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IMMIGRATION AND INTERNATIONAL PRICES

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Immigration and International Prices*

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Abstract

This paper considers the relation between immigration and prices for a large number of cities across the world over the period from 1990 to 2006. Aggregate immigration ratios are shown to have a negative impact on international relative prices. The evidence is consistent with demand-side and supply-side considerations both being relevant for the price-reducing effect of immigration, with the latter offering a more likely explanation at annual frequencies during this period. Our findings regarding the inverse relation of immigration and prices and the channels via which this operates across international cities, are broadly consistent wih Lach (2007) and Cortes (2008) who investigate the same relation within Israel and for the US respectively.

Keywords: immigration, prices, inflation, international price differences.

JEL Classification: E31, J10, J61

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1 Introduction

Immigration is an important demographic force likely to have an important role in shaping future economic outcomes and welfare. Its effect on the labor market and domestic wages has been the focus of a large body of work that includes a series of papers by Borjas (1994, 1995, 2003).[1] By contrast, its role in determining prices of final goods has not been considered by more than a handful of papers. Lach (2007) utilizes Israeli data on individual product prices and immigration across Israeli cities and finds that immigration reduces prices through a demand-side channel of increased search and higher price elasticities for immigrants. Cortes (2008) uses prices and immigration data across U.S. cities, to show that an increase in immigration reduces prices via a supply-side channel by reducing wages. Finally, Frattini (2008) finds a similar negative effect of immigration on prices in the UK.

In theory, we would expect three forces to be driving the relation between prices and immigration, two on the demand side and one on the supply side. First, there should be a positive effect on prices after an increase in overall demand due to immigration similar to a baby boom effect. Second, to the extent that immigrants are poorer than locals, we would expect them to have higher search and substitutability parameters that would act to negate any positive demand-side effects on prices. This is a "short term" effect that is likely to work when the immigration flow is relatively large and unexpected as in Lach (2007). Third, one would expect immigrants to receive lower wages at given productivity levels, partly because of a lower opportunity cost related also to subjectively perceived wage comparisons relative to the typically poorer home country. Overall, these three factors would be consistent with the presence of a negative impact of immigration on prices depending on the relative magnitude of each of these three forces, the last two of which have an opposing effect as compared to the first one. In addition, illegal immigration, consisting

[1] Previous studies, including Borjas (2003) have typically found negative effects of immigrants on wages.

of relatively poorer individuals that are willing (due to lower opportunity cost) or have to (due to being restricted to a smaller set of potential employer matches who face the risk of being caught) work for less, would be expected to amplify the last two forces acting negatively upon prices.

The goal of this paper is to estimate the impact of immigration on prices for a large number of cities across the world during the period from 1990 to 2006. Consistent with the evidence of Lach (2007) for Israel and Cortes (2008) for the US, we show that there exists a negative impact of immigration flows on prices of a broad number of goods and services that comprise the CPI. The elasticity of prices with respect to immigration flows across the world is as high as 16 %. The price impact of immigrants employed in specific occupations or sectors, appears to be lower than the price impact of the overall number of immigrants in the local economy. This might be because the overall price effect of immigration is small enough to begin with, so that the impact of the relatively small number of immigrants in any one particular occupation or sector could not possibly show up in the price of final goods and services. In addition, given that illegal immigration likely amplifies the negative price effect of immigration and that it should be correlated with the presence of legal immigrants (e.g. due to an existing local network for each immigrant ethnic group), then to the extent that different measures of immigrants correlate more highly with the overall level of illegal immigration, we should expect them to have a bigger estimated effect on prices. For example, the overall level of illegal immigration should correlate more highly with our aggregated measure of employed immigrants than with the number of immigrants employed in particular occupations or sectors. Thus, we should expect the overall number of immigrants to have a higher impact on prices than more specific immigration measures.

Moreover, the impact of the overall number of immigrants on basic food items they are more likely to consume (such us bread, butter, rice, potatoes, bananas, tomatoes, eggs, frozen chicken, etc) is comparable to or higher than the impact on the average good in the consumption basket. Similarly, the impact of the overall number of immigrants on services they are more likely to produce

(such us Laundry, Dry cleaning, Domestic cleaning help, and Baby-sitting,) is comparable to or higher than the impact on the average good in the consumption basket, depending on whether we consider the specification in levels or in changes. From this, we infer that both demand-side and supply-side considerations can be relevant for the adverse effect of immigration on prices we document here.

2 Data

The price data

Microeconomic price levels are assembled by the Economist Intelligence Unit (EIU) and are available for 304 items across 140 cities in 90 countries for the period 1990 to 2006. This includes prices of more than one hundred distinct individual goods like "Margarine, 500g", "Toothpaste with fluoride, 120 g" or "aspirins, 100 tablets" typically sampled in both a supermarket and at a "mid-priced" store, and a number of services like "man's haircut, tips included" and "three-course dinner for four people".

The immigration data

We use employed migrant population I_{jnt} into each country n, in occupation or sector j for the period 1990 to 2006, from the Labour Statistics Database assembled by the International Labour Organization (ILO). We also use total employment E_{jnt} by occupation or sector for each country from the same source, to construct the fraction of migrant workers in each occupation $\frac{I_{jnt}}{E_{jnt}}$. We construct the total migrant employed population I_{nt} and total employment E_{nt} for each country by summing across all occupations. We also consider specifications that utilize data on immigrants employed in services-related occupations and immigrants employed in the Agricultural sector.

Other data

City-specific population data are obtained for 1990 and 2000 from the Henderson revised in-

Table 1: Country availability.

Nation	Cities	Tables
Austria	Vienna	2, 3
Azerbaijan	Baku	2^a, 3^a
Colombia	Bogota	3
Denmark	Copenhagen	2^a, 3^a
Ecuador	Quito	2^b, 3^b
Finland	Helsinki	2^a, 3
France	Lyon, Paris	2, 3
Greece	Athens	2^a, 3^a
Hungary	Budapest	2^a, 3^a
Indonesia	Jakarta	3^a
Ireland	Dublin	2, 3
Israel	Tel Aviv	2^a, 3^a
Japan	Osaka, Tokyo	3^b
Korea	Seoul	2^b, 3^b
Malaysia	Kuala Lumpur	2, 3
Netherlands	Amsterdam	3^a
Norway	Oslo	2^a, 3
Philippines	Manila	2^a, 3^a
Poland	Warsaw	2^a, 3^a
Portugal	Lisbon	3^b
Spain	Barcelona, Madrid	2, 3
Sweden	Stockholm	2^a, 3^a
Switzerland	Geneva, Zurich	2, 3
UK	London, Manchester	2, 3
US	Seventeen cities *	2^b, 3

Notes: The country-sample for Table 4 is the same as that for Tables 2 and 3 for the levels and difference specifications respectively. The same goes for Table 5. ^{a} Country available only for agricultural sector data. ^{b} Country not available for agricultural sector. * These are: Atlanta, Boston, Chicago, Cleveland, Detroit, Honolulu, Houston, Lexington, Los Angeles, Miami, Minneapolis, New York, Pittsburgh, San Francisco, San Juan, Seattle, Washington DC.

ternational urban database.[2] Country-specific population is obtained annually for the period from 1990 to 2006 from the Word Development Indicators (WDI) database, and used to construct a city-specific measure of population size for the period 1991 to 1999 and for the period 2001 to 2006, based on the observed city to country population ratios of 1990 and 2000. More specifically, the observed city to country ratio for 1990 is applied to the country population data from 1990 to 1995 and the observed city to country population ratio for 2000 is applied to the country population data from 1996 to 2006 to obtain a city-specific measure of the population level.

We also obtained exports and imports of goods and services as a percentage of GDP from the WDI, and used their sum as a measure of overall openness of the economy. Policies that foster productivity growth such as deregulation and trade liberalization can lower prices and at the same time make immigration more attractive or even feasible.[3] We control for these country-level trends by using a measure of "openness". Finally, labor costs per hour in US dollars for each country are also available from the EIU dataset.

We were able to assemble immigration and other data for 27 of the countries for which price levels data exists, for 48 different cities. The country sample is shown in Table 1.

3 Estimation

The estimable regression equation takes the following form:

$$\begin{aligned} DEV \ln p_{ict} &= \mu_c + \mu_t + \beta DEV \ln \frac{I_{jnt}}{E_{jnt}} + \gamma DEV \ln Pop_{ct} + \delta DEV \ln Cost_{nt} \\ &\quad + \rho DEV \ln p_{ict-1} + \xi DEV \ln O_{nt} + u_{ict} \end{aligned} \tag{1}$$

where $DEV \ln p_{ict} \equiv \ln p_{ict} - \frac{1}{C}\sum_{c=1}^{C} \ln p_{ict}$ is the deviation of the log price level for product i in city c at time t relative to the average common currency log price level across all cities for that product and time, I_{jnt} is the number of immigrants into sector j in country n where city c belongs to, E_{jnt} is

[2] I thank Yiannis Ioannides for providing these data.
[3] I thank Saul Lach for pointing this out.

employment for sector j in country n where city c belongs to, Pop_{ct} is the population size of city c at time t, $Cost_{nt}$ is the country level labor costs per hour in common currency[4], O_{nt} captures the degree of openness of the economy, and u_{ict} is an idiosyncratic random error. All explanatory variables are demeaned relative to the mean across all locations for each time period, similarly to the dependent variable. That is, $DEV \ln \frac{I_{jnt}}{E_{jnt}} \equiv \ln \frac{I_{jnt}}{E_{jnt}} - \frac{1}{N}\sum_{n=1}^{N} \ln \frac{I_{jnt}}{E_{jnt}}$,[5] $DEV \ln Pop_{ct} \equiv \ln Pop_{ct} - \frac{1}{C}\sum_{c=1}^{C} \ln Pop_{ct}$, $DEV \ln Cost_{nt} \equiv \ln Cost_{nt} - \frac{1}{N}\sum_{n=1}^{N} \ln Cost_{nt}$, and $DEV \ln O_{nt} \equiv \ln O_{nt} - \frac{1}{N}\sum_{n=1}^{N} \ln O_{nt}$, where C is the total number of cities and N is the total number of countries.

To control for a number of possible omitted variables, we also opt to include dummies for cities and time, μ_c and μ_t, specific to city c or time t, respectively. The fixed effects model is desireable here as it allows for and is therefore robust to arbitrary correlation between the effect μ_c or μ_t with the observed explanatory variables $\frac{I_{jnt}}{E_{jnt}}$, Pop_{ct}, $Cost_{nt}$, and O_{nt}. Finally, it should be noted that since we have demeaned the data relative to the mean price of each good across locations, it is no longer necessary to also include a product dummy.[6] It should also be noted that the estimates we obtain by demeaning the data as above are very close to those obtained when using instead price levels data along with product-specific effects.[7]

We also estimate a regression equation in log differences between periods t and $t-s$ as follows:

$$\begin{aligned} \Delta(DEV \ln p_{ict}) &= \lambda_c + \lambda_t + \eta\Delta(DEV \ln I_{jnt}) + \theta\Delta(DEV \ln Pop_{ct}) + \kappa\Delta(DEV \ln Cost_{nt}) \\ &\quad + \phi DEV \ln p_{ict-s} + \psi\Delta(DEV \ln O_{nt}) + \omega\Delta(DEV \ln Y_{nt}) + v_{ict} \end{aligned} \tag{2}$$

where $\Delta(DEV \ln P_{ct}) = DEV \ln P_{ct} - DEV \ln P_{ct-s}$, $\Delta(DEV \ln I_{jnt}) = DEV \ln I_{jnt} - DEV \ln I_{jnt-s}$, $\Delta(DEV \ln Pop_{ct}) = DEV \ln Pop_{ct} - DEV \ln Pop_{ct-s}$, $\Delta(DEV \ln Cost_{nt}) = DEV \ln Cost_{nt} -$

[4]This measure of labor costs is closely related to the level of income in each country, so we do not include both income per capita and labor costs as explanatory variables.

[5]We initially consider aggregate rather than sectoral immigration, I_{nt}, and employment, E_{nt}, for each country.

[6]Doing so leaves the coefficient estimates of the remaining explanatory variables largely unchanged and does not increase the explanatory power of the estimated model leaving the adjusted R^2 unchanged.

[7]For instance, the estimated price impact of immigration when the data are not demeaned while including product-specific effects, compared to what is reported in columns (2), (4), (6), (8), (10) and (12) of Table 2, equal strogly significant estimated values of -0.169, -0.132, -0.094, -0.081, -0.030, and -0.027 respectively.

$DEV \ln Cost_{nt-s}$, $\Delta(DEV \ln O_{nt}) = DEV \ln O_{nt} - DEV \ln O_{nt-s}$, $\Delta(DEV \ln Y_{nt}) = DEV \ln Y_{nt} - DEV \ln Y_{nt-s}$, Y_{nt} is real GDP and s is the first available lag for each variable. That is, we consider the change over time of the deviation of the price of each good relative to the mean across cities, explained by changes over time for immigration, population size, labor costs, openness, and real GDP relative to their respective means across locations. GDP growth is added here in order to control for the well documented effect of the business cycle on inflation. The specification in log changes considered here serves as a robustness check for the relation between local prices and the number of immigrants, and as a check that our coefficient estimates are not the mere outcome of a spurious regression in the presence of a non-stationary process for international price deviations.[8]

4 Empirical Results

Price levels

In Table 2, we present estimates based on the specification in levels described in equation (1). That is, price deviations for each good relative to its mean across locations are being explained by the respective deviations of immigration, population size, cost, and openness relative to the average across all locations for the period from 1990 to 2006. The first lag of the price deviation is included in all specifications along with city and time effects. Moreover, in order to alleviate potential endogeneity problems, we consider the first available lag of immigration instead of its contemporaneous value in the specifications shown in columns (3), (4), (7), (8), (11), and (12).

In the first four columns of Table 2, we consider the overall number of immigrants employed in the local economy. The price elasticity with respect to overall immigration is about minus 12.4 % in column one. Introducing a measure of the degree of openness in column (2), the estimated impact of immigration jumps to minus 16.3 %. Using lagged immigration reduces the estimates in absolute terms to minus 9.9 % in column (3) without the measure of openness included, and to

[8]We should not, however, that using the same set of prices, Adrade and Zachariadis (2009) show that international relative prices are clearly stationary.

Table 2: Immigration and International price levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Overall immigration				Immigrants in Services				Immigrants in Agriculture			
Immigration	-0.124***	-0.163***	-0.099***	-0.127***	-0.083***	-0.089***	-0.074***	-0.078***	-0.032***	-0.032***	-0.029***	-0.029***
	(0.012)	(0.013)	(0.008)	(0.009)	(0.010)	(0.010)	(0.008)	(0.008)	(0.004)	(0.005)	(0.004)	(0.004)
Cost	0.409***	0.619***	0.348***	0.560***	0.399***	0.511***	0.329***	0.439***	0.221***	0.222***	0.196***	0.193***
	(0.018)	(0.029)	(0.017)	(0.026)	(0.018)	(0.026)	(0.017)	(0.025)	(0.014)	(0.014)	(0.014)	(0.015)
Pop size	-0.207***	-0.066	-0.255***	-0.107**	-0.137***	-0.040	-0.210***	-0.114**	0.253***	0.254***	0.199***	0.196***
	(0.045)	(0.048)	(0.046)	(0.048)	(0.044)	(0.048)	(0.045)	(0.049)	(0.032)	(0.032)	(0.032)	(0.032)
Price lag	0.875***	0.876***	0.884***	0.885***	0.876***	0.876***	0.884***	0.885***	0.896***	0.896***	0.895***	0.895***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Openness		0.445***		0.487***		0.248***		0.252***		0.006		-0.013
		(0.048)		(0.046)		(0.044)		(0.044)		(0.031)		(0.030)
Observations	47958	47958	52818	52818	47958	47958	52818	52818	30308	30308	30539	30539
Cities (Nations)	30 (10)	30 (10)	30 (10)	30 (10)	30 (10)	30 (10)	30 (10)	30 (10)	16 (14)	16 (14)	16 (14)	16 (14)
adjusted R^2	0.824	0.825	0.821	0.821	0.824	0.824	0.820	0.821	0.877	0.877	0.874	0.874

Notes: *** p-value < 0.01, ** < 0.05, * < 0.10. In Columns (3) and (4), (7) and (8), and (11) and (12), we use the first available lag of the immigration variable.

minus 12.7 % in column (4).

In columns (5) to (8) of Table 2, we consider immigrants employed in the service sector. The price elasticity with respect to immigrants employed in Services is lower than the elasticity relative to overall immigration. This is estimated at minus 8.3 % as shown in column (5). Introducing a measure of openness, the estimate in column (6) is equal to minus 8.9 %. Considering lags of immigration rather than its contemporaneous values gives estimates equal to minus 7.4 % in column (7), and minus 7.8 % in column (8) once we re-introduce a measure of openness.

Finally, in columns (9) to (12) of Table 2, we report the estimated elasticities based on immigrants employed in the agricultural sector. The estimates for the price elasticity with respect to immigration are now at their lowest. These are equal to minus 3.2 % in columns (9) and (10), and to minus 2.9 % in columns (11) and (12) using lagged values of immigration, remaining the same irrespective of whether we include openness or not.

The estimated coefficients for the remaining explanatory variables in columns (1) to (12) are as follows: The cost of production has a large positive statistically significant impact on prices throughout as expected. The first lag of the price level has a positive significant impact on next period's price level deviation as expected, estimated to be just below 90 %. Population size has a negative effect on prices in columns (1) to (8) as would be expected if it was capturing scale effects or if it was inversely related to export markups. However, the sign of this effect is reversed in columns (9) to (12). Moreover, the negative estimated impact of population size becomes statistically insignificant in columns (2) and (6) once a measure of openness is included. As smaller economies tend to be more open, the measure of openness should be expected to be highly and inversely correlated with the measure of population size, which is consistent with the impact of the latter becoming smaller or even insignificant when openness is allowed for in the regressions. The degree of openness is estimated to have a significant positive impact on prices in columns (2), (4), (6), and (8), that becomes statistically indistinguishable from zero in columns (10) and (12). This

Table 3: Immigration and International price changes.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Overall immigration			Immigrants in Services			Immigrants in Agriculture		
Immigration	-0.035***	-0.038***	-0.046***	0.008	0.009	0.009	-0.014***	-0.015***	-0.012***
	(0.013)	(0.013)	(0.013)	(0.007)	(0.007)	(0.007)	(0.002)	(0.002)	(0.002)
Cost	0.661***	0.617***	0.598***	0.628***	0.580***	0.562***	0.464***	0.458***	0.429***
	(0.018)	(0.021)	(0.021)	(0.017)	(0.021)	(0.021)	(0.014)	(0.014)	(0.014)
Pop size	0.391***	0.351***	0.322***	0.412***	0.374***	0.355***	0.073***	0.072***	0.065***
	(0.026)	(0.027)	(0.028)	(0.026)	(0.027)	(0.027)	(0.017)	(0.017)	(0.017)
Price lag	-0.107***	-0.107***	-0.107***	-0.107***	-0.107***	-0.107***	-0.125***	-0.125***	-0.125***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Openness		-0.151***	-0.151***		-0.147***	-0.146***		-0.014	-0.005
		(0.032)	(0.032)		(0.032)	(0.032)		(0.017)	(0.017)
GDP growth			0.002***			0.002**			0.003***
			(0.001)			(0.001)			(0.000)
Observations	74123	74123	74123	74123	74123	74123	57443	57443	57443
Cities (Nations)	36 (15)	36 (15)	36 (15)	36 (15)	36 (15)	36 (15)	39 (21)	39 (21)	39 (21)
adjusted R^2	0.155	0.156	0.156	0.155	0.156	0.156	0.177	0.177	0.178

Notes: *** p-value < 0.01, ** < 0.05, * < 0.10.

surprising positive impact might be another outcome of the inter-relation and resulting collinearity of openness with size. Moreover, since fixed city and time dummies are included, these might be absorbing some of the effects associated with an expected negative effect of trade liberalization on prices to the extent that this is specific to a certain location or time period.

Inflation rates

In Table 3, we present estimates based on the specification in changes described in equation (2). That is, for the period from 1990 to 2006, we explain changes in price deviations for each good relative to its mean across locations by the respective deviations of immigration, population size, cost, and openness relative to the average across all locations. A lag of the price deviation is included in all specifications along with city-specific and time-specific effects. We also consider deviations of each country's GDP growth rate relative to the average across locations as an additional explanatory

variable meant to control for the positive relation between prices and the business cycle at an annual frequency. That is, countries at a higher point on their business cycle relative to others would be expected to experience more rapid changes in prices.

In the first three columns of Table 3, we report results obtained using changes in the overall number of immigrants employed in the local economy. The estimated coefficient for the impact of immigration on relative inflation rates is minus 3.5 % in column (1). Introducing changes in openness in column (2), the impact of immigration is now estimated at minus 3.8 %. Finally, adding GDP growth, we obtain an impact of immigration that is now equal to minus 4.6 % in column (3).

In columns (4) to (6) of Table 3, we report estimates when utilizing immigrants employed in services-related occupations. The estimated impact of immigrants employed in Services is found to be statistically indistinguishable from zero in all cases. Finally, we consider immigrants employed in the Agricultural sector and report results in columns (7) to (9) of Table 3. In this case, the estimated impact of immigration on price changes is equal to minus 1.4 % in columns (7), minus 1.5 % in columns (8), and minus 1.2 % in column (9), always smaller in absolute terms than the impact of overall immigration shown in columns (1) to (3).

Turning now to the remaining explanatory variables, changes in the cost of production are shown to be positively related to price changes. Interestingly, consistent with economic intuition, while population levels typically have an inverse impact on price levels related to economies of scale in distribution or an inverse relation of market size with markups, changes in population are found to have a positive impact on prices as a proxy of higher demand resulting from an increase in population in any given city. On the other hand, the lagged price level has a negative impact on price changes consistent with initially low-price locations experiencing greater increases in prices. Moreover, openness now has the expected negative effect on price changes which, however, turns insignificant in columns (8) and (9). This inverse relation of price changes with the rate at which

Table 4: Immigration and International prices of "consumed" goods.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	levels				changes		
Immigration	-0.132***	-0.169***	-0.091***	-0.114***	-0.047*	-0.048*	-0.044*
	(0.028)	(0.030)	(0.019)	(0.020)	(0.027)	(0.027)	(0.027)
Cost	0.392***	0.586***	0.332***	0.505***	0.658***	0.647***	0.655***
	(0.034)	(0.053)	(0.033)	(0.050)	(0.037)	(0.043)	(0.045)
Pop size	-0.183**	-0.053	-0.208**	-0.085	0.364***	0.353***	0.366***
	(0.085)	(0.089)	(0.085)	(0.090)	(0.054)	(0.057)	(0.059)
Price lag	0.806***	0.806***	0.816***	0.817***	-0.179***	-0.179***	-0.180***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)
Openness		0.412***		0.401***		-0.040	-0.040
		(0.095)		(0.093)		(0.065)	(0.065)
GDP growth							-0.001
							(0.001)
Observations	14644	14644	16137	16137	22558	22558	22558
Cities (nations)	30 (10)	30 (10)	30 (10)	30 (10)	36 (15)	36 (15)	36 (15)
R^2 a	0.755	0.756	0.754	0.755	0.175	0.175	0.175

Notes: *** p-value < 0.01, ** < 0.05, * < 0.10. In Columns (4) and (5) we use the first available lag of immigration.

trade liberalization is implemented, is consistent with economic intuition regarding the increase in product availability and resulting higher competition across differentiated products that occurs as trade becomes more liberalized. Finally, real GDP growth has a small positive impact on prices as expected from the relation between prices and the business cycle at an annual frequency. Overall, the set of control variables considered here appear to capture well a number of economic factors that are likely to be influencing prices, so that any remaining impact of immigration on inflation rates is less likely to be due to omitted variables.

The Demand channel

In Table 4, we consider the impact of the overall number of immigrants employed in the economy, on the prices of common food items for which lower income groups including immigrants are more likely to constitute an important part of demand as compared to other products not deemed

as necessities. These necessities are food items such us bread, butter, rice, potatoes, bananas, tomatoes, eggs, pork chops, and fresh or frozen chicken. A complete list of the forty-five goods considered here is found in the appendix Table A1. In the first four columns of Table 4, we estimate regression equation (1) in levels for the overall number of immigrants as in columns (1) to (4) of Table 2, restricting the set of goods as described above. For columns (5) to (7) of Table 4, we estimate regression equation (2) in log changes for the overall number of immigrants as in columns (1) to (3) of Table 3, again restricting the set of goods as above.

Looking in the first column of Tables 2 and 4 respectively, the impact of immigration on food items shown in the latter table equals minus 0.132 as compared to the impact on the average good in the consumption basket which is shown to equal minus 0.124 in the former table. Comparing the estimates in column (2) of Tables 4 and 2 that include the full set of our explanatory variables, the estimated impact of immigration on food items is minus 0.169 in Table 4 as compared to minus 0.163 for the impact on the average good in the consumption basket reported in Table 2. For the specification with lagged immigration including again the full set of explanatory variables reported in column (4) of each Table, the price impact of lagged immigration on food items is estimated at minus 0.114 in Table 4 as compared to minus 0.127 for the impact on the average good in the consumption basket as shown in Table 2. Overall, the impact of immigration on prices of items likely to be consumed by immigrants is comparable to its impact on the price of the average good in the consumption basket.

Turning to the comparison of the estimates obtained from the specification in changes for the restricted versus the full sample of goods and services, these appear to be comparable and in most cases higher for the impact of immigration on the restricted sample of goods. For example, comparing the estimates in column (1) of Table 3 with those in column (5) of Table 4 the impact on the inflation rate for food items is minus 0.047 as compared to an estimate of minus 0.035 shown in the former table. Comparing the estimate in column (6) of Table 4 with that in column (2) of

Table 5: Immigration and International prices of "produced" services.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			levels			changes	
Immigration	-0.080*	-0.132***	-0.049	-0.084**	-0.145**	-0.151**	-0.142**
	(0.044)	(0.050)	(0.031)	(0.035)	(0.066)	(0.066)	(0.065)
Cost	0.404***	0.694***	0.363***	0.628***	0.761***	0.689***	0.708***
	(0.080)	(0.120)	(0.079)	(0.115)	(0.081)	(0.095)	(0.102)
Pop size	0.070	0.271	0.066	0.255	0.165	0.095	0.126
	(0.189)	(0.190)	(0.192)	(0.193)	(0.141)	(0.152)	(0.165)
Price lag	0.887***	0.890***	0.896***	0.898***	-0.089***	-0.088***	-0.088***
	(0.013)	(0.013)	(0.012)	(0.012)	(0.010)	(0.010)	(0.010)
Openness		0.606***		0.603***		-0.248*	-0.249*
		(0.226)		(0.222)		(0.151)	(0.151)
GDP growth							-0.002
							(0.003)
Observations	1856	1856	2040	2040	2863	2863	2863
Cities (nations)	30 (10)	30 (10)	30 (10)	30 (10)	36 (15)	36 (15)	36 (15)
adjusted R^2	0.893	0.894	0.890	0.891	0.324	0.325	0.325

Notes: *** p-value < 0.01, ** < 0.05, * < 0.10. In Columns (4) and (5), we use the first available lag of immigration.

Table 3 for the specification that accounts for all explanatory variables other than GDP growth, the impact on the inflation rate for food items is 0.048 compared to 0.038 for the full sample of goods and services. Finally, comparing the estimates in the last column of Table 4 with those in column (3) of Table 3 including the full set of our explanatory variables, the estimated impact of immigration on food items is minus 0.044 in Table 4 which is comparable to the estimated value of minus 0.046 for the impact on the average good in the consumption basket reported in column (3) of Table 3.

The Supply channel

In Table 5, we consider the impact of the overall number of immigrants on services they are more likely to produce such us Laundry, Dry cleaning, Domestic cleaning help, and Baby-sitting. These categories resemble those in Cortes (2008) as typical services likely to be offered by immigrants.

Overall, we consider eleven service items for these four types of services shown in Table A2. In the first four columns of Table 5, we estimate regression equation (1) in levels for the overall number of immigrants[9] as in columns (1) to (4) of Table 2, but restricting the set of items to the list of services described above. For columns (5) to (7) of Table 5, we estimate regression equation (2) in changes for the overall number of immigrants as in columns (1) to (4) of Table 3, but again restricting the set to the services described above.

Comparing the estimates in column (2) of Tables 5 and 2 for the specifications that include all our explanatory variables, the estimated impact of immigration on service items is minus 0.132 in Table 5 as compared to minus 0.163 for the impact on the average good in the consumption basket reported in Table 2. For the specification with lagged immigration including again the full set of explanatory variables, the price impact of lagged immigration on food items is estimated at minus 0.084 in column (4) of Table 5 as compared to minus 0.127 for the impact on the average good as shown in column (4) of Table 2.

Turning to the estimates for the specification in changes based on regression equation (2), the estimated impact of immigration on services relative inflation rates reported in column (6) of Table 5 is 0.151 compared to 0.038 for the full sample of goods reported in column (2) of Table 3. These estimates are based on a specification that accounts for all explanatory variables other than GDP growth. The estimate for the impact of immigration on service items in the last column of Table 5 that accounts for the full set of our explanatory variables is minus 0.142, as compared to the estimated value of minus 0.046 for the impact on the average good in the consumption basket reported in column (3) of Table 3. We note that while for the specification in levels described by

[9]It would be natural here to consider the impact of immigrants employed in services on the price of services. This impact is actually estimated to be negative in all specifications corresponding to those reported in Table 5, but the effect is significant for only one of the specifications corresponding to that in column (4) of Table 5, using lagged immigration along with the full set of explanatory variables, where it equals -0.053. The lag of a strong significant negative impact for immigration in services as compared to the impact of overall immigration might be related to the fact pointed out in the introduction regarding the relation of each of these measures with illegal immigration in conjunction with the likely strong negative impact of the latter on wages and prices.

regression equation (1), estimates of the impact of employed immigrants on prices of services they are more likely to produce is comparable but lower than the impact on prices for the full sample of goods, for the specification in log changes described by regression equation (2), the estimated impact of immigration on price changes for services is estimated to be more than three times as high as the impact on the average good in the consumption basket.

5 Conclusion

We have undertaken an investigation of the relation between immigration and prices for a number of cities across the world. More specifically, we have considered the relation between international price differences and the ratio of the number of immigrants present in a country relative to the overall number of employees in that country. We have also considered the relation between the growth rate of the number of immigrants and the rate of price changes across countries. In both cases, we have considered the aggregated number of immigrants, the number of immigrants employed in services, and the number of immigrants in the agricultural sector.

Our analysis suggests that aggregate immigration has a larger impact on prices for both the levels and log changes specifications alike. In the light of this result, we have considered the impact of aggregate immigration on the prices of basic food items immigrants are more likely to consume and on the prices of basic services they are more likely to produce. The impact on these basic food items is comparable to and often somewhat higher than that on the average good for both the specification in levels and log changes.

The impact on the relative inflation for services immigrants are likely to produce is considerably higher relative to that for the average good or service in the sample providing some evidence for a supply-side explanation of the impact of immigration on prices, consistent with Cortes (2008). Our finding regarding this inverse effect of the rate of immigration growth on relative inflation is consistent with Bentolila, Dolado, and Jimeno (2008) who document an inverse relation between

immigration and inflation resulting in a shift of the Phillips curve for the Spanish economy, with lower unemployment rates becoming consistent with lower inflation as a result of immigration flows.

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Table A1: Description of basic food items used in Table 4

1	White Bread (1 kg)	24	Eggs (12)
2	Butter (500 g)	25	Peas, canned (250 g)
3	Margarine (500 g)	26	Tomatoes, canned (250 g)
4	White rice (1 kg)	27	Peaches, canned (500 g)
5	Spaghetti (1 kg)	28	Sliced pineapples, canned (500 g)
6	Flour, white (1 kg)	29	Beef: steak, entrecote (1 kg)
7	Sugar, white (1 kg)	30	Beef: stewing, shoulder (1 kg)
8	Cheese, imported (500 g)	31	Beef: roast (1 kg)
9	Cornflakes (375 g)	32	Beef: ground or minced (1 kg)
10	Yoghurt, natural (150 g)	33	Veal: chops (1 kg)
11	Milk, pasteurised (1 l)	34	Veal: fillet (1 kg)
12	Olive oil (1 l)	35	Veal: roast (1 kg)
13	Peanut or corn oil (1 l)	36	Lamb: leg (1 kg)
14	Potatoes (2 kg)	37	Lamb: chops (1 kg)
15	Onions (1 kg)	38	Lamb: Stewing (1 kg)
16	Mushrooms (1 kg)	39	Pork: chops (1 kg)
17	Tomatoes (1 kg)	40	Pork: loin (1 kg)
18	Carrots (1 kg)	41	Ham: whole (1 kg)
19	Oranges (1 kg)	42	Bacon (1 kg)
20	Apples (1 kg)	43	Chicken: frozen (1 kg)
21	Lemons (1 kg)	44	Chicken: fresh (1 kg)
22	Bananas (1 kg)	45	Frozen fish fingers (1 kg)
23	Lettuce (one)		

Table A2: Description of basic services used in Table 5

1	Laundry, one shirt in standard high-street outlet,
2	Laundry (one shirt) (mid-priced outlet)
3	Dry cleaning, man's suit (standard high-street outlet)
4	Dry cleaning, man's suit (mid-priced outlet)
5	Dry cleaning, woman's dress (standard high-street outlet)
6	Dry cleaning, woman's dress (mid-priced outlet)
7	Dry cleaning, trousers (standard high-street outlet)
8	Dry cleaning, trousers (mid-priced outlet)
9	Hourly rate for domestic cleaning help
10	Maid's monthly wages (full time)
11	Babysitter's rate per hour