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The Healthy Immigrant Effect: Patterns and Evidence from Four Countries

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Abstract The existence of a healthy immigrant effect—where immigrants are on average healthier than the native born—is a widely cited phenomenon across a multitude of literatures including epidemiology and the social sciences. There are many competing explanations. The goals of this paper are twofold: first, to provide further evidence on the presence of the healthy immigrant effect across source and destination country using a set of consistently defined measures of health; and second, to evaluate the role of selectivity as a potential explanation for the existence of the phenomenon. Utilizing data from four major immigrant recipient countries, USA, Canada, UK, and Australia allows us to compare the health of migrants from each with the respective native born who choose not to migrate. This represents a much more appropriate counterfactual than the native born of the immigrant recipient country and yields new insights into the importance of observable selection effects. The analysis finds strong support for the healthy immigrant effect across all four destination countries and that selectivity plays an important role in the observed better health of migrants vis a vis those who stay behind in their country of origin.

Keywords Immigrant health · Selection effects · Smoking · Obesity

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Introduction

It is widely accepted that new immigrants to developed countries enjoy significant health advantages relative to comparable native-born populations.[1] This has come to be known as the "healthy immigrant effect" (HIE). The phenomenon is present despite the majority of immigrants coming from developing countries where mortality and morbidity indicators are higher than the developed countries to which they are migrating. The literature outlines a number of potential explanations for the conundrum, including the following: health screening or selection via skills and education by host country immigration authorities, relatively healthy behaviors of new immigrants prior to migration, immigrant self-selection whereby the healthiest and wealthiest individuals are the most likely to migrate, and finally the salmon effect whereby the less healthy or successful immigrants return home.[2] Distinguishing among the various explanations is difficult as they are interrelated and many of the dimensions are not directly observable. Thus, this is beyond the scope of the current paper. Instead, we focus on shedding light on the potential importance of self-selection effects of immigrant arrivals, a key component of all above explanations, although operating through a less direct pathway in the explanations based on premigration healthy behavior and the salmon bias effect. Hartwich (2011) cogently argues that it is precisely Australia's selectivity mechanisms that have led to its multicultural success compared to other nations, particularly the UK.

Using data from the UK, Australia, Canada, and the USA enables an analysis of migrants from each of the four source countries compared with their own respective native-born nonmigrants. This provides much more direct evidence on the healthy immigrant effect and the role of selectivity than the traditional comparison of migrants with native born of the destination country.

Heuristic Model of Migration and Associated Hypotheses

The work of Jasso et al. (2004) and Rosenzweig (2010) follows in the classic tradition of Sjaastad's (1962) seminal paper on migration as well as the analysis of investment in health by Grossman (1972). The more recent contributions highlight the roles of country skill price differentials, transferability of skills across country, and both the pecuniary and nonpecuniary costs of moving between countries.[3] In simple terms, the

[1] For Canada, see Newbold and Danforth (2003), McDonald and Kennedy (2004), Ng et al. (2005) and Wu and Schimmele (2005). Veenstra (2009) finds that the healthy immigrant effect offsets disparities in health by race. Biddle et al. (2007) document a healthy immigrant effect for immigrants to Australia, while Singh and Siahpush (2002), Jasso et al. (2004) and Antecol and Bedard (2006) do so for immigrants to the USA.

[2] Other explanations for the HIE have also been discussed in the literature. Jasso et al. (2004) and McDonald and Kennedy (2004) suggest that reporting—either where recent immigrants understate the incidence of certain chronic conditions because of differences in perception or because such conditions have not yet been diagnosed due to barriers in access to health services—can give rise to the appearance of a healthy immigrant effect. However, Jasso et al. (2004) report that their results are robust to these considerations. As well, McDonald and Kennedy (2004) show that the use of basic health services among recent immigrants to Canada converges to native-born levels much more quickly than is the case for health measures.

[3] Nonpecuniary costs capture a myriad of factors including isolation associated with leaving close relatives, cultural adaptation, and assimilation as well as cross-country differences in access and quality of health services.

decision to migrate is based on a comparison of the costs versus the benefits. The Grossman model of the demand for health assumes that education increases the efficiency of health production, thus reducing the shadow price. This in turn implies that health and education are positively correlated.

The above heuristics prompt a number of hypotheses relating to the likelihood of migration and characteristics of the migrant group. As costs of migration rise, ceteris paribus, the likelihood of migration declines implying individuals who do migrate will be drawn from higher and higher up the distribution in terms of associated benefits of migration. Thus, as the costs rise, migrant selectivity will increase. Selectivity may revolve around a number of distinct factors associated with the increased benefits of migration. For given cross-country skill prices, the more obvious factors are increased skills and education and due to the positive correlation, health. Thus, as costs of migration rise ceteris paribus, immigrant selectivity with respect to skill, education, and health will become more pronounced and thus the gap between migrant characteristics and their associated source country nonmigrants will rise. This in turn will increase the magnitude of the observed healthy immigrant effect.

Second, as suggested by Jasso et al. (2004), intercountry differences in skill prices also affect the extent of selectivity on the basis of skill and education, and via associated positive correlation, health. Thus, ceteris paribus, the higher skill prices are, in the home country relative to those in the chosen migration destination, the greater the degree of selectivity. Similarly, the lower the transferability of skills, the greater the selectivity of the migrant cohort.

Selectivity may arise via a number of mechanisms, including the following: institutional selection favoring highly skilled immigrants as well as health screening by host country authorities prior to migration and immigrant self-selection whereby the healthiest and wealthiest source country residents are the most likely to have the financial and physical means to migrate.

Many immigrant destination countries actively court highly skilled immigrants. Canada and Australia in particular both attempt to attract younger and more educated immigrants via a skilled immigrant intake based on a point system that explicitly considers age, education level, as well as language fluency. Similarly, the UK introduced the Highly Skilled Migrant Program in 2002,[4] while the USA offers a variety of forms of temporary work visa to significant numbers of immigrants on the basis of education and skills that are in high demand in the US economy (though obtaining permanent residency is generally substantially more difficult).

Since both age and education are strong correlates of health, immigrant intakes should include relatively healthier individuals. Chiswick et al. (2008) find that visa category plays a significant role in Australian immigrant health, with refugees (skilled class) more (less) likely to be in poorer self-reported health.

It is also the case that immigrant-receiving countries assess the health of applicants for migration in order to evaluate the potential burden on the health systems of the host country. There is little formal analysis of the impact of health screening in the literature although it appears unlikely to be the principal determinant of the health gap. For example, Laroche (2000) reports that the percentage of applicants to Canada that are

[4] In 2006, the UK announced a restructuring of their immigration program that introduces a point-based system for all prospective immigrants to the UK.

rejected on health grounds is very low. Uitenbroek and Verhoeff (2002) find that an explanation based on selection by authorities "is not convincing" in their study of the mortality of Mediterranean immigrants in Amsterdam. For permanent migration to Australia, only a handful of medical conditions such as active tuberculosis are listed as potentially serious enough to result in denied entry.[5] The USA has a longer list of conditions deemed to be inadmissible without treatment such as Hansen disease and sexually transmitted diseases, although it is noteworthy that HIV was removed from the list of inadmissible conditions in 2010.[6]

Positive selection by immigration authorities implies that better educated and skilled immigrants gain entry. Moreover, the existence of this process may also induce positive self-selection on behalf of individuals, i.e. applicants who believe they have a good chance of gaining entry. To the extent that these individuals are also in better health, this self-selection may give rise to the healthy immigrant effect. Similarly, if individuals anticipate a rigorous health screening process, less healthy individuals may be deterred from applying in the first place.

Though self-selection may be based on factors observable to the researcher (e.g., young and more highly educated) and related to the institutional processes, it may also be cast in terms of unobservable characteristics such as motivation and the degree to which the individual is forward-looking, both factors that are also likely to be correlated with good health. Jasso et al. (2004) find evidence of positive self-selection in terms of health status, though with substantial variation by source country. Also, Swallen (1997) finds lower mortality rates among immigrants to the USA compared with mortality rates of nonimmigrants in their respective home countries. Recent work by Rubalcava et al. (2008) compares Mexican immigrants to the USA to Mexican nonimmigrants and finds only weak evidence of the healthy immigrant effect.[7]

Methodology

Our methodological approach proceeds in three steps. First, we document the existence of the HIE among recently arrived (i.e., 10 years or less) immigrants in four major immigrant-receiving countries (USA, Canada, the UK, and Australia) using a uniformly defined set of health outcomes and behaviors. We then examine the extent to which differences are due to observable characteristics such as education and age that have been shown to figure prominently in personal migration decisions and immigration selection policy. Finally, we compare health outcomes and behaviors of immigrants with nonimmigrants in the corresponding *source* countries. Health outcomes for immigrants from the USA, UK, Canada, and Australia are particularly informative about self-selection since culture, language, socioeconomic profile, and health/medical technologies in source and destination countries are similar. In terms of the methodological approach to addressing questions related to selection effects, Jasso et al. (2004) and others argue that the appropriate comparison with which to gauge the healthy

[5] http://www.immi.gov.au/allforms/health-requirements/overview-health-req.htm. Accessed 13/8/2013.
[6] http://www.cdc.gov/immigrantrefugeehealth/laws-regs/hiv-ban-removal/final-rule.html. Accessed 13/8/2013.
[7] For related work on immigrant self-selection in terms of labor market outcomes, see Aydemir 2009; Aydemir and Skuterud 2005, Chiquiar and Hanson 2005, and Borjas 1987.

immigrant effect is between immigrants and "similar" people in the source countries and not native-born people from the host countries. This is precisely the focus of the method employed in the current analysis.

Our statistical approach involves estimation of logistic regression models of health outcomes and behaviors as a function of gender, age, education, marital status, and years since migration for immigrants. We estimate the models separately for each immigrant arrival group and the native-born in each recipient country. [8] We use these regression results to generate predicted prevalence levels for each group in each host country. Ceteris paribus, this allows us to determine the extent to which observed differences are driven by differences in the observable characteristics. If there is no selection on unobservable characteristics, then we would not expect to see any significant differences in the standardized results that control for differences in observables.

Data

The data used in this paper are drawn primarily from pooled national cross-sectional individual datasets for each of our four main immigrant recipient countries of interest. We assemble data from each country over roughly the same period of time in order to account for possible cohort effects across destination and source countries. The core datasets are the following: for the USA, consecutive cross-sections of National Health Institutes Survey (NHIS) data from 2000–2005 inclusive; for Canada, the 1996–1997 National Health Population Survey (NPHS) cross-sectional file and the 2000–2001, 2002–2003, and 2004–2005 Canadian Community Health Survey (CCHS) cross-sectional files; and for Australia, the National Health Surveys (NHS) from 1995, 2001 and 2004–2005. For the UK, there are two alternative sources of data: consecutive cross-sections of the General Household Survey (GHS) from 2000–2001 to 2004–2005 inclusive and pooled cross-sections of data from the 1999 and 2004 waves of the Health Survey for England (HSE). Specific details of each dataset are contained in the Appendix and include discussion of the strengths and limitations of particular surveys, comparability issues across surveys for a particular country, and more justification of particular years adopted.

For our working datasets for each country, samples are restricted to those aged 21 to 65 years native born and immigrants who arrived in their destination country within 10 years of the survey date (the average time since immigration for the sample is around 5 years for each destination country).

Ideally, our sample would be limited to very recent immigrants as that would best capture immigrant health status and health behaviors "on arrival" (though it might also amplify the effect of short-term barriers to the adjustment of new immigrants to an unfamiliar health system). However, given sample size restrictions, we adopted the approach outlined above and controlled for the differential effects of time (from 1 to 10 years) in the destination country on the health outcomes of particular immigrants (as would occur with acculturation) by including years since migration variables in our regression analysis.

[8] Population weights and robust stand errors are used throughout.

The pooled sample sizes of recent immigrants and (for comparison) native-born individuals for the four destination countries are as follows: the USA 129,727; Canada 227,136; UK GHS 45,959; UK HSE 11,217; and Australia 33,303. We exclude New Zealand immigrants from the Australian data due to long-standing reciprocal arrangements that provide unrestricted entry to Australia.

We consider individual information on demographic and socioeconomic factors, health outcomes, health behaviors, and immigrant characteristics. In defining particular variables for analysis, we have aimed to maintain consistency across the four country data sets. Maintaining consistency implies two limitations: first, some of our variables, including region of origin, must be categorized more broadly than is optimal; and second, certain health conditions and health behaviors must be omitted from consideration as not available in all datasets.

We measure health status in two main ways: self-reports of chronic conditions and self-reports of the general status of one's health. For the presence of chronic conditions, we define a variable that takes a value one if the respondent reports having been diagnosed with any of the following conditions: cancer, heart disease (including coronary heart disease, angina, heart attack, and other diseases of the heart), diabetes, ulcer, arthritis, hypertension, bronchitis/emphysema, and asthma.

While reasonably consistently defined across countries, an important difference in how information on chronic conditions is collected arises with the UK data. In the USA, Canada, and Australia, the surveys ask individuals whether they have been diagnosed with a particular condition by a health care professional, for a given list of specified chronic conditions. For both UK data sets, however, individuals are simply asked to name up to six chronic conditions that they suffer from. Thus, without prompting, people might be less likely to report having a condition and partly for this reason, chronic condition incidence rates appear to be significantly lower for the UK compared with other countries.

There are also cross-country discrepancies in self-assessed health status. Self-assessed health in the USA, Canada, and Australia is based on a 5-point scale: poor, fair, good, very good, and excellent. For the UK GHS, self-assessed health status is measured on a 3-point scale: poor, fair, and good, while for the HSE, self-assessed health is based on a 5-point scale: very poor, poor, fair, good, and very good. For ease of comparison, we adopt the approach of defining an indicator variable for "worse" health that is the bottom two categories where there is a 5-point scale and the bottom category where there is a 3-point scale.

Our two measures of health behaviors are the incidence of obesity and whether a person has ever smoked cigarettes daily. Obesity data are only available for the UK HSE data and not for the UK GHS data, but these variables are otherwise consistently defined across the surveys.

Given the importance of region of origin to our analysis, we use as narrowly defined classifications for particular regions as possible while at the same time ensuring consistency across the four destination countries and anonymity of respondents with cells of sufficient sample size. The regions that are consistently defined across the four destination countries (with some minor exceptions) are East and Southeast Asia, South Asia, Middle East/West Asia, Continental Africa, Continental Europe, UK and Ireland, USA, as well as Canada, Australia, and New Zealand which we group together as one immigrant group due to sample size considerations. Summary statistics of the composition of recent immigrants by region of origin are reported in Table 1.

Measures of personal characteristics that are available and consistently defined across surveys include age, gender, marital status, and education.[9] For ease of comparison and because of sample size considerations, we aggregate individuals into one of two education categories—those with at least an undergraduate university degree and those without a university degree.

Results

Initial Evidence of Selection on Education

We begin with the traditional approach of comparing recent immigrants in their destination of choice to the native born in the same country. Given we are using data for the UK, Australia, USA, and Canada we replicate the analysis for each country and each distinct immigrant group. In Table 2, we present some initial evidence of immigrant selection by considering the proportion of immigrants and native-born residents with at least a university degree.[10] With only a few exceptions, immigrants from each region of origin are more likely to have university education than the developed country native born. These are typically large differences in the order of 20 percentage points or more.[11] Verwiebe and Riederer (2010) examine educational achievement of native versus migrant groups across western society. They point to a complex array of factors influencing the pattern, including factors at the country, school, and individual levels. They also point to the role of social and cultural capital.

The above evidence represents the traditional approach relying on a comparison of immigrants in a given destination with the native born in the same destination. This somewhat tangential approach is legitimized by transitivity and the fact that the average education levels of the native born in each of the four migrant destination countries will be greater than the nonmigrant level in each of the source countries. More direct evidence of selection on education is readily apparent via comparisons of developed country immigrants and nonimmigrant residents of their home countries. Even though US nonimmigrant residents on average are the most educated of the four destination countries, immigrants from the USA are significantly more likely to have a degree (typically over 50 % of these immigrants have a degree) than nonimmigrant Americans (around 28 % have a degree). Immigrants from Britain are also significantly more educated than UK nonimmigrants, as are immigrants from Canada/Australia.

Using aggregate data on educational attainment, it is also possible to evaluate the extent of education selection for immigrants from developing countries.[12] Data on

[9] Unlike in the UK, Canada and Australia, the USA is characterized by a significant proportion of native-born residents who belong to an ethnic minority. None of the results in this paper are quantitatively affected by the restriction of the native-born sample in each country to white individuals only.

[10] Age and gender are both important determinants of health but in the interests of brevity, we do not explore those relationships in detail here. However, as explained in the paper, we control for differences in age and gender composition in obtaining our standardized estimates of immigrant native-born differences.

[11] The main exception is Mexican and other Central American immigrants in the USA who have markedly lower education levels.

[12] There is an extensive theoretical and empirical literature on the so-called brain drain from developing countries. Estimates of the extent of brain drain from a wide range of developing countries are presented in Docquier and Marfouk (2006) and Adams (2003).

Table 1 Composition of recent immigrants by region of origin and country of current residence

	USA	Canada	UK general survey	UK health survey	Australia
Proportion of recent FB (10 years or less)					
Middle East	0.026	0.064	0.050	*	0.069
South Asia	0.072	0.158	0.150	0.151	0.100
East/Southeast Asia	0.132	0.302	0.130	0.032	0.370
USA	–	0.025	0.071	*	0.025
UK/Ireland	*	0.026	–	–	0.177
Continental Europe	0.114	0.166	0.258	*	0.138
Canada/Australia/NZ	0.024	–	0.071	*	–
Africa	0.047	0.072	0.248	0.198	0.061
Mexico	0.329	0.011	*	*	*
Rest of Central America	0.090	0.015	*	*	*
South America	0.082	0.040	*	*	*
Caribbean	0.078	0.036	0.023	0.021	0.021
Proportion of ALL residents who are:					
Foreign-born	0.158	0.211	0.093	0.094	0.280
Recent Foreign-born	0.051	0.068	0.035	0.033	0.075

* Not available or suppressed for confidentiality

Continental Europe includes UK/Ireland in the US data

East/Southeast Asia includes only immigrants of Chinese ethnicity in the UK health data

South Asia includes X while East/Southeast Asia includes Y

Caribbean includes immigrants from the Americas outside of Canada and the USA in the Australian data

average years of education (Barro and Lee 2000) for 2000 indicate that the native born in India aged 25–64 years have an average number of years of education of 6.1 for men and 3.3 for women. Similarly, in China in 2000, the native born have an average of 6.9 years of education for men and 4.5 years for women. This compares with 11.5 and 11.4 years of education for men and women on average in Canada, 10.9 and 10.3 years in Australia, 12.3 and 12.2 years in the USA, and 9.4 and 9.3 years in the UK. Since immigrant educational attainment is significantly higher than nonimmigrant rates, it follows that immigrants from developing countries are even more strongly selected by education level.

Standardized Regression Results

Table 3 provides adjusted differences between immigrants and the native born in two measures of health (incidence of chronic conditions and low self-reported health) and two measures of health-related behaviors (obesity and ever smoked daily). The adjusted comparison holds characteristics such as age, education, and gender constant (at the level of the average native-born Canadian), but allows the estimated coefficients to vary by source and destination.

Table 2 Proportion of recent immigrants with a university degree or more by region of origin and country of current residence

Region of origin	USA	Canada	UK general survey	Australia
Mideast	0.42	0.41	0.42	0.20
South Asia	0.73	0.42	0.36	0.58
East/Southeast Asia	0.51	0.38	0.48	0.37
USA	–	0.51	0.64	0.59
UK and Ireland	*	0.30	–	0.26
Continental Europe	0.43	0.43	0.43	0.28
Canada/Australia/NZ	0.52	–	0.57	–
Africa	0.39	0.39	0.21	0.40
Mexico	0.04	0.32	*	*
Rest of Central America	0.08	0.07	*	*
South America	0.31	0.27	*	*
Caribbean	0.18	0.18	0.23	*
All recent immigrants	0.27	0.35	0.39	0.35
Nonimmigrants	0.28	0.18	0.19	0.17

* Not available or suppressed for confidentiality

Continental Europe includes UK/Ireland in the US data

Comparing Immigrants and Nonimmigrants in the Same Destination Country

Beginning with Table 3 column 1 for each country, we can see that after adjusting for observable characteristics in each destination country, the predicted proportion of immigrants with a chronic condition is statistically significantly less than that for the native born. A similar pattern is found for immigrants from each specific region of origin in each of the destination countries, and the differences are significantly less than zero in most cases. For low self-reported health in Table 3 column 2, there is more variation than for the measures of chronic conditions. However, even after controlling for observable characteristics, most immigrant groups in the USA, UK, and Australia are less likely to be in low self-reported health than comparable nonimmigrants.

The next two columns concern immigrant and native-born health behaviors. In Table 3 column 3, we find that again after controlling for observable characteristics, obesity rates are lower for immigrants than the native born in each destination country, both overall and for almost all source regions. For smoking, standardized immigrant rates of daily smoking presented in Table 3 (d) are significantly lower than daily smoking rates for otherwise comparable native-born residents for most immigrant groups. The two main exceptions are immigrants from the Middle East in the USA and Australia and immigrants from continental Europe in each of the four destination countries.

Comparing Nonimmigrant Residents in the Immigrants' Source Countries

In Table 4, we extract and regroup key results from Table 3 on health measures in order to compare immigrants to their nonimmigrant peers in their home countries. These

Table 3 Difference in prevalence chronic conditions, self-assessed health, obesity, and smoking behavior between immigrants and nonimmigrants by region of origin

	USA				Canada				UK				Australia			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
All FB	−0.17	**0.01**	−0.14	−0.16	−0.11	0.11	−0.07	−0.28	−0.06	−0.06	**0.01**	−0.21	−0.09	**0.03**	−0.11	−0.15
Middle East	**−0.09**	0.22	−0.14	**0.09**	−0.11	**−0.00**	**−0.05**	−0.26	*	0.28	*	**−0.15**	−0.14	**−0.04**	−0.04	**0.03**
South Asia	−0.13	**−0.09**	−0.22	−0.28	−0.09	0.13	−0.08	−0.46	−0.08	**−0.11**	**−0.04**	−0.35	**−0.02**	**−0.07**	−0.21	−0.47
East/Southeast Asia	−0.24	0.04	−0.27	−0.21	−0.15	0.17	−0.13	−0.35	−0.14	**−0.08**	−0.21	−0.33	−0.14	0.12	−0.19	−0.26
USA	–	–	–	–	**−0.05**	−0.14	**−0.01**	−0.12	*	**−0.02**	*	**−0.15**	−0.13	−0.31	−0.06	0.07
UK/Ireland	*	*	*	*	**−0.08**	**0.11**	**0.08**	−0.26	–	–	–	–	−0.05	−0.07	−0.15	**−0.03**
Continental Europe	−0.17	0.02	−0.18	**0.05**	−0.09	0.14	−0.08	**−0.06**	*	−0.15	*	**0.02**	**−0.03**	0.09	−0.15	−0.05
Canada/Australia/NZ	**−0.07**	−0.30	−0.17	**0.04**	–	–	–	–	*	**−0.03**	*	**−0.18**	–	–	–	–
Africa	−0.22	−0.04	**−0.06**	−0.25	−0.10	−0.00	**0.00**	−0.31	**−0.01**	−0.09	**0.01**	−0.26	−0.16	−0.09	**0.02**	−0.11
Mexico	−0.22	0.10	−0.08	−0.24	−0.24	0.04	**−0.05**	**−0.06**	*	*	*	*	*	*	*	*
Rest Central America	−0.12	**−0.03**	−0.09	−0.25	−0.13	0.28	−0.14	−0.36	*	*	*	*	*	*	*	*
South America	−0.19	−0.08	−0.17	−0.11	−0.21	−0.13	−0.13	−0.31	*	*	*	*	*	*	*	*
Caribbean	−0.13	−0.09	−0.10	−0.14	−0.12	−0.04	**−0.03**	−0.50	**−0.06**	*	**0.02**	*	*	*	*	*
NB Prevalence	0.39	0.32	0.28	0.42	0.26	0.34	**0.17**	0.56	0.15	0.35	**0.23**	0.50	0.33	0.41	0.25	0.58

A indicates difference in the prevalence of chronic conditions between immigrants and nonimmigrants by region of origin; B indicates difference in the prevalence of lower self-assessed health status between immigrants and nonimmigrants by region of origin; C indicates difference in the prevalence of obesity between immigrants and nonimmigrants by region of origin; D indicates difference in the prevalence of ever having smoked daily between immigrants and nonimmigrants by region of origin

Bold print indicates the value is *not* significantly different from the corresponding value for the native-born group at the 5 % level of significance

* Indicates the entry is not available or has been suppressed due to confidentiality concerns

The region "Continental Europe" includes the UK and Ireland in the US data

comparisons provide the most direct insights into possible selection effects. On average, American immigrants in Canada and Australia are all less likely to have a chronic condition than nonimmigrant Americans, after controlling for observable characteristics. This is also the case for Australians in the USA compared with their nonimmigrant compatriots in Australia, but the result does not apply for Canadians abroad compared to nonimmigrant Canadians. Since it is the case that for the nonstandardized results (not shown), Canadian and Australian immigrants in the USA are less likely to have a chronic condition than both Australian and Canadian native born, the implication is that selection is mostly on observable characteristics such as education and age. That is, better reported health among these immigrants is due mainly to the fact they are younger and more educated than nonimmigrants in their home countries, and once this is accounted for in the regression analysis, the immigrant health gap for these groups is not significant. Unfortunately, comparisons of the chronic conditions of UK immigrants with nonimmigrant Britons are not possible because of the data issues in the UK surveys noted earlier in the paper.

Turning to column 2 in Table 4, American immigrants to both Canada and Australia have significantly better self-assessed health than nonimmigrant Americans. Similarly, Canadian and Australian immigrants to the USA have significantly higher self-assessed

Table 4 Prevalence of health conditions and health behaviors

Adjusted–standardized	Chronic condition	Worse SAHS	Obese	Ever a daily smoker
USA				
US born	0.392	0.322	0.278	0.419
US in Canada	**0.212**	0.194	**0.160**	0.439
US in UK general survey		**0.332**		**0.349**
US in Australia	0.202	0.100	0.196	0.641
Canada				
Canadian born	0.257	0.336	0.165	0.559
Canada/Australia in UK		**0.319**		**0.328**
Canada/Australia in USA	**0.318**	0.026	0.104	**0.455**
UK				
UK born (General Survey)		0.349		0.503
UK born (Health Survey)	0.145	0.179	0.227	0.527
UK/Ireland in Australia	**0.276**	0.337	0.105	**0.544**
UK/Ireland in Canada	0.181	**0.446**	**0.244**	0.303
Continental Europe + UK in USA	0.219	**0.342**	0.097	**0.473**
Australia				
Australian born	0.330	0.410	0.251	0.575
Canada/Australia in UK		**0.319**		**0.328**
Canada/Australia in USA	**0.318**	0.026	0.104	**0.455**

The figures in Table 4 are derived from those in Table 3. The top row for each country in Table 4 is taken from the bottom of Table 3. The equivalent immigrant value in Table 4 are derived by adding or subtracting the relevant difference in the incidence of the health measure between immigrants and nonimmigrants given in Table 3 to the associated nonimmigrant incidence. Figures in bold are not significantly different from the associated figure for nonimmigrants

health than Australian and Canadian nonimmigrants. The Australian/Canadian immigrants to the UK have better self-assessed health than Australian/Canadian nonimmigrants, although the difference is not significant. In terms of the unadjusted comparison, the difference is negative and significant, thus, controlling for education, age, and other characteristics leads the healthy immigrant effect to become insignificant. Thus, once again, self selectivity appears to be captured by the observed characteristics.

Table 4, column 3 outlines the differences in obesity levels. Immigrants from the USA are less obese than the US native born. Also, British immigrants in Australia and Canada are less likely to be obese than native-born Britons, and Canadian/Australian immigrants in the USA are less likely to be obese than native-born Canadians and Australians. American immigrants to Canada and the UK and Australia are less likely to have ever smoked daily than nonimmigrant Americans (though only marginally so in the case of Australia). Similarly, Australian/Canadian immigrants in the USA and UK immigrants in Canada and Australia are less likely to have ever smoked daily than their nonimmigrant home country peers. Results are similar for those who are current daily smokers. Overall, the comparison of developed country immigrant health indicates that while immigrants are on average in better health, the difference with their nonimmigrant developed country counterparts is often accounted for by differences in education levels and age.

To gain some additional insights into the extent of immigrant self-selection for immigrants from developing countries, we use readily available data on smoking prevalence from the World Health Organization [13] to compare average smoking rates for developing countries with rates among recent immigrants illustrated in the figures. Overall, average smoking rates among immigrants are substantially lower than for their respective home country peers. For example, average rates of daily smoking in China are 24 %, in India 16 %, in Egypt 29 %, and in Vietnam 27 %.[14] All of these rates are considerably higher than are those for immigrants from these country areas, in all four destination countries.[15]

Discussion

We have established that there is clear evidence of a healthy immigrant effect across all immigrant groups in each of our destination countries of interest—the USA, the UK,

[13] Data on smoking rates by country are taken from *The World Tobacco Atlas* by J. MacKay and M. Eriksen, published in 2002 by The World Health Organization (www.who.int/tobacco)

[14] There are wide differences in smoking rates by gender in developing countries that are not apparent from these averages: for example, 4 % of females and 44% of males are daily smokers in China; comparable figures for India are 4 and 28%, for Egypt 18 and 40%, and Vietnam 4 and 51%.

[15] Comparing obesity incidence with published country-specific obesity rates does not yield consistent patterns. (Note that obesity data are only available for selected countries so that it is not possible to calculate exact weighted average obesity rates for our classification of regions of origin. Thus, this discussion should be seen as indicative rather than conclusive). Obesity rates in China and Vietnam are in the order of 1 %, close to what is found for immigrants from East Asia. Obesity rates for India are also around 1 % and are substantially lower than what is seen for Indian immigrants. For the Middle East, immigrant obesity rates are probably lower than for nonimmigrants since comparable rates for Iran and Turkey are 18 and 22 %, respectively. Finally, obesity rates for European immigrants are probably lower than for nonimmigrant Europeans, which vary from 7 % in France and 8 % in Italy to 17 % in Russia, 18 % in Bosnia and 19 % in Germany. Source: WHO Global Infobase (http://infobase.who.int).

Canada, and Australia—using a consistently defined set of indicators for both physical health and healthy behaviors and consistently defined regions of origin. While overall levels of health vary across destination countries, how immigrant groups compare to their respective destination native-born counterparts is similar across destination countries even though there is significant variation in immigration policy across these countries—in particular, policies governing the selection of immigrants. There is also evidence that the HIE is stronger for immigrants from developing countries than for those from developed countries.

Certain health behaviors of immigrants from developing countries are superior to those of immigrants from developed countries, although evidence from other research (e.g., McDonald and Kennedy 2005; Antecol and Bedard 2006) suggests that there is some reduction in the gap the longer immigrants are exposed to their new environment. There is evidence that immigrants from all regions are positively selected on the basis of educational attainment, and interestingly, the most highly educated immigrants come from both developed and developing countries. However, differences in educational attainment and other observable factors important to health such as age do not fully explain the health gap between immigrants and nonimmigrant residents. Immigrants from both developing and developed regions are less likely to have a chronic condition, are less likely to smoke, and are less likely to be obese than comparable nonimmigrant residents of the four destination countries considered after accounting for observable differences.

The results for immigrants from the four destination countries are particularly noteworthy since they imply positive immigrant selection effects in health outcomes and behaviors: similar health systems, language, and culture among these four countries would seem to rule out other explanations for the HIE. We find evidence that immigrants from developed countries also tend to be healthier than the native-born in both their new country and their country or region of origin. This suggests that immigrant self-selection effects are important given the relatively small differences in the cultures and diets of the four destination countries examined in this study. While selection on observable characteristics such as age and education is important, there remains significant evidence of a healthy immigrant effect among these similar groups even after controlling for such factors.

Furthermore, our results suggest that the self-selection of immigrants generates additional benefits for the host country in terms of a healthier immigrant cohort and consequently lower health care costs and a more productive workforce. Even with major differences in immigration programs across our four countries, the evidence indicates an immigrant population healthier than their nonimmigrant equivalents in both host and sending countries.

A number of caveats should be noted. First, we are using measures of self-reported information that may be subject to reporting biases. As well, we also do not observe information on the timing of the onset of a chronic condition, for example, whether the condition arose after arrival in the host country. Finally, we cannot conclusively identify immigrant self-selection as distinct from other possible theories given available data sources. Nevertheless, our results are strongly indicative of an immigrant self-selection effect. Future work could build on the comparisons of immigrants with their nonimmigrant home country counterparts, particularly for developing countries where differences between immigrants from those countries and nonimmigrants are likely to be much more pronounced.

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Appendix: Data Sources and Characteristics

The US data are drawn from the public-use National Health Interview Surveys (NHIS) for the years 2000 to 2005. While earlier years of data are available for the NHIS, they do not contain immigrant region of origin information. US-born Hispanics are included in the native-born US, but their exclusion has little impact on the results. When measuring region of origin in the US data, immigrants from Europe include those from the UK as well as from Continental Europe. Moreover, there are no data on mother tongue or language first spoken. Australian and Canadian immigrants are not explicitly identified in the USA data but are assumed to be immigrants from other areas who are white ("other" areas include Canada, Australia, New Zealand, and the pacific islands—thus, this approximation seems reasonable). Immigrants from India are not explicitly identified, but we impute this category based on immigrants from South Asia who are of "Indian" descent.[16]

The Canadian micro-data are based on confidential versions of recent large-scale datasets collected by Statistics Canada: the National Population Health Survey (1996) and the Canadian Community Health Survey (2001 and 2003). Specific country of origin is available in the Canadian data so it is possible to combine groups of countries in order to be consistent with the more limited data on region of origin available in the US and UK data.

Two sets of comparable micro-data for the UK are drawn from two separate sources: the General Population Surveys 2000 to 2004 and the UK Health Surveys for 1999 and 2004 (note that people born in Ireland who are in the UK are not considered immigrants for the purposes of this study). While the general population survey has more disaggregated information on region of origin, it also appears seriously to under-report the incidence of particular chronic conditions, as the reported incidence is very low for all conditions. There are also no data on body mass index and obesity in this survey. For these reasons, we utilize the UK Health Surveys for 1999 and 2004. Unfortunately, while health surveys are available for other years, it is only for these 2 years that information on year of arrival and region of origin are both available. Also, only a limited number of regions of origin are identified for immigrants. Asians outside of South Asia are grouped into a single category—thus, to approximate the region East Asia, we include only those immigrants who report being of Chinese descent. Therefore, the percentage of this group among all foreign-born is much lower than for the UK general survey. Further, Europe, USA, Canada, and Australia are not separately

[16] The "public use" NHIS data only began reporting region of origin for immigrants in the 2000 NHIS, although data on year of arrival and race of immigrants is available from earlier NHIS surveys. As well, although there is detailed information on race/ethnicity, data on region of origin are reported for groups of countries rather than individual countries. However, this does not prove to be a serious obstacle, as either the regions of origin represent relatively homogeneous sets of countries, or a single country dominates the supply of immigrants (for example immigrants from "East Asia" are mainly Chinese).

identified, so to approximate developed country foreign-born, we select foreign-born white immigrants and report them as one pooled category. The incidence of chronic conditions as measured by the UK health surveys is still lower than for other countries but higher than for the UK general surveys.

Australian micro-data are sourced from confidentialized versions of the Australian Bureau of Statistics National Health Surveys from 1995 and 2001. New Zealanders are excluded from the subsample of immigrants owing to the reciprocal rights of residency, employment, and income support between Australia and New Zealand. Country of origin information is available on these data sets and so immigrants can be categorized for consistency with the regions of origin available in the UK and US data.

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