on wages by traded and nontraded sectors, we assume that variation in the net skilled emigration explains the net mean wage differences across country pairs, which in turn explains in movements in bilateral RER, as argued in the theoretical section. Two price components of RER, namely the external and internal prices, identify the relative strength of each channel in explaining the movements in RER. A fixed effect model may seem to be a natural choice for estimation, but for a couple of reasons, we opt for an alternative strategy. First, the within-group (country-pair) variation in net skilled emigration is not significantly high. Second, there could be some measurement errors involved in the estimation of skilled emigration rates (Artuç et al. 2015). In such cases, fixed effects models are too restrictive and often produce undesirable results (Angrist and Pischke 2009).

It is plausible to expect that the effect of skilled emigration on RER through the wage channel includes a time lag.[8] As discussed in footnote 6, it is difficult to ascertain the rate of skilled emigration for a period, which restricts the possibility of considering a particular time lag in the regressions. However, the overall flow of the global emigration rate peaked in the early 1990s and then slowed down. Similarly, the global trend of emigration slowed down immediately before 1990. Together, these two trends might suggest that the bilateral emigration figures are not biased by very recent emigration flow, which otherwise is a legitimate concern.[9] Moreover, it is possible that real exchange rates and net skilled emigration are endogenous, as Mishra and Spilimbergo (2011) argue that devaluation of currency may trigger some out-migration. They find that the elasticity of domestic wages to real exchange rate range from .15 to .40 depending on the level of barriers to labor mobility. We address such endogeneity bias by considering an instrumental variable framework. We employ two instruments, a measure of corruption[10] and lagged real GDP per capita growth. A growing base of studies examines the effect of corruption as a push factor behind emigration. In a recent study, Cooray and Schneider (2014) find that as corruption increases, the emigration rate of those with high levels of educational attainment also increases. In another study, Dimant, Krieger, and Meierrieks (2013) argue that the existence of corruption could lower the returns to education slowing down the process of economic growth acting as a push factor for out-migration. Based on such studies, it is plausible to assume that corruption is correlated with skilled emigration and affects movements

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[8] We thank an anonymous referee for pointing this out.

[9] But as a robustness check, we have also examined the lagged effects of net skill emigration rate on real exchange rates using the real exchange rate in 1991 and 2001. Please check section 3.3 and Appendix 4 for the results.

[10] The corruption index is calculated based on the absolute political institution quality measure in Kuncic (2012). This political institution quality measure is mainly constructed based on a country's democracy, bureaucratic quality, and corruption level. A higher value indicates a better political institution quality, range roughly from 0.17 to 0.93. Here we subtract the political institution quality measure from its maximum value (i.e., 0.93) to proxy a country's corruption level.

in real exchange rates only through skilled emigration. Also, employment conditions and wage level also serve as economic factors of international emigration (Greenwood 2005; Mayda 2005). Hence we include a lagged real GDP per capita growth rate as an instrument to correct such bias.

With regards to other control variables, a country with a relatively high real GDP per capita compared to other countries is expected to have higher incomes and hence increases demand for nontraded goods, causing a real exchange rate appreciation, an outcome known as Harrod-Balassa-Samuelson effect. Insofar as government spending tends to be largely biased to the nontraded sectors, we expect that an increase in the share of government expenditure tends to cause an appreciation of real exchange rate. Higher real interest rates tend to attract more capital inflows and cause a higher demand for domestic currency, resulting in an appreciation of real exchange rate. If net capital inflow increases due to capital account liberalization, it leads to an expansion in the monetary base, and raises the current expenditure and demand for nontraded goods, resulting in a real exchange rate appreciation. The trade openness is used to proxy for trade restrictions in a country. A relatively closed economy or a country with higher tariffs tends to have a worse current account position and increased demand for the price of nontraded goods, appreciating the real exchange rate. The overall effects of terms of trade on the real exchange rate are ambiguous and can be classified into income and substitution effects. The income effect indicates that an improvement of the term of trade (i.e., an increase in export prices, or a fall in import prices) tends to raise the income of an economy, and further increase the demand for nontraded goods. On the other hand, the substitution effect suggests that an improvement of the term of trade resulting from an export price increase may cause a depreciation of domestic currency since now nontraded goods become relatively cheap under given levels of the nominal exchange rate and nontraded prices. Finally, dummy for the year 2000 is used to control for the time effect.

3.3 Empirical Outcomes on the Effect of Net Skilled Emigration on RER

We provide descriptive statistics in Appendix 3. It shows the number of observations (country pairs) available for each variable. We expected to have 2,211 unique country pairs[11] from a sample consisting of 67 countries. However, as shown in Appendix 3, we have missing observations for some countries, which makes the actual number of observations to be less than 2,211. In the baseline model, we now have 1,472 observations. Table 2 reports two-stage least squares (2SLS) outcomes. We use RER and its price components (the external and the internal prices) as dependent variables. The skilled emigration elasticity of RER is estimated to be .73. The internal price channel explains almost 80% of this change with an estimated elasticity of .6. This indicates that on average, a larger gap in net high-skilled emigration in favor of the source country appreciates its exchange rate compared to the migrant-receiving country. As argued in the theoretical model, in the absence of LOOP, this outcome could be driven by the resource allocation effect, which in turn makes the internal price a stronger pass-through channel compared to the external prices. However, in the case of failure of LOOP, both spending effect and resource allocation effect contribute to the appreciation of RER, and the dominance of internal price suggests a relatively stronger resource allocation effect compared to spending effect.

[11] For example, we consider bilateral real exchange rate and net skilled emigration only for *i* (source country) to *j* (host country); we do not consider entries for *j* (source country) to *i* (host country) as this will involve double counting.

As long as government spending tends to be largely biased toward the nontraded sectors, we expect that an increase in the share of government expenditure tends to cause an appreciation of real exchange rate. However, our estimates suggest that a larger gap in government spending between the source and skilled migrant-receiving countries depreciates the RER. Similarly, a lower gap in openness also depreciates the real exchange rate. To some extent, these two outcomes are driven by the countries paired together. For country pairs that have a smaller gap in openness, the RER for the skilled migrant-sending country appreciates. As discussed earlier, the overall effects of terms of trade on the real exchange rate are ambiguous and can be classified into income and substitution effects. The income effect tends to raise the income of an economy and further increase the demand for nontraded goods. On the other hand, the substitution effect suggests that improvement of the term of trade resulting from an export price increase may cause a depreciation of domestic currency, since now nontraded goods become relatively cheap under given levels of the nominal exchange rate and nontraded prices. We find evidence that larger the terms of trade gap are associated with a depreciation of RER in the migrant-sending country. Overall the signs of the control variables suggest the degree of integration between the skilled migrant-sending and the skilled migrant-receiving countries. This also implies the skilled emigration elasticity of RER mainly through the channel of negative supply shock resulting from skilled emigration.

We perform a Durbin-Wu-Hausman test to check the presence of endogeneity bias. It rejects the test statistic if bilateral real exchange rates and the net skilled emigration are endogenous. We find strong statistical evidence supporting the presence of endogeneity. This is reported in the second-last row of Table 2. As a result of this, we use lagged real GDP per capita and net corruption index as instruments in the 2SLS estimation. The third-last row reports outcomes on Hanson J statistic, which tests for over-identification restrictions in the presence of multiple instruments. The instruments are valid in most of the cases, as we cannot reject the null hypothesis. The issue of dependencies between observations is also a valid concern, especially when the dependent variable in our regression is correlated bilateral real exchange rates.[12] It raises the concern for the cross-sectional dependence problem leading to inconsistent estimation and endogeneity issues (Baltagi 2005; Pesaran 2004). We apply the weak cross-sectional dependence test developed by Pesaran (2015) on the regression errors. The null hypothesis of the test is that the error term (or variable) is weakly cross-sectional dependent, meaning that correlation between two units i and j in time t is zero. The outcomes of this test reported in the last row of Table 2 suggest that there is no significant cross-sectional dependence problem in our estimation even though our bilateral real exchange rates have obvious cross-sectional dependence property.

As a robustness check, we also consider a lagged version of our model (Appendix 4), since it is plausible to expect that the effect of skilled emigration on RER through the wage channel includes a time lag. We run a set of regressions to check whether skilled emigration in 1990 and 2000 affects the RER in 1991 and 2001, respectively. This involves a one-year lag, and the new regression outcomes are in line with the baseline outcomes (Table 2). We have also reported the estimated outcome using GMM since the GMM estimator could be more efficient than 2SLS if heteroskedasticity problem exists. As an alternative estimation strategy, we report the 2-step GMM outcomes in Table 3. In a majority of the cases, the instruments do not pose any issues with the over-identification restrictions. The skilled emigration elasticity of RER is estimated to be .85. The internal price channel explains almost 70% of this change with an estimated elasticity of .61. The skilled emigration elasticity of external price is slightly

[12] We thank an anonymous referee for pointing this out.

higher compared to the 2SLS outcome. Overall, the GMM outcomes are consistent with the 2SLSL outcome suggesting that heteroscedasticity does not pose any major threat to the regression model.

Table 2: The Impact of Skilled Emigration on Real Exchange Rate

	rer_{ijt}	rer_{ijt}^{XT}	rer_{ijt}^{IN}
Constant	**5.781*** **	**4.796*** **	**0.985***
	(0.703)	(0.363)	(0.520)
$netSkill_{ijt}$	**0.732***	0.133	**0.600** **
	(0.403)	(0.208)	(0.302)
$dTradeopen_{ijt}$	**–0.0438*** **	**–0.0292*** **	**–0.0146***
	(0.00954)	(0.00379)	(0.00782)
$dRGDPPC_{ijt}$	0.0686	0.0334	0.0352
	(0.0590)	(0.0302)	(0.0438)
$dKAopen_{ijt}$	**0.0555*** **	**0.0344*** **	**0.0211** **
	(0.0130)	(0.00575)	(0.0104)
dr_{ijt}	**0.717*** **	0.0107	**0.706*** **
	(0.235)	(0.112)	(0.181)
$dGovtgdp_{ijt}$	**–0.211*** **	**–0.192*** **	–0.0181
	(0.0633)	(0.0286)	(0.0489)
$dTOT_{ijt}$	–0.838	–0.446	–0.391
	(0.643)	(0.308)	(0.498)
D_{2000}	–0.0336	0.0359	–0.0695
	(0.119)	(0.0574)	(0.0909)
Observations	1,472	1,472	1,472
Hanson J Statistic	1.898 [0.168]	5.624 [0.018]	0.076 [0.782]
Durbin-Wu-Hausman χ^2 test	27.838 [0.000]	0.7097 [0.3995]	48.461 [0.000]
Pesaran (2015) Weak Cross-Sectional Dependence Test (CD test)	–0.1403 [0.8884]	0.1550 [0.8769]	–0.1156 [0.9079]

[1] * significance at 10%; ** significance at 5%; *** significant at 1%.

[2] IV (2SLS) estimation outcomes robust to heteroskedasticity; Instruments are net corruption and lagged RGDPPC growth between country *i* and *j*.

[3] The p-values of Hansen J-Test of over-identifying restrictions are reported in baskets.

[4] Durbin-Wu-Hausman Chi-square test is to test the endogeneity of net skilled emigration ratio (in logarithm). The null is that regressor is exogenous. The p-values are reported in baskets.

[5] Pesaran (2015) weak cross-sectional dependence test is to test the cross-sectional dependence in error terms. The null is errors are weakly cross-sectional dependent.

[6] rer_{ijt} represents ln(RER), $rer_{ijt}^{XT}$and rer_{ijt}^{IN} represent external and internal price components of RER (in logarithm), respectively.

Table 3: Instrumental Variable (2-step GMM) Outcomes—The Impact of Skilled Emigration on Real Exchange Rate

	rer_{ijt}	rer_{ijt}^{XT}	rer_{ijt}^{IN}
Constant	**5.985*** **	**5.121*** **	**1.004***
	(0.687)	(0.337)	(0.516)
$netSkill_{ijt}$	**0.854** **	**0.319***	**0.611** **
	(0.394)	(0.192)	(0.299)
$dTradeopen_{ijt}$	**–0.0438*** **	**–0.0293*** **	**–0.0146***
	(0.00954)	(0.00379)	(0.00782)
$dRGDPPC_{ijt}$	0.0862	**0.0609** **	0.0369
	(0.0576)	(0.0278)	(0.0434)
$dKAopen_{ijt}$	**0.0564*** **	**0.0370*** **	**0.0211** **
	(0.0130)	(0.00565)	(0.0104)
dr_{ijt}	**0.770*** **	0.0974	**0.712*** **
	(0.232)	(0.106)	(0.180)
$dGovtgdp_{ijt}$	**–0.223*** **	**–0.212*** **	–0.0192
	(0.0627)	(0.0273)	(0.0487)
$dTOT_{ijt}$	–1.017	**–0.688** **	–0.406
	(0.630)	(0.290)	(0.495)
D_{2000}	–0.0462	0.00183	–0.0698
	(0.118)	(0.0556)	(0.0909)
Observations	1,472	1,472	1,472
Hanson J Statistic	1.898	5.624	0.076
	[0.168]	[0.018]	[0.782]

[1] * significance at 10%; ** significance at 5%; *** significant at 1%.

[2] IV (2-step GMM) estimation outcomes robust to heteroskedasticity; Instruments are net corruption and lagged GDPPC growth between country *i* and *j*.

[3] The p-values of Hansen J-Test of over-identifying restrictions are reported in baskets.

3.4 Empirical Outcomes on the Developed Versus Developing-Source Countries

Since the labor market works very differently across developed and developing countries, the negative supply shock due to skilled emigration is likely to have different outcomes on RER through the wage channel. Next, we discuss Table 4, which reports empirical outcomes separately for two sub-samples, developed-source country, and developing-source country.[13] We have a relatively large sample of developing countries because skilled emigration from developing countries to developed countries outweighs the reverse direction of labor migration. For example, more than two-thirds of skilled migrants are directed to the US, the UK, Canada, and Australia, but they come from more than 100 countries, most of which are developing.

Theoretically, one would expect a larger effect of skilled emigration on RER in a developing-source country compared to a developed-source country provided that the labor market institutions do not overturn the positive effect of a skilled-labor supply shock on domestic wages. This is because skilled emigration is more intense in the nontraded sector for developed-source countries, whereas for the developing-source countries it is the traded sector which experiences more skilled emigration. Another reason could be that the pricing-to-market model is more effective for determining

[13] This is based on the World Bank classification.

prices for traded goods in developing-source countries. For the developing country sample, the skilled emigration elasticity of RER is estimated to be .52, which is negative but statistically insignificant for the developed country sample. For the developing-source country sample, the net skilled emigration pass-through effect on the external prices component of the real exchange rate appears to be stronger than the internal price component of the real exchange rate. However, the estimated coefficient for the external channel is not statistically significant. For the developed-source country sample we find exactly the opposite outcome. Overall, the outcomes are in line with the theoretical predictions. One possible reason for this outcome could be through a more effective pricing-to-market channel for developing-source countries.

Table 4: The Impact of Skilled Emigration on Real Exchange Rate: Developed versus Developing-Source Countries

	Developed-Source Country			Developing-Source Country		
	rer_{ijt}	rer_{ijt}^{XT}	rer_{ijt}^{IN}	rer_{ijt}	rer_{ijt}^{XT}	rer_{ijt}^{IN}
Constant	1.606	1.159	0.446	**5.440*** **	**5.033*** **	**0.406** **
	(4.339)	(5.532)	(1.268)	(0.460)	(0.350)	(0.194)
$netSkill_{ijt}$	–2.012	–2.570	0.558	**0.521** **	0.306	**0.215** **
	(3.119)	(3.979)	(0.914)	(0.249)	(0.190)	(0.106)
$dTradeopen_{ijt}$	–0.0135	0.00273	–0.0162	**–0.0258*** **	**–0.0194*** **	–0.00644
	(0.0643)	(0.0815)	(0.0181)	(0.00947)	(0.00666)	(0.00449)
$dRGDPPC_{ijt}$	–0.327	–0.417	0.0899	0.0386	0.00788	0.0308
	(0.551)	(0.704)	(0.163)	(0.0439)	(0.0328)	(0.0195)
$dKAopen_{ijt}$	0.0489	0.0346	0.0143	**0.0524*** **	**0.0321*** **	**0.0203*** **
	(0.0590)	(0.0750)	(0.0168)	(0.0120)	(0.00891)	(0.00580)
dr_{ijt}	–0.859	–1.813	0.955	**0.550*** **	0.00260	**0.548*** **
	(2.695)	(3.433)	(0.781)	(0.173)	(0.129)	(0.0734)
$dGovtgdp_{ijt}$	–0.439	–0.592	0.153	**–0.203*** **	**–0.178*** **	–0.0254
	(0.401)	(0.511)	(0.117)	(0.0736)	(0.0553)	(0.0306)
$dTOT_{ijt}$	4.666	4.734	–0.0684	–0.624	**–0.727*** **	0.103
	(5.912)	(7.554)	(1.709)	(0.391)	(0.269)	(0.189)
D_{2000}	–0.145	–0.483	0.338	–0.0336	–0.0241	–0.00950
	(0.747)	(0.953)	(0.219)	(0.112)	(0.0833)	(0.0513)
Observations	602	602	602	870	870	870
Hanson J Statistic	0.123 [0.726]	0.001 [0.978]	1.312 [0.252]	0.001 [0.982]	0.237 [0.627]	0.758 [0.384]
Durbin-Wu-Hausman χ^2 test	7.758 [0.005]	31.125 [0.000]	14.509 [0.000]	23.107 [0.000]	8.279 [0.004]	11.191 [0.000]

[1] * significance at 10%; ** significance at 5%; *** significant at 1%.

[2] IV (2SLS) estimation outcomes robust to heteroskedasticity; Instruments are net corruption and lagged RGDPPC growth between country *i* and *j*.

[3] The p-values of Hansen J-Test of over-identifying restrictions are reported in baskets.

[4] Durbin-Wu-Hausman Chi-square test is to test the endogeneity of net skilled emigration ratio. The null is that regressor is exogenous. The p-values are reported in baskets.

3.5 Empirical Outcomes on the High Versus Low Net Emigration Countries

If we expect that the level of emigration is related to the labor market institutions in both the migrant-source and migrant-receiving country and the integration of both economies, then a larger gap in net emigration may have a different effect on RER compared to a smaller gap. To check whether there is any level effect due to emigration, we ran regressions on high and low net emigration countries separately. We use the median absolute value of emigration ratio, measured as net of emigrants to total population, as a cut-off point between these two samples. As a result, there is a systematic difference in the sample sizes between these two groups within total sample. For the sample with high emigration countries, the skilled emigration elasticity of RER is estimated to be .77. On the other hand for the low net emigration countries sample, the skilled emigration elasticity of RER is estimated to be only .04, but the result is not statistically significant. The external channel plays a dominant role in the high emigration country sample. The outcomes on high net emigration countries support the association of appreciation of real exchange rates and the growth of the skilled emigration rate. Based on our theoretical model predictions, the empirical outcomes suggest a robust relationship between the level of net skilled emigration and appreciation of real exchange rates. This supports the Balassa-Samuelson channel. However, the roles played by the external and the internal price in skilled emigration effect pass-through interchange positions across different sub-samples of countries.

Table 5: The Impact of Skilled Emigration on Real Exchange Rate by Emigration Size

	High Emigration Sample			**Low Emigration Sample**		
	rer_{ijt}	rer_{ijt}^{XT}	rer_{ijt}^{IN}	rer_{ijt}	rer_{ijt}^{XT}	rer_{ijt}^{IN}
Constant	**6.233*** **	**5.975*** **	0.257	**4.579*** **	**4.455*** **	0.124
	(0.924)	(0.801)	(0.264)	(0.306)	(0.346)	(0.164)
$netSkill_{ijt}$	**0.767***	**0.619***	0.147	0.0420	–0.0559	0.0979
	(0.418)	(0.361)	(0.121)	(0.189)	(0.219)	(0.111)
$dTradeopen_{ijt}$	**–0.0964*** **	**–0.0768*** **	**–0.0196** **	**–0.0371*** **	**–0.0272*** **	**–0.00990** **
	(0.0306)	(0.0266)	(0.00950)	(0.00780)	(0.00897)	(0.00486)
$dRGDPPC_{ijt}$	0.0509	**0.0902***	**–0.0392** **	0.00130	0.0107	–0.00936
	(0.0616)	(0.0520)	(0.0175)	(0.0306)	(0.0336)	(0.0200)
$dKAopen_{ijt}$	**0.0621*** **	**0.0405*** **	**0.0216*** **	**0.0484*** **	**0.0350*** **	**0.0134** **
	(0.0174)	(0.0145)	(0.00583)	(0.00652)	(0.00719)	(0.00520)
dr_{ijt}	**0.716*** **	0.256	**0.460*** **	**0.381*** **	–0.197	**0.579*** **
	(0.255)	(0.223)	(0.0774)	(0.106)	(0.124)	(0.0708)
$dGovtgdp_{ijt}$	**–0.207** **	**–0.218*** **	0.0110	**–0.207*** **	**–0.220*** **	0.0128
	(0.0808)	(0.0674)	(0.0250)	(0.0330)	(0.0357)	(0.0227)
$dTOT_{ijt}$	**–2.129***	**–2.238** **	0.109	**0.281** **	–0.0909	**0.372*** **
	(1.273)	(1.111)	(0.387)	(0.132)	(0.167)	(0.124)
D_{2000}	–0.269	–0.237	–0.0321	0.0812	0.0780	0.00315
	(0.226)	(0.194)	(0.0661)	(0.0662)	(0.0701)	(0.0393)
Observations	944	944	944	528	528	528
Hanson J Statistic	5.551 [0.019]	0.786 [0.375]	26.943 [0.000]	2.032 [0.154]	0.034 [0.855]	4.082 [0.043]
Durbin-Wu-Hausman χ^2 test	23.111 [0.000]	15.037 [0.000]	2.217 [0.136]	0.058 [0.810]	0.357 [0.550]	2.081 [0.149]

[1] * significance at 10%; ** significance at 5%; *** significant at 1%.

[2] High emigration sample is defined as $\frac{abs(Emigration_{ijt} - Emigration_{jit})}{Population_{it} + Population_{jt}} \geq median.$

3.6 Empirical Evidence on the Wage Channel

Empirical findings discussed so far explain the possible roles that both sets of prices play in determining the movements in real exchange rates, but they do not provide any direct evidence of the magnitude of the wage effect of skilled emigration. In a related paper, Alessandria and Kaboski (2011), building on a pricing-to-market model based on international productivity differences and search frictions, show that international differences in wages account for almost 63% of the violation from absolute purchasing power parity. Since data on average country-level wages by nontraded and traded sectors is not available, it becomes difficult to measure the precise multiplier effect of the wage channel on real exchange rates. As a second-best option, we use the standardized monthly and daily wages computed by Freeman and Oostendorp (2001). This data set contains monthly and daily wages for different occupations and industries based on the International Labour Organization (ILO) classification. We use this information together with the classification of traded and nontraded industries and occupations from Kletzer and Jensen (2010) to compute country-level weighted average wages for traded and nontraded sectors. The information available in Kletzer and Jensen (2010) is based on US data. However, we assume that such classification is likely to be similar across countries.

Table 6: OLS Outcomes on the Wage Effects of Skilled Emigration

	Wages in 1990 and 2000 (in logarithm)				**Average wage of (1990–1995) and (2000–2005)** (in logarithm)			
	Traded Sectors		**Nontraded Sectors**		**Traded Sectors**		**Nontraded Sectors**	
	Hourly Wage	**Monthly Wage**	**Hourly Wage**	**Monthly Wage**	**Hourly Wage**	**Monthly Wage**	**Hourly Wage**	**Monthly Wage**
Constant	**–12.75****	–6.692	–11.93	1.109	**–17.10*****	**–10.54*****	**–10.54*****	–6.216
	(5.459)	(4.873)	(7.197)	(9.017)	(3.723)	(3.696)	(3.696)	(6.753)
Skilled emigration share	**1.311****	**1.129****	0.793	0.890	**1.424*****	**1.377*****	**1.377*****	**1.506****
	(0.581)	(0.504)	(0.717)	(0.687)	(0.487)	(0.459)	(0.459)	(0.589)
Tradeopen	**–0.390*****	**–0.379*****	**–0.273****	**–0.220****	**–0.339*****	**–0.294*****	**–0.294*****	–0.126
	(0.0846)	(0.0784)	(0.117)	(0.107)	(0.0741)	(0.0756)	(0.0756)	(0.109)
ln(RGDPPC)	**1.040*****	**1.010*****	**1.405*****	**1.327*****	**0.951*****	**0.903*****	**0.903*****	**1.173*****
	(0.128)	(0.115)	(0.158)	(0.142)	(0.103)	(0.0986)	(0.0986)	(0.128)
KAopen	0.0408	0.0366	0.0617	0.0690	0.0293	0.0305	0.0305	0.00496
	(0.0831)	(0.0754)	(0.111)	(0.106)	(0.0503)	(0.0474)	(0.0474)	(0.0640)
Real Interest Rate	**2.123****	**2.350****	**3.565****	2.969	0.641	**0.727***	**0.727***	1.014
	(0.866)	(0.870)	(1.643)	(2.040)	(0.444)	(0.430)	(0.430)	(0.800)
ln(Govt/GDP)	0.292	0.134	0.383	0.172	0.322	0.238	0.238	0.202
	(0.200)	(0.214)	(0.273)	(0.259)	(0.235)	(0.235)	(0.235)	(0.286)
ln(TOT)	0.954	0.918	–0.0686	–1.587	**2.084****	**1.899****	**1.899****	0.241
	(1.171)	(1.070)	(1.639)	(2.068)	(0.801)	(0.825)	(0.825)	(1.566)
D	0.0155	0.0326	–0.367	–0.160	0.0139	–0.0320	–0.0320	–0.0241
	(0.177)	(0.169)	(0.229)	(0.268)	(0.145)	(0.135)	(0.135)	(0.210)
Observations	39	39	38	38	53	53	53	50
R-squared	0.912	0.919	0.895	0.870	0.884	0.875	0.875	0.864

[1] * significance at 10%; ** significance at 5%; *** significant at 1%.

[2] *D* is year 2000 dummy.

In Appendix 5, we compare the average wages between developed and developing countries for traded skilled, traded unskilled, nontraded skilled, and nontraded unskilled workers. The growth in nominal average wages is significantly higher in developing countries, especially for the skilled workers. Since wage data for both 1990 and 2000 is available for only 20 countries, the summary evidence may reflect some selection bias and hence, should be interpreted with caution. As a final step, we run some cross-country regressions to examine the correlation between skilled emigration and wages across traded and nontraded sectors. The estimated coefficients (shown in Table 6) suggest a positive and statistically significant correlation between skilled emigration and wages. The outcomes are robust across monthly and daily wages. Overall, both the summary and regression outcomes indicate a positive relationship between skilled emigration and wages. This supports our theoretical prediction of the wage effect of skilled emigration.

4. CONCLUSION

This study aims to contribute to the growing literature on the economics of international migration. While more than two-thirds of skilled migrants are directed to the US, the UK, Canada, and Australia, they come from more than 100 countries. Thus, skilled emigration opens up many indirect general equilibrium questions in the source country. This study, in particular, aims to look at the relationship between skilled emigration and real exchange rate movement in the source country. Building on a simple analytical model, we argue for two possible channels of causality. If the Law of One Price (LOOP) holds, then skilled emigration appreciates RER through the "spending effect" and "resource allocation effect," which are analogous to the remittance-based Dutch disease effect. The second channel is based on a pricing-to-market model, where local wages affect the price-setting behavior of firms and, unlike the first channel, the pricing-to-market model allows pass-through for both external (relative prices of traded goods) and internal (relative prices of traded to nontraded goods) prices assuming possible violations of LOOP. We postulate that both of these channels contribute to an appreciation of real exchange rates.

We provide cross-country empirical evidence from 67 countries that the net skilled emigration appreciates bilateral real exchange rates in source countries. To identify the potential channels of causality, we decompose the real exchange rate into two sets of relative prices, viz. the relative price of traded goods between economies (external prices) and the relative price of traded and nontraded (internal prices) within each country. The skilled emigration elasticity of real exchange rate is estimated to be in the range between .6 and .8 across the country samples that we use. Overall, the internal (relative price of traded to nontraded) price channel provides a stronger pass-through to the skilled emigration effect on the real exchange rate. The outcomes are robust across different levels of skilled emigration and alternative model specifications.

Certain caveats deserve mention. The role of remittances in the discussion of the wage effects of skilled emigration is imperative (Mishra and Topalova 2007; Spatafora and Aggarwal 2005). Although the main goal of this paper is to provide evidence for an alternative channel linking skilled emigration and real exchange rates, we acknowledge the possibility of a potential negative labor supply effect due to an increase in remittances. With an increase in reservation wages due to remittances, there could be alternative wage effects, and in such cases, one needs to identify and separate the wage channel effect that we hypothesize and test in this paper. Also, an almost 54% growth in skilled emigration rate between 1990 and 2000 in developing countries warrants a more refined study of skilled emigration disaggregated by gender, industry, and occupation groups. We leave these concerns as possible areas for future studies.

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APPENDIX 1: SKILLED EMIGRATION RATIO (% OF TOTAL EMIGRATION AMONG SAMPLE ECONOMIES): ALL 67 SAMPLE COUNTRIES

Countries	1990	2000	Countries	1990	2000
Argentina	38.10	41.75	Malaysia	31.68	35.29
Australia	49.20	56.63	Mexico	13.67	14.95
Austria	30.80	35.60	Morocco	12.33	14.80
Belgium	29.52	38.90	Netherlands	38.13	43.52
Brazil	31.32	33.66	New Zealand	39.09	49.07
Bulgaria	16.57	23.35	Norway	30.50	38.54
Canada	47.86	61.18	Pakistan	8.39	15.67
Chile	40.93	40.59	Panama	57.09	56.94
Colombia	26.27	32.29	Paraguay	17.27	7.03
Costa Rica	42.52	42.50	Peru	35.08	36.26
Croatia	21.62	19.94	Philippines	50.71	56.00
Cyprus	23.68	38.68	Poland	29.69	39.55
Czech Republic	39.98	35.25	Romania	24.74	33.21
Denmark	34.28	40.83	Russian Federation	14.43	29.17
Egypt	23.45	29.78	Saudi Arabia	34.20	38.55
Estonia	30.87	36.61	Singapore	33.48	42.60
Finland	19.69	26.94	Slovakia	12.65	17.88
Germany	35.71	41.18	Slovenia	22.13	22.26
Greece	17.95	22.33	South Africa	55.83	65.06
Hong Kong, China	59.35	62.39	Spain	14.72	24.11
Hungary	39.38	40.71	Sri Lanka	20.69	25.93
India	13.66	29.31	Sweden	38.87	46.56
Indonesia	14.83	18.14	Switzerland	43.55	44.76
Iran	49.33	52.98	Syria	24.16	30.13
Ireland	21.07	33.48	Thailand	34.96	36.23
Israel	50.09	55.48	Trinidad and Tobago	53.15	49.47
Italy	14.72	18.40	Tunisia	16.20	20.40
Japan	54.69	60.23	Turkey	8.76	9.59
Kazakhstan	11.35	22.10	Ukraine	7.90	28.79
Republic of Korea	39.99	50.39	United Kingdom	39.03	48.57
Kuwait	25.83	30.95	United States	52.17	60.21
Latvia	36.43	38.15	Uruguay	32.26	20.92
Lithuania	20.67	27.22	Venezuela	47.95	52.82
Macedonia	23.38	27.71			

APPENDIX 2: THE DECOMPOSITION OF REAL EXCHANGE RATES

We decompose real exchange rate fluctuations into two sets of relative prices, viz. the relative price of traded goods between economies (so-called price competitiveness) and the relative price of tradables and nontradables within each country. The (log) aggregate price index can be expressed as a weighted average of the price of tradable (T) and nontradables (N):

$p_1 = \alpha p_{N1} + (1-\alpha)p_{T1}$, for the domestic country (A1)

and, $p_2 = \beta p_{N2} + (1-\beta)p_{T2}$, for the foreign country. (A2)

We can then write the real exchange rate, $rer = e + p_2 - p_1$, as the sum of (a) the relative price of traded goods between economies and (b) the relative price of nontraded to traded goods within each economy.

$$rer = (e + p_{T2} - p_{T1}) + \beta(p_{N2} - p_{T2}) - \alpha(p_{N1} - p_{T1})$$

$$= \underbrace{e + p_{T2} - p_{T1}}_{(a)} + \underbrace{(p_2 - p_{T2}) - (p_1 - p_{T1})}_{(b)} \quad \text{(A3)}$$

We can rewrite equation (A3) as follows:

$$rer = rer^{XT} + rer^{IN} \quad \text{(A4)}$$

While the CPI is used to compute the real exchange rate, PPI is used to proxy the price index for tradable goods.

APPENDIX 3: DESCRIPTIVE STATISTICS

Variable	Obs	Mean	Std. Dev.	Min	Max
Year 1990					
rer_{ijt}	2,211	4.300	1.708	–4.264	11.349
rer_{ijt}^{XT}	2,211	4.461	1.470	–3.708	11.340
rer_{ijt}^{IN}	2,211	–0.160	0.938	–4.752	4.203
$dSkill_{ijt}$	1,881	–1.659	1.053	–8.051	0.000
$dTradeopen_{ijt}$	1,368	0.363	2.366	–9.129	7.261
$dRGDPPC_{ijt}$	1,953	–0.384	1.113	–3.343	2.983
$dKAopen_{ijt}$	1,431	–0.835	2.308	–4.303	4.303
dr_{ijt}	820	–0.008	0.125	–0.429	0.573
$dGovtgdp_{ijt}$	2,016	–0.114	0.599	–2.514	1.894
$dTOT_{ijt}$	325	–0.040	0.281	–0.738	0.780
$dCorrupt_{ijt}$	1,596	0.041	0.281	–0.714	0.678
$dRGDPPCG_{ijt}$	1,596	–0.004	0.075	–0.344	0.363
Year 2000					
rer_{ijt}	2,211	4.599	0.379	3.028	6.117
rer_{ijt}^{XT}	2,211	4.598	0.390	3.131	6.314
rer_{ijt}^{IN}	2,211	0.001	0.214	–0.839	0.902
$dSkill_{ijt}$	1,847	–1.476	1.033	–9.186	0.000
$dTradeopen_{ijt}$	2,098	0.399	2.408	–8.000	10.163
$dRGDPPC_{ijt}$	2,211	–0.506	1.088	–3.227	2.651
$dKAopen_{ijt}$	2,211	–0.876	2.022	–4.303	4.303
dr_{ijt}	1,711	0.005	0.133	–0.576	0.574
$dGovtgdp_{ijt}$	2,211	–0.087	0.438	–1.382	1.191
$dTOT_{ijt}$	2,145	0.011	0.059	–0.235	0.257
$dCorrupt_{ijt}$	2,211	0.040	0.227	–0.611	0.609
$dRGDPPCG_{ijt}$	2,145	–0.006	0.048	–0.146	0.165

APPENDIX 4: LAGGED MODEL, THE IMPACT OF SKILLED EMIGRATION ON REAL EXCHANGE RATE

Using real exchange rate in 1991 and 2001, we examine the lagged effects of net skill emigration rate on real exchange rates. All the control variables are one-year lagged compared to the real exchange rates.

	$\boldsymbol{rer_{ijt}}$	$\boldsymbol{rer_{ijt}^{XT}}$	$\boldsymbol{rer_{ijt}^{IN}}$
Constant	**5.602*** **	**4.615*** **	**0.988***
	(0.608)	(0.310)	(0.513)
$netSkill_{ij,t-1}$	**0.627***	0.0258	**0.601** **
	(0.351)	(0.179)	(0.297)
$dTradeopen_{ij,t-1}$	**–0.0338*** **	**–0.0231*** **	–0.0107
	(0.00839)	(0.00342)	(0.00782)
$dRGDPPC_{ij,t-1}$	0.0695	0.0259	0.0436
	(0.0509)	(0.0259)	(0.0434)
$dKAopen_{ij,t-1}$	**0.0562*** **	**0.0359*** **	**0.0204** **
	(0.0111)	(0.00491)	(0.0104)
$dr_{ij,t-1}$	**0.532** **	–0.0864	**0.618*** **
	(0.207)	(0.0989)	(0.181)
$dGovtgdp_{ij,t-1}$	**–0.202*** **	**–0.179*** **	–0.0236
	(0.0548)	(0.0252)	(0.0487)
$dTOT_{ij,t-1}$	–0.569	–0.180	–0.389
	(0.560)	(0.262)	(0.489)
D_{2000}	–0.0129	0.0551	–0.0679
	(0.0999)	(0.0471)	(0.0892)
Observations	1,472	1,472	1,472
Hanson J Statistic	4.016 [0.045]	9.931 [0.02]	0.219 [0.640]

[1] * significance at 10%; ** significance at 5%; *** significant at 1%.

[2] IV (2SLS) estimation outcomes robust to heteroskedasticity; Instruments are net corruption and lagged RGDPPC growth between country *i* and *j*.

[3] The p-values of Hansen J-Test of over-identifying restrictions are reported in baskets.

[4] Durbin-Wu-Hausman Chi-square test is to test the endogeneity of net skilled emigration ratio (in logarithm). The null is that regressor is exogenous. The p-values are reported in baskets.

[5] rer_{ijt} represents ln(RER), rer_{ijt}^{XT} and rer_{ijt}^{IN} represent external and internal price components of RER (in logarithm), respectively.

APPENDIX 5: EVOLUTION OF MONTHLY AND DAILY WAGES

Unit: US$		Developed			Developing		
		1990	2000	% Change	1990	2000	% Change
Monthly Wage	Traded skilled worker	1,902.19	2,134.56	12.22	143.13	256.78	79.40
	Traded unskilled worker	1,411.40	1,576.14	11.67	106.82	148.98	39.47
	Nontraded skilled worker	2,088.76	2,422.93	16.00	137.08	205.68	50.05
	Nontraded unskilled worker	1,494.83	1,706.41	14.15	102.83	140.72	36.85
Daily wage	Traded skilled worker	11.35	12.75	12.41	0.72	1.29	78.41
	Traded unskilled worker	8.25	9.24	11.95	0.51	0.75	46.06
	Nontraded skilled worker	12.62	14.78	17.13	0.68	1.04	52.73
	Nontraded unskilled worker	8.76	9.88	12.86	0.49	0.70	43.73

Note: Authors' compilation based on Freeman and Oostendorp (2001) data on wages.