

# The Globalization of Household Production<sup>\*</sup>

Michael Kremer

Stanley Watt

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## Abstract

Immigration restrictions are arguably the largest distortion in the world economy and the most costly to the world's poor. Yet, these restrictions seem firmly in place due to fears in rich countries that immigration would exacerbate inequality among natives, fiscally drain the welfare state, and change native culture. Many “new rich” countries are creating a new form of immigration that may not encounter these obstacles. Foreign private household workers, primarily female, constitute more than 6% of the labor force in Bahrain, Kuwait, Hong Kong, Singapore, and Saudi Arabia, and about 1% in Taiwan, Greece, and Israel. Providing temporary visas for these workers can potentially allow high-skilled native women to enter the market labor force. This increased labor supply by native high-skilled workers can increase the wages of low-skilled natives and provide a fiscal benefit by correcting distortions toward home production created by income taxes. Calibration suggests welfare gains to natives from a Hong Kong style program may be equivalent to those from a 1% increase income. We argue that there will be a Pareto improving level of migration from an ex ante perspective, but that this migration may nonetheless be inconsistent with ethical norms in “old rich” countries ex post, at least in societies where membership is based on length of residence. Programs with temporary, non-renewable visas may be more acceptable in these countries.

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# 1. Introduction

Migration restrictions are arguably the most important distortion in the world economy and the most harmful to the world's poor. Klein and Ventura (2004) estimate that the removal of immigration restrictions in OECD countries could increase world output by up to 172%. They assume that capital is mobile and that immigrants can take advantage of OECD levels of total factor productivity. Even without these favorable assumptions, Walmsley and Winters (2003) estimate that an increase of 3% of labor supply in immigration in developed countries could raise world welfare by 0.6%, half of the gains associated with complete trade liberalization. Williamson (1996) argues that 19<sup>th</sup> Century mass migration led to income convergence across today's rich countries by directly raising the wages of the migrants and by reducing labor supply in the sending countries. Free migration can also provide a check against oppression. The trigger for the collapse of communism may well have been West Germany's openness to migration from the East.

Yet despite occasional calls for freer mobility (perhaps, most notably from Mexico's President Fox) the elimination of immigration restrictions is not under consideration in rich countries. High-income countries limit migration due to concerns that immigration of low-skilled workers would (1) exacerbate inequality among natives, (2) create a burden on the welfare state, (3) change native culture, and (4) increase crime. In this context, it seems worth examining a new form of immigration that, as we discuss in section 2, is becoming widespread in countries that have become prosperous recently, from Saudi Arabia to Hong Kong to Greece. In this new type of immigration, foreigners,

women in particular, are employed as private household workers either on temporary visas or under the table.

We argue that this type of immigration may potentially address each of the obstacles to migration cited above. It can potentially (1) equalize wages among natives, (2) provide a fiscal benefit, (3) limit the impact of immigration on culture, and (4) make it harder for anti-immigration advocates to raise fears of a potential rise in crime.

To see the logic, note that in standard models, such as Borjas (1995), migration by low-skilled immigrants exacerbates inequality among natives. The welfare gains for the host country are Harberger triangles and are small compared to distributional effects.

Borjas (1995) writes that “the relatively small size of the immigration surplus – particularly when compared to the very large wealth transfers caused by immigration – probably explains why the debate over immigration policy has usually focused on the potentially harmful labor market impacts rather than the overall increase in native income.” In fact, Mayda (2004) finds that in rich countries low-skilled natives are particularly likely to oppose immigration. In the US, for example, 28.8% of high school graduates support immigration as opposed to 45.7% of people with college education.<sup>2</sup>

When foreign workers perform services previously done within households, such as cooking, cleaning, and care for children, the sick, and the elderly, new effects arise.

Immigrants involved in these industries arguably displace pre-existing non-market labor.

Since high-skilled natives with a higher opportunity cost of time are more likely to

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<sup>2</sup> These results come from the World Value Survey which asked the following “How about people from other countries coming here to work. Which one of the following do you think the government should do? (a) Let anyone come who wants to? (b) Let people come as long as there are jobs available? (c) Place strict limits on the number of foreigners who can come here? (d) Prohibit people coming here from other countries? (e) Don’t know” People supporting immigration were defined to be those who answered either (a) or (b) out of the entire sample who answered either (a), (b), (c), or (d).

purchase these services, native high-skilled workers, women in particular, will spend more time working in the labor market. To the extent that foreign private household workers lead to increases in high-skilled labor supply, they create a new effect beyond those analyzed in standard models such as Borjas (1995). By freeing up high-skilled labor for market production, immigrant private household workers can reduce wage inequality, since the increase in labor supply of high-skilled workers leads to a decline in their relative wage, and increase in the relative wage of complementary low-skill native labor. Moreover, when high-skilled women hire immigrant private household workers and transfer their labor from home production to market work, their output becomes taxable, providing a fiscal benefit for the population, even without considering the taxes paid by the migrants, themselves.

The impact of foreign private household workers on native culture is limited, since immigrant private household workers are typically not allowed to bring families with them on their visas. These workers are typically female, and crime is, therefore, less likely to be perceived as a problem.

We construct a simple model designed to illustrate the possibility of these effects. A very rough calibration of this model suggests the benefits of this type of migration could be substantial. With taxes at U.S. rates, immigration of 5% of the native labor force is estimated to increase welfare of low-skilled natives by the equivalent of a 1.6% increase in income. It increases welfare of the high-skilled by the equivalent of a 0.3% change in income. Total welfare accruing to natives increases by approximately 100 times the amount found by Borjas (1999).

We also explore an extension to the model in an appendix in which some natives would send their children to childcare centers staffed by natives in the absence of migration. The qualitative results are similar to the basic model if we assume childcare center services are as skill intensive as the economy as a whole, which seems to be true empirically, and parents can obtain more hours of childcare from foreign private household workers than from childcare centers.

The model still abstracts from a number of key factors affecting the impact of immigration. A back of the envelope calculation taking into account these factors, suggests a similar or possibly even slightly larger impact of foreign private household workers, but a somewhat smaller impact on relative wages.

Yet, if immigration by foreign private household workers avoids many of the political economy obstacles to other forms of migration, it may be seen as inconsistent with ethical norms in some countries. This may help explain why foreign private household worker programs have been instituted on a much wider scale in “new rich” countries than among the historically rich. Restricting people who have lived in a country for twenty or thirty years to private household work and preventing them from bringing their families may well be considered inconsistent with ethical norms in societies where membership is based in part on length of residence.

Yet, this creates a paradox. Under ethical norms that place little obligations on society to those born overseas regardless of time spent in the host country, foreign domestic helpers may be admitted, making them and the host society better off. Under ethical norms that place low value on foreigners as long as they stay overseas but that consider foreigners entitled to better treatment given enough time in the host country,

societies may be unwilling to admit foreigners, potentially making everyone worse off. This represents a basic time consistency problem inherent to societies in which membership is based on length of residence.

Programs with temporary non-renewable visas might make introducing foreign private domestic workers more palatable, reducing this time consistency problem. Host societies can also structure policies in ways advantageous to foreign private household workers. One important step would be to make changing employers easier.

The rest of the paper is structured as follows: Section 2 documents basic facts on foreign private household workers immigration in “new rich countries”. Section 3 lays out a simple model designed to illustrate the potentially new effects of foreign private household workers on wages and welfare in the host country. Section 4 calibrates the model, reviews its limitations, and then goes through a back of the envelope calculation suggesting that results would be similar in a somewhat more realistic model. Section 5 discusses ethical issues, and section 6 concludes.

## **2. Basic Facts**

“Old rich” and “new rich” countries are pursuing immigration policies with very different implications for the developing world, and in particular for the poor in the developing world. Old rich countries are increasingly focusing on attracting high-skilled immigrants in a global competition for talent. Kapur (2004) describes how Australia, Germany, Canada, the UK, and to a lesser extent the US are changing immigration systems to favor skilled workers. He argues that the costs associated with this “brain drain” for developing countries are great, although others like Commander, Kangasniemi, and Winters (2003)

argue that these costs may be mitigated by increased incentives to invest in human capital and return migration.

In contrast, many newly rich economies admit substantial numbers of foreign domestic helpers. Table 1 shows that in Bahrain, Kuwait, and Saudi Arabia around 10% of the labor force or more are foreign workers in private households. In Hong Kong and Singapore, two of the three countries other than Puerto Rico to have joined the ranks of the world's richest 25 countries in the last 40 years, about 6.8% and 7.0% of the total labor force, respectively, are foreign domestic helpers.<sup>3</sup> Among countries that have not quite reached this income category, many also have substantial numbers of foreigners working as domestics, although the numbers are not as dramatic. Foreign domestic helpers make up at least 0.8% of the labor force in Taiwan, and immigrant workers in private households are at least 0.8% of the labor force in Israel. Non-Greek, non-EU employees in private households constitute about 1% of the labor force in Greece.

These figures exclude illegal workers. Anecdotal evidence suggests that substantial numbers of foreign women work illegally as household employees. Authorities find it harder to enforce laws against hiring illegal workers when private households, rather than firms, are doing the hiring. Chile, Italy and Israel are all reported to have significant numbers of foreigners working illegally as private household workers. Statistics on the number of foreign private household workers are not readily available for Chile, but 4.7% of the labor force is occupied in domestic service, and anecdotal evidence suggests substantial numbers of these workers are Bolivian and Paraguayan

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<sup>3</sup>Only Hong Kong, Singapore, Puerto Rico, and Korea have entered the ranks of the world's 25 richest economies as measured by real GDP per capita between 1960 and 2000. Source: WDI

women (Stefoni, 2002). In the US 35% of women illegal immigrants reported that their first job was working in a private household (Cortes 2004).

Compared to “new rich” countries, the share of the labor force in “old rich” countries composed of foreigners performing domestic work is much smaller. For example, foreign workers in private households constitute only around 0.3% of the working population in the US<sup>4</sup>. To the extent that some illegal workers are not captured in the census, this percentage might be raised somewhat, but it is unlikely to change the conclusion that the U.S. has a much smaller proportion of foreign private household workers than many “new rich” countries.

Not only is the share of foreign private household workers small in “old rich” countries, but private household work in general is small. In the US, only around 1% of the entire employed population (including natives and non-natives) are employed in the personal services – private household industries. In the UK in 1990, only 0.05% of the working population was employed as domestic housekeepers, although this is a narrower definition of private household workers than we have typically been using.

Foreign private household worker programs have expanded rapidly among “new rich” countries. For example, from 1987 to 1996, the percentage of households employing domestic servants in Hong Kong more than doubled from 2.5% to 6.1%.<sup>5</sup> In Singapore in 1980 less than 0.3% of the working population were foreign private

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<sup>4</sup> This figure is taken from the March 1998 CPS where the total number of non-citizens in the industry category Personal Services – Private Households is divided by the total number of people reporting to be working in an industry. The CPS supposedly contains data collected from illegal immigrants.

<sup>5</sup> These figures come from various Hong Kong Special Topics Report.

household workers whereas today one in seven households employ a live-in helper (Kolesnikov-Jessop, 2004).<sup>6</sup>

The data suggest that high-skilled natives are most likely to employ domestic workers. In 1990 almost 18% of university educated mothers in Singapore hired domestic workers while only 15% of polytechnic educated mothers, 2% of secondary educated mothers and less than 1% of primary school educated mothers hired domestic workers (Singapore Census of Population 1990).

Table 2 shows labor force participation and fertility rates for a number of countries. One problem is that labor force participation statistics for some countries include foreign private household workers. We hope to obtain better data in the future, but it is worth noting that data for Bahrain does not include foreigners. Consistent with the idea that foreign domestic workers can increase female labor force participation, Hong Kong and Singapore both have high rates of female labor force participation, much higher than in Korea and even higher than that of the US and UK (see Table 2). Female labor force participation was not high in these countries in the 1970's before large numbers of domestic workers from abroad began to enter the labor force, casting doubt on purely cultural explanations. Fertility rates for Hong Kong and Singapore are much lower and have fallen more quickly than in comparable countries, consistent with the view that women freed up from household work to participate in the labor market have fewer children.

It is worth noting that immigration of foreign private household workers will only raise wages for low-skilled workers and provide fiscal benefits to the extent that the time

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<sup>6</sup> 4,123 Singaporean non-residents were employed in domestic service out of a total working population of 1,077,090 in 1980 (Singaporean Census of Population 1980).

of native women released from home production is devoted towards market production rather than either leisure or increased production of children. The extent to which this occurs may depend on social norms. Trends in female labor force participation in Hong Kong and Singapore are consistent with the hypothesis that foreign domestic helpers have freed high-skilled women to enter the labor force (although of course it is also possible that high female labor force participation has driven policy decision to admit foreign domestic helpers.). In the gulf, female labor force participation is low relative to other countries with comparable income, although female labor force participation has increased rapidly and fertility has fallen.

If foreign private household workers free up time that natives devote to leisure or simply lead to more household work being done than would be done otherwise, relative wages between different classes of native workers will be unaffected. If foreign private household workers lead to higher fertility among high-skilled natives, long-run income distribution among natives' may be equalized. First, higher fertility could increase the long-run supply of high-skill labor, at least to the extent that high-skilled parents can transmit education to their children. Second, to the extent that greater fertility among high-skill workers leads them to split their bequests and attention among more children the distribution of wealth will be equalized. We hope to consider more general cases in the future.

### **3. Model**

We present a model designed to illustrate the potentially new effects of foreign private household worker migration beyond those from the standard models. For simplicity, we present a very basic model that illustrates the key ingredients necessary to derive these

results. Subsection 3.1 sets up the model by describing households and producers. Subsection 3.2 solves the model with zero immigration. Subsection 3.3 analyzes the equilibrium with immigration. Subsection 3.4 shows that there always exists a Pareto-improving level of immigration. Section 4 discusses several factors that are abstracted away from in this simple model.

### **3.1. Households and Producers**

Households in our model consume two types of private consumption goods, a general good and a domestic good like cooking, cleaning, or childcare. The domestic good can either be purchased from the market, which we term outside hiring, or produced at home. An identical utility function governs all households:

$U = A^\alpha (C + L_C)^{1-\alpha} + v(g)$  where  $A$  is the amount of the general good consumed,  $C$  is that amount of domestic good consumed from outside hiring,  $L_C$  is the amount of time invested in home production of the domestic good,  $g$  is a public good provided by the government, and  $v(\cdot)$  is an increasing, concave function.

Households inelastically supply one unit of labor and face the budget constraint:  $W_i(1 - \tau)(1 - L_C) = P_A A + P_C C$ , where  $W_i$  is the wage of the consumer ( $i \in \{H, L, I\}$  which we describe later),  $P_A$  is the price of good  $A$ ,  $P_C$  is the price of good  $C$ , the domestic good, hired from the outside and  $\tau$  is the tax rate on labor income. Because we assume that the outside and home produced domestic goods are perfect substitutes, households will either home produce or buy outside from the market all consumption of the domestic good. If prices are such that consumers are indifferent between home production and outside hiring, any combination of outside hiring and home production will be feasible. The assumption of perfect substitutability is made for

convenience and is not critical for arriving at our main results. Given Cobb-Douglas utility and Kuhn-Tucker conditions, consumers spend share a  $\alpha$  of their income on good

A:  $A = \frac{\alpha(1-\tau)W_i}{P_A}$ . If  $P_C < (1-\tau)W_i$ , consumers will purchase all domestic good

consumption from the market and set  $C = \frac{(1-\alpha)(1-\tau)W_i}{P_C}$  and  $L_C = 0$ . If  $P_C > (1-\tau)W_i$ ,

$L_C = 1 - \alpha$  and  $C = 0$ . Finally, if  $P_C = (1-\tau)W_i$ , households will be indifferent between and home-producing and  $C \in [0, 1 - \alpha]$  and  $L_C = 1 - \alpha - C$ .

Producers can hire three types of labor: native high-skilled workers, native low-skilled workers and immigrants. We normalize the native population to one and assume that a fraction  $h$  are high-skilled leaving  $1 - h$  the fraction of low-skilled natives. Let  $m$  denote the population of immigrants making the total population in the host country  $1 + m$ .

The production function for good A is  $A = (\beta H^\varphi + (1-\beta)(L + \theta I)^\varphi)^{1/\varphi}$  where  $H$  is high-skilled native labor,  $L$  is low-skilled native labor,  $I$  is immigrant labor, and  $\theta < 1$ .  $0 < \beta < 1$  and  $0 < \varphi < 1$ , where higher  $\beta$  represent technologies that use high-skilled labor more intensively and  $\eta \equiv 1/(1-\varphi)$  is the elasticity of substitution between high-skilled and low-skilled labor. Immigrants imperfectly substitute for native low-skilled labor and complement native high-skilled labor in production of A.

Good C is produced with a linear production technology in the labor of any type:  $C = \delta * Labor$ . However, because consumers generally tend to prefer their own cooking, cleaning, and childcare, and get utility from at least some aspects of this work, we assume that domestic good production hired from the outside is less efficient than home domestic

good production and so  $\delta < 1$ . We assume all workers are equally effective in producing good C, but this assumption could be weakened.

The assumption that immigrants and low-skilled natives are not perfect substitutes and that immigrants have a comparative advantage at producing the domestic good is necessary for our results. Imperfect substitutability of immigrants and native low-skilled workers may arise due to either differences in skills between these workers or to government policies that restrict certain immigrants' ability to work outside the domestic sector, as in the Hong Kong foreign domestic helpers program or the US and UK Au Pair programs. Some evidence that immigrants have a comparative advantage in domestic work is provided by the fact that in 1998 in the US, non-citizens were almost five times more likely to work in personal service – private household category as citizens. 3.6% of non-citizens were employed in those occupations as opposed to 0.7% of US citizens.<sup>7</sup>

In order to abstract from debates about whether immigrants pay more in taxes than they receive from the government in social services, we assume that immigrants are neither taxed nor enjoy the benefits of the government good. Therefore, our welfare analysis will remain largely agnostic about the direct net contribution of immigrants to the public sector. The government taxes the labor income of all natives at tax rate,  $\tau$ , and spends all tax revenue on a public good that is only enjoyed by natives.

In order to focus on the worst case scenario for the host country, we consider the case in which immigrants extract all surplus associated with producing the domestic good. The opposite assumption would be that employers of private household workers

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<sup>7</sup> These figures are from the authors' calculations from the CPS March 1998. Private Household - personal service industry is defined to include private households who "employ workers that are cooks, laundresses, maids, sitters, butlers, personal secretaries, managers of personal affairs; and outside workers, such as gardeners, caretakers and other maintenance workers" as defined by OSHA US Department of Labor.

hold all the bargaining power and are able to negotiate wages that are equal to the reservation utility of the immigrant. As discussed in section 5.1, the split of surplus is likely to depend on legal institutions. We hope to generalize this in future work. We conjecture that for alternative sharing rules the impact on relative wages and tax collected will be qualitatively similar, but native employers of foreign private household workers will be better off.

### **3.2. Equilibrium without Immigration**

We first focus on the case where high-skilled workers earn more than low-skilled workers and where there are no private household workers in the absence of immigration. Appendix C explores an extension to our basic model where some natives send their children to childcare centers staffed by natives as part of their domestic good consumption. Qualitative results are similar to the basic model if we assume that childcare center services are, at least, as skill intensive as the economy overall, which seems to be true empirically, and if households can obtain more hours of childcare from hiring a private household worker than from childcare centers.

All firms in sector A and sector C operate in competitive markets. We first solve for the sector A firms' zero profit condition and find an expression for wages (Kuhn-Tucker conditions):

$$\frac{W_H}{P_A} = \beta H^{\varphi-1} (\beta H^\varphi + (1-\beta)(L + \theta I)^\varphi)^{(1-\varphi)/\varphi} \quad (1)$$

or  $H = 0$  if  $\frac{W_H}{P_A} > \beta H^{\varphi-1} (\beta H^\varphi + (1-\beta)(L + \theta I)^\varphi)^{(1-\varphi)/\varphi}$

$$\frac{W_L}{P_A} = (1 - \beta)(L + \theta I)^{\varphi-1} (\beta H^\varphi + (1 - \beta)(L + \theta I)^\varphi)^{(1-\varphi)/\varphi} \quad (2)$$

or  $L = 0$  if  $\frac{W_L}{P_A} > (1 - \beta)(L + \theta I)^{\varphi-1} (\beta H^\varphi + (1 - \beta)(L + \theta I)^\varphi)^{(1-\varphi)/\varphi}$

These expressions must be satisfied in equilibrium. The interior solution gives

$$\frac{W_L}{W_H} = \frac{(1 - \beta)}{\beta} \left( \frac{L + \theta I}{H} \right)^{-1/\eta} \text{ which is equal to } \frac{(1 - \beta)H^{1/\eta}}{\beta L^{1/\eta}} \text{ in the absence of immigration.}$$

Under the assumption that high-skilled workers do not employ private household workers in the absence of immigration, we have  $H = \alpha h$ , and  $L = \alpha(1 - h)$  which implies

$$\frac{W_L}{W_H} = \frac{(1 - \beta)}{\beta} \left( \frac{h}{1 - h} \right)^{1/\eta}. \text{ This assumption holds if } P_C > (1 - \tau)W_H. \text{ We next focus on the}$$

production of good C to find  $P_C$ .

Because all types are equally efficient at producing good C, firms producing good C will only hire types with the lowest wages. Given this production function and the firm zero profit condition,  $P_C = \frac{\min(W_H, W_L)}{\delta}$ .

To proceed, we need the following simplifying assumptions. First, to ensure that high-skilled wage is higher than low-skilled wage, we need to assume that  $W_H > W_L$ .

Second, to guarantee that there are no private household workers in the absence of

immigration, we assume that  $\frac{W_L}{\delta} > (1 - \tau)W_H$ . These two inequalities can be rewritten as

$$\frac{W_L}{W_H} < 1 \text{ and } \frac{W_L}{W_H} > (1 - \tau)\delta. \text{ Since } \frac{W_L}{W_H} = \frac{(1 - \beta)}{\beta} \left( \frac{h}{1 - h} \right)^{1/\eta}, \text{ we can summarize these}$$

conditions in the following assumptions:

**Assumption A1:**

$$\bar{h} \equiv \frac{(\delta\beta(1-\tau))^n}{(1-\beta)^n + (\delta\beta(1-\tau))^n} < h < \min \left[ \frac{(\delta\beta(1-\tau))^n}{(\theta(1-\beta))^n + (\delta\beta(1-\tau))^n} \equiv \bar{h}, \frac{\beta^n}{(1-\beta)^n + \beta^n} \right]$$

The first inequality guarantees that high-skilled workers do not earn so much that they employ private household workers in the absence of immigration while the second inequality guarantees that the high-skilled earn higher wages than low-skilled natives

without immigration,  $h < \frac{\beta^n}{\beta^n + (1-\beta)^n}$ .

The following proposition follows from the previous discussion.

**Proposition 1:** Under assumption A1, the ratio of low-skilled wages to high-skilled

wages is  $\frac{W_L}{W_H} = \frac{(1-\beta)}{\beta} \left( \frac{h}{1-h} \right)^{1/\eta}$ .

Letting the price of good A be the numeraire, under assumption A1

$$W_L = (1-\beta) \left( \frac{\beta h^\varphi + (1-\beta)(1-h)^\varphi}{(1-h)^\varphi} \right)^{(1-\varphi)/\varphi} \quad \text{and} \quad W_H = \beta \left( \frac{\beta h^\varphi + (1-\beta)(1-h)^\varphi}{h^\varphi} \right)^{(1-\varphi)/\varphi}.$$

Assumption A1 means that native workers are never formally employed in the domestic sector. Below we characterize the no immigration equilibrium when some natives perform domestic work for others.

### **3.3. Equilibrium with Immigration**

In order to examine the impact of immigration on the host economy, we first determine the local effects around the no immigration equilibrium. In this subsection we analyze the effects of immigration when assumption A1 holds, and no native workers are hired to perform domestic work for others. In the next subsection we analyze the equilibrium under assumption A2.

Because immigrants are less efficient at producing good A than the native low-skilled, immigrants will have the lowest wage in the economy, which implies that, if any domestic goods are hired from the outside, they will be produced by the immigrants. Recall that  $m$  is the number of immigrants entering the host country.

Because high-skilled natives have the higher wage, they will outbid the low-skilled for the hired domestic good services offered by immigrants. High-skilled natives will pay no more than  $(1 - \tau)W_H$  for this service, since at this price they are indifferent between hiring from the outside or home producing. Thus, by being hired to produce the domestic good immigrants will earn a wage of  $\delta(1 - \tau)W_H$ , since we have assumed that the immigrants extract all surplus associated with producing the domestic good.

If good A is the numeraire, the sector A firms' zero profit condition describes labor demand given wages.

$$I = \frac{\beta^{1/\varphi} H}{\theta} \left( \left( \frac{W_I}{\theta(1-\beta)} \right)^{\eta-1} - (1-\beta) \right)^{-1/\varphi} - \frac{L}{\theta} \text{ or } I = 0 \text{ if } W_I > \theta W_L. \quad (3)$$

We have earlier asserted that by assuming  $h < \bar{h}$ , we guarantee that entering immigrants will first work in the outside production of the domestic good. Proposition 3 shows how  $h < \bar{h}$  is sufficient for generating this result.

**Proposition 3:** If assumption A1 holds, as long as the number of immigrants is not too large, entering immigrants work exclusively in the good C sector.

**Proof:** Given the existing labor supplies of the high and low-skilled natives,

$$W_I = \delta(1 - \tau)W_H > \theta W_L \text{ if and only if } h < \frac{(\beta\delta(1 - \tau))^\eta}{(\theta(1 - \beta))^\eta + (\beta\delta(1 - \tau))^\eta} \equiv \bar{h}. \text{ If } m \text{ is close to}$$

zero, the wage of the immigrant in sector C is strictly higher than the marginal product of

the immigrant in sector A, and the immigrant's labor supply in sector A is  $I=0$ . There is a level of immigration  $\bar{m} > 0$  such that all immigrants up to  $\bar{m}$  enter the good C sector. We note that because  $\delta < 1$ , immigrants home produce their own domestic good consumption so that the amount of hired domestic good available to be purchased is  $\alpha\delta m$ . ◦

The propositions in this section apply to levels of  $m < \bar{m}$  such that all immigrants work in sector C.

**Proposition 4:** Under assumption A1 and under a level of immigration local to zero, the wages of low-skilled natives increase relative to native high-skilled wages with the level of immigration.

**Proof:** By proposition 3 we know that the immigrants produce domestic good only for the high-skilled and do not work in sector A. Because immigrants only supply  $\alpha$  units of their own labor to the labor force, high-skilled natives only need to home produce  $h(1-\alpha) - \alpha\delta m$  of the domestic good, allowing them to supply  $\alpha h + \alpha\delta m$  to the formal sector. Low-skilled natives still home produce their own domestic good and each low-skilled household supplies  $\alpha$  units of labor to the formal sector. Using the expressions

given for wages in sector A,  $\frac{W_L}{W_H} = \frac{(1-\beta)[h + \delta m]^{1/\eta}}{\beta(1-h)^{1/\eta}}$ . Relative native low-skilled wages

are increasing in the number of immigrants for  $\eta > 0$ . ◦

Letting  $P_C$  be the numeraire,  $W_H = \beta \left( \beta + \frac{(1-\beta)(1-h)^\varphi}{(h + \delta m)^\varphi} \right)^{(1-\varphi)/\varphi}$  and

$$W_L = \beta \left( \frac{\beta(h + \delta m)^\varphi}{(1-h)^\varphi} + (1-\beta) \right)^{(1-\varphi)/\varphi}.$$

**Proposition 5:** If assumption A1 holds, immigration increases taxes collected by the government and, thus,  $g$ .

**Proof:** Total factor payments are equal to total production for CES production functions. Since no immigrants work in sector A, all income goes to individuals taxed at rate  $\tau$ . Total production in sector A is increasing in high-skilled labor, implying that taxes increase with immigration. ◦

When market work is taxed more heavily than home production, taxation introduces a distortion as households do not hire from the outside enough of the domestic good. When immigrants reduce the price of the hired production of the domestic good, this distortion can be mitigated. For expositional purposes, we set this issue aside for the time being, however, by considering the case in which the marginal utility of the public good is zero. Assuming that the marginal utility of the public good is zero is a very strong assumption as natives essentially pay taxes to a worthless good.

**Proposition 6:** When assumption A1 holds, immigration is local to zero, and the marginal utility of the public good is zero, welfare for high-skilled types is decreasing in the number of immigrants.

**Proof:** High-skilled types provide  $\alpha + \alpha\delta m/h$  labor in sector A, at a rate net of taxes of  $(1-\tau)W_H$ . They pay  $\alpha\delta(1-\tau)m/h$  for hired domestic good production, so that ultimate net income is  $\alpha(1-\tau)W_H$ . Since  $W_H$  is falling in  $m$  for  $\eta > 0$ , consumption of good A falls with immigration. Consumption of good C is constant. Together these imply a fall in welfare for high-skilled types. ◦

Intuitively the increase in income of each high-skilled native from working more in sector A is spent paying for hired domestic good production. Collectively the high-

skilled increase the supply of high-skilled labor, causing their wages to fall relative to no immigration.

**Proposition 7:** When assumption A1 holds, immigration is local to zero, and the marginal benefit of the public good is zero, the welfare of native low-skilled is increasing in immigration.

**Proof:** Low-skilled income is  $\alpha(1-\tau)W_L$  and  $W_L$  is increasing in immigration. Immigration has not changed the consumption of the domestic good for the low-skilled but has increased absolute wages, implying a rise in welfare. ◦

Finally, although we have demonstrated that the wages of the native low-skilled rise with immigration and that wage inequality has decreased, we have not shown how income (wage times labor supply) inequality has changed with immigration. Both

incomes are increasing in the number of immigrants. Relative income  $\frac{I_L}{I_H}$  equals

$\frac{\alpha W_L}{(\alpha + \alpha \delta m / h) W_H}$ . This is proportional to  $(\alpha h + \alpha \delta m)^{(1-\eta)/\eta}$ , implying income inequality

rises if  $\eta > 1$ . The empirical evidence supports an elasticity of substitution between high-skilled and low-skilled labor of greater than one, suggesting that income inequality among natives increases even when immigration is local to zero. (Katz and Murphy 1992, Krusell et al. 1997, Heckman, et al. 1998).

### **3.4. Pareto – Improving levels of Immigration**

With the further infusion of additional migrants, the analysis of subsection 3.3 will continue to hold for higher levels of immigration until the occurrence of one of the three following outcomes occurs: (1) native low-skilled wages rise such that low-skilled

natives begin purchasing domestic good from the outside, (2) alternative wages to immigrants paid by sector A rise as more high-skill natives work in the sector, and eventually immigrants begin working in sector A, or (3) immigrants fulfill all demand for market produced domestic good at  $P_C = (1 - \tau)W_H$ , and  $P_C$  falls below this level. Which outcome among the three happens first will depend on parameters.

Regardless of the timing of these outcomes, however, increased immigration has unambiguous effects on welfare and income, which we show below by considering all possible timings. Initially immigration frees up high-skilled labor and reduces the relative wages of the high-skilled, but eventually with enough immigration low-skilled labor will be expanded so that relative wages will return to non-immigration levels while more domestic goods will be available through outside hiring.

**Proposition 11:** Under assumption A1, there always exists a Pareto-improving level of low-skilled immigration,  $\bar{m}$  such that all natives are no worse off than without immigration.

**Informal Proof:** More formal versions of the proofs of propositions 11 and 12 are given in Appendix A and B. For expositional ease, we separate this proof into two different cases.

**Case 1:** Immigrants are relatively efficient in sector A:  $\delta(1-\tau) < \theta$

**Lemma 1:** If  $\delta(1-\tau) < \theta$ , low-skilled natives never hire from the outside production of the domestic good.

**Proof:** Immigrants always have the lowest wages in the economy since they are  $\theta < 1$  times as productive as the low-skilled. Because immigrants can always choose to work in good A production, immigrant wages can be no less than  $\theta W_L$ . In order for the native

low-skilled to hire from the outside production of the domestic

good  $(1 - \tau)W_L > P_C = \frac{W_I}{\delta} \geq \frac{\theta W_L}{\delta}$  which will never occur when  $\delta(1 - \tau) < \theta$ .

In this case low-skilled natives will never hire immigrants to produce the domestic good so outcome (1) will never occur. As immigration increases either immigrants will first begin working in good A production, outcome (2), or  $P_C$  will first fall below  $(1 - \tau)W_H$ , outcome (3). If immigrants satisfy demand for domestic goods at  $P_C = (1 - \tau)W_H$ ,  $P_C$  will fall below this level, and all high-skilled workers will supply their full unit of labor to the outside labor force. Low-skilled native wages will be unaffected by further immigration since low-skilled natives are neither expanding their labor supply by hiring domestic good production from the outside (Lemma 1) nor facing labor competition from the immigrants in sector A. The high-skilled, however, will consume more domestic good since the price of hiring domestic good production has fallen relative to their wage, and welfare will be increasing with further drops in  $P_C$  brought by more immigration. Eventually with even more immigration,  $P_C$  and, thus,  $W_I$  will fall so much such that immigrants will start working in the sector A.

When entering immigrants work both in sector A, outcome (2), and in producing the domestic good for others, outcome (3), further immigration reduces the wages of the native low-skilled but still increases the welfare of native high-skilled types by increasing their consumption of the domestic good. When the level of immigration reaches

$$m = \frac{(1 - \alpha)}{\alpha\theta(1 - \beta)} \left[ (1 - h)(1 - \beta) + h\beta(1 - \tau) \left( \frac{1 - h}{h} \right)^\eta \right] \equiv \bar{m}, \text{ low-skilled wages and welfare}$$

are equal to wages at zero immigration. High-skilled welfare is higher since wages have

been restored to the no immigration equilibrium, and high-skilled types can afford to consume more of the domestic good.

Above, we had assumed that the price of good C fell, outcome (3), before immigrants began working in sector A, outcome (2). Nothing would change if this were reversed and freed up high-skill labor increases demand for immigrants in sector A enough for at least some of them to move to that sector before wages fall in production of good C. In this case, new immigrants work both in sector A and sector C, but they divide their labor between the two sectors such that the labor they free up for the high-skilled exactly offsets the extra labor that immigrants provide in sector A, i.e.  $\frac{H}{L + \theta I}$  remains constant. Thus, wages for high and low-skilled natives do not depend on immigration. And, welfare for natives does not change as consumption of good C remains constant at  $I - \alpha$ . Eventually, increased immigration will result in so much production of the domestic good that high-skilled demand will be exhausted at  $P_C = (I - \tau)W_H$ . To see this, note that the ratio of high-skilled to low-skilled labor remains constant in sector A, implying that for high enough immigration, high-skilled individuals eventually engage in no domestic goods production. At this point, the analysis will proceed exactly as it did in the previous paragraph.

**Case 2:** Immigrants are relatively inefficient in sector A:  $\delta(I - \tau) \geq \theta$

**Lemma 2:** If  $\delta(I - \tau) \geq \theta$ , immigrants will not work in sector A until all natives have purchased from the outside all their domestic good production.

**Proof:** Because high-skilled wages are higher than low-skilled wages, low-skilled natives will not hire domestic good production until high-skilled natives are outside hiring. If low-skilled natives have not outside hired all consumption of the domestic good,

immigrant wages paid in the hired production of the domestic good are  $W_I \geq \delta(1 - \tau)W_L$ . From equation (3) we know that sector A firms will hire no immigrants if the marginal product of immigrants are lower than the wages, i.e.  $W_I > \theta W_L$ . Since  $\delta(1 - \tau) \geq \theta$ , we know that  $W_I \geq \delta(1 - \tau)W_L \geq \theta W_L$  and so sector A firms will hire no immigrants so long as all natives have not outside hired all consumption of the domestic good.<sup>8</sup>

By lemma 2 we know that immigrants will not work in sector A until all low-skilled workers have outside hired all domestic good production, outcome (2) will occur last. We proceed as we did in the previous case by analyzing the effects when outcome (3) – supply hired domestic good production exhausts demand at  $P_C = (1 - \tau)W_H$  – precedes (1) – low-skilled wages rising sufficiently for low-skilled natives to demand outside hiring for the domestic good – and then the reverse. Outcome (3) preceding outcome (1) implies that  $P_C < (1 - \tau)W_H$  and that the low-skilled are not outside hiring for the domestic good. High-skilled natives supply a full unit of labor to the outside labor force, and low-skilled wages and welfare are not affected by further immigration since low-skilled natives are neither outside hiring nor facing immigrant labor competition in sector A. High-skilled welfare is increasing in the level of immigration, as increased immigration reduces  $P_C$  and increases high-skilled consumption of the domestic good. With enough immigration, eventually,  $P_C$  will fall such that low-skilled natives will outside hire the domestic good and outcome (1) will be obtained.

When outcome (1) and (3) are obtained, low-skilled natives outside hire for the domestic good, and increased immigration frees up the low-skilled to enter the formal workforce. Thus, further immigration reduces low-skilled wages and raises high-skilled

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<sup>8</sup> We have assumed that in the knife edge case where  $\delta(1 - \tau) = \theta$  and low types are outside hiring only part of their domestic good consumption, sector A firms hire no immigrants.

wages. When  $m = \frac{(1-h)(1-\alpha)}{\alpha\delta} \left( 1 + \frac{\beta}{1-\beta} \left( \frac{1-h}{h} \right)^{(1-\eta)/\eta} \right) \equiv m$ , each low-skilled native

supplies 1 unit of labor to the outside labor force, and domestic good consumption is still exactly  $1 - \alpha$ . At this point all natives are supplying one unit of labor to sector A, and the original wage equilibrium without immigration obtains. The native low-skilled are now indifferent to immigration at this level and zero immigration, and the native high-skilled are better off since they can now consume more of the domestic good.

The analysis for letting outcome (1) precede outcome (3) is similar. ◦

**Proposition 12:** If assumption A1 holds, income inequality is non-decreasing with immigration.

**Proof:** Given in Appendix B.

Our model has abstracted from the existence of childcare centers. We extend the model by allowing for the existence of native childcare centers in Appendix C. The main results of the model including proposition 11 continue to hold, if we assume that childcare center services are equally as skill intensive as the overall economy and if private household workers can provide more hours of childcare than childcare centers.

## 4. Calibration

Subsection 4.1 calibrates the model outlined in section 3. Subsection 4.2 discusses the limitations associated with our calibration. Subsection 4.3 provides a rough back of the envelope calculation of the possible welfare effects, taking into account some factors not yet in the model.

## 4.1. Calibration of the Model

We calibrate the model using data from Hong Kong from around the year 2000 and from the U.S.

We first attempt to find an estimate for  $\alpha$ , the utility parameter associated with the general consumption good. If we believe our model of Cobb-Douglas utility, we know that  $1 - \alpha$  is the share of time a household spends on producing its own domestic good. Using the Multinational Time Use Study, Freeman and Schettkat (2004) estimate that over the course of a seven day week, men aged 25 to 54 on average spend 44.1 hours in market work and 16.1 hours doing domestic work. Women aged 25 to 54 on average spend 28.7 hours per week in market work and 30.1 hours doing domestic work. Their results come from a survey done in the US in 1992. If we assume that a household consists of one man and one woman, we find that on average an American household spent 38.8% of its working time doing household work. This gives us an estimate of 0.61 for  $\alpha$ .

The Hong Kong Census and Statistics Bureau conducted a time use survey of residents in 2001 and 2002. In Hong Kong, people spend approximately 0.68% of their total time in market and household work on market work.

In our model low-skilled immigrants are generally imperfect substitutes for low-skilled natives in the production of the general consumption good. The parameter  $\theta < 1$  gives the relative efficiency of low-skilled immigrants relative to natives. However, the foreign domestic worker program in Hong Kong legally prohibits domestic workers from working in any other sector. Therefore, in practice  $\theta = 0$  in Hong Kong, and we make this assumption for our calibration.

In the 1996 Hong Kong population census, 2.2 million people in the working population had not completed a high school degree which we define to be low-skilled in Hong Kong and about 800,000 had high school degrees and above. These figures, however, include about 118,000 foreign domestic helpers of which, according to a 1996 survey of domestic helpers, 79% had secondary school educational attainment or below.<sup>9</sup> Since  $1 - h$  in our model is the fraction of low-skilled natives, we adjust the census figures by subtracting the appropriate number of high and low-skilled domestic helpers. We estimate  $h$  in Hong Kong to be around 0.26.

Katz and Murphy (1992) estimate  $\eta$ , the elasticity of substitution between high-skilled and low-skilled workers, to be 1.41 using US data from 1963 to 1987. Krusell et al. (1997) estimate the elasticity to be 1.3 using a US dataset expanded to 1991 and an estimate of 1.67 from a model with capital-skill complementarity. Heckman, et al. (1998) estimate the elasticity to be 1.44 using a model incorporating job training. For simplicity, we assume that  $\eta$  is 1.5 for the purposes of our calibration.

We use statistics of earnings by educational attainment in 1993 from the US Census Bureau to estimate  $\beta$ , the factor intensity of high-skilled workers (Kominski and Adams, 1994). When there are very few low-skilled immigrants in the domestic sector,

$\frac{W_L}{W_H} = \frac{(1 - \beta)h^{1/\eta}}{\beta(1 - h)^{1/\eta}}$ . If we characterize high-skilled workers in the United States as those

having completed a college education, we find that the ratio of low-skilled mean earnings to high-skilled mean earnings is about 0.49. We also find that, of the total population of

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<sup>9</sup> The data do not differentiate between secondary school graduation and secondary school matriculation. We make the assumption that all domestic helpers in this category only matriculated and did not graduate and, therefore, are considered low-skilled. This assumption makes marginal difference to our calibrations.

18 year olds and older who report earnings, 24.1% are classified as high-skilled under this definition. This gives us an estimate of  $\beta$  equal to 0.49.

Standard tax rates in 2002 in Hong Kong were 15%, and employees were required to make social security contributions of 5%. Because the tax rate for Hong Kong is so low, we also calibrate the model with a higher tax rate. In 2003, the top tax rate in the United States was 35%. After including 15.3% payroll taxes (Social Security and Medicare) and a state tax rate of 5.3%<sup>10</sup> high-income taxpayers who would be likely to hire personal household workers face a marginal rate of around 51.6%.

Finally, we need an estimate for  $\delta$ , the relative efficiency of hired domestic good production. Households will be on the margin of whether or not to hire foreign domestic helpers when wages for the domestic worker are  $\delta(1-\tau)$  times the wage of the household. We find that in 1996 80.3% of domestic helpers earned 3,750 Hong Kong dollars a month<sup>11</sup>. (Hong Kong General Household Survey 1996). However, this figure does not include food and lodging which we estimate to be equivalent to 55% of the take home wage.<sup>12</sup> This implies that total compensation to domestic helpers in 1996 was around 5,814 Hong Kong dollars a month. From the same report, the rate of households employing domestic helpers jumps from 5.3% to 11.3% when moving from a monthly household income bracket between 20,000 to 29,999 to a bracket between 30,000 to 39,999 Hong Kong dollars per month. Thus, we interpret households with monthly

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<sup>10</sup> This is the state income tax rate in Massachusetts.

<sup>11</sup> In 1996, the Hong Kong dollar was pegged to the US dollar at a rate of 7.73 Hong Kong dollars to one US dollar.

<sup>12</sup> We know today that foreign domestic helpers in Hong Kong receive a minimum wage of 3,270 Hong Kong dollars. If food is not provided by the employer, a mandatory food allowance of 300 HK dollars is to be paid. Finally, through conversations with employers, we also estimate the value of lodging for a domestic helper to be around 1,500 Hong Kong dollars. This implies that non-wage compensation accounts for about 55% of the listed minimum wage today.

incomes of 35,000 to be the marginal household. Assuming a 15% tax rate on native household income<sup>13</sup> imply that  $\delta = 0.20$ .

This estimate for  $\delta$  may seem too low, as it suggests that five private household workers substitute for only one high-skilled native. However,  $\delta$  captures both efficiency and preference effects. Although private household workers may be less efficient, a mother who hires a household worker to take care of her child for five hours may still want to spend four hours with her child based on her own preferences. A household with a private household worker may still prefer to prepare their own meals.

With regards to the public good, we assume that the government keeps expenditure at a constant level. Thus, any increases in tax revenue brought about by immigration will contribute to a lowering of the tax rate. To describe the distortionary effects of labor taxation through costs like tax evasion, tax collection, and labor distortion, Browning (1987) defines the marginal welfare cost as the change in total welfare brought about by a unit change in tax revenue. We assume that the marginal welfare cost is around 1.4 which implies that for every one fewer dollar of taxes collected, the increase in total welfare is equivalent to an increase of \$1.40. The column labeled 'MCF = 1' gives the alternative welfare effects, if we assume that taxes are non-distortionary.

Table 3 gives the results of our calibration. The column labeled 'no tax' assumes that the tax rate is zero. Columns labeled 'MCF = 1.4' assume the marginal cost of raising \$1 in tax revenue as \$1.40. Columns labeled 'MCF = 1' assume no distortion associated with taxation. The level of immigration is set such that immigrants are

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<sup>13</sup> The Mandatory Provident Fund Schemes (Social Security for Hong Kong) was implemented in December of 2000.

equivalent to 5% of the native workforce. Because immigrants still spend  $1 - \alpha$  units of labor producing their own domestic good, actual labor displaced is  $\alpha * \delta * 5\%$ .

We first notice that low-skill relative wages increase by 2.5% with immigration. This corresponds roughly to the percentage increase in the high-skill native labor supply we consider.

The welfare effects of immigration can be sizeable. We calculate welfare as the transfer of gross income before immigration required such that natives are indifferent between immigration and no immigration. Welfare for high-skilled natives decreases by 1.4% and for low-skilled natives increases by 1.0% when we assume that taxes are set at zero. The welfare loss for high-skilled natives may be exaggerated since we assume in our model that high-skilled natives receive no surplus associated with hiring foreign private household workers. The overall welfare gain is about 0.01% of GNP. Even after considering the tax benefits of immigrants, high-skilled natives lose welfare, and low-skilled natives gain. With a 20% tax rate, high-skilled workers lose the equivalent of 0.7% of income in welfare, low-skill workers gain the equivalent of 1.2% of income, and the overall welfare gain is 0.4% of GNP. Welfare gains are higher for all types under the 51.6% tax rate, as a higher tax rate implies that immigrant household workers can reverse a larger preexisting distortion. High-skilled workers gain the equivalent of 0.3% of income, low-skilled workers gain 1.6%, and the economy gains the equivalent of 1.0% of income. When we assume no distortions associated with taxation, the welfare with taxation and the public good unsurprisingly decreases, although the magnitude of this effect is not large.

Borjas (1999) estimates increases in national income accruing to natives under the standard model for the US. He finds that when immigrants account for 10% of the workforce, national income at most increases by 0.01% to 0.02%.<sup>14</sup> Assuming linearity, when immigrants account for 5% of the US workforce, Borjas's figures should be around .005% to .01%. Using the 51.6% tax rate and the  $MCF = 1.4$ , our estimated welfare effects are more than 100 times larger than Borjas's figures.

The estimate for  $\bar{m}$ , the Pareto – improving level of immigration if  $\theta = 0$  and if there are no fiscal effects associated with immigration, is 400.9% of the native labor.

By freeing up natives to enter the workforce, immigration should have an even stronger positive effect on measured GDP than on welfare accruing to natives. In Table 3 we compute 'National Income', which measures how much more gross income is generated by natives with immigration, to be 1.5%.

## 4.2. Limitations

The models and calibrations are subject to a number of limitations:

1) To the extent that private household workers contribute to increased fertility or consumption of leisure, as may be the case in the Gulf States, our calibration will overestimate the high-skilled labor response and will overestimate changes in wages and welfare.

2) The model does not allow for capital. To the extent that capital is mobile or otherwise adjusts over time, the estimates may be reasonable in the long run, but in the short run, overall increases in output will not be as sharp. The pattern in changes and

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<sup>14</sup> Borjas (1999) estimates these gains for a variety of different assumptions. We take the estimates from his three factor model of production (capital, skilled and unskilled labor) where the supply of capital is perfectly elastic.

returns to factors will depend on the patterns of complementarity and substitutability among skilled labor, unskilled labor, and capital.

3) Our model abstracts from childcare centers. In fact, many high-skilled workers send their children to childcare centers. This may well be the most important limitation of the model, and we are in the midst of revising the model to address this issue. However, we do not think this will lead to qualitatively different estimates for a number of reasons.

Childcare centers and private household workers are not perfect substitutes as childcare centers provide limited flexibility and care during set times of the day. Parents still have responsibilities to bring the child to the childcare center, pick him/her up, and care for the child when he/she is sick. Hence, the labor supply of high-skilled workers can be considerably larger when their children are being looked after by private household workers than when they are in childcare centers.

Many high-skilled occupations require more than a forty hour work week. High-skilled women with children, if they do work, often choose not to participate in these occupations but work in different occupations where the time demands are less extreme. Thus, foreign private household workers might be able to free up enough time so that the high-skilled are able to make the occupational shift to the more time demanding job. If time demanding occupations are for the very high-skilled, the effects of foreign private household workers could be larger than our calibration suggests.

Although foreign private household workers will undoubtedly displace some workers in childcare centers as well as free up time of high-skill native workers through employment, it is unlikely that the net impact of foreign private household workers on wages of low-skill natives will be negative. To see this, note that foreign private

household worker will not displace native childcare workers one for one, since child to staff ratios for childcare facilities are typically much bigger in childcare facilities than with foreign private household workers. Kisker et al. (1991) (cited by Blau (2003)) finds that the national average child to staff ratio in day care centers was about 9. Evidence from Hong Kong and Singapore seems to indicate that ratios are even higher. Minimum required staff child ratios are 1:8 for children under age 2 and about 1:15 for children over aged 2 in Hong Kong and roughly analogous for Singapore. (Hong Kong Social Welfare Department 2004 and Singapore Ministry of Community Development, Youth, and Sports 2004). Moreover, even if foreign private household workers free up an equal amount of time for high-skilled employers and low-skilled native childcare workers, the proportional increase in high-skill labor in the economy will be much larger than that in low-skill labor. Hence, low-skilled natives' relative wages should increase.

Finally, the childcare workers displaced by private household workers will not necessarily be lower skill than workers in the economy in general. Kisker et al. (1991) finds that 47% of teachers in day care centers have completed college. This is higher than the 24.1% proportion of workers with college degrees in the general economy (Kominski and Adams, 1994). Freeing up childcare workers could therefore actually increase relative wages of the low-skilled.

4) Another critical issue relates to the skill-level of the employers' labor freed up by foreign private household workers. Although high-skilled workers have the highest opportunity cost of time, some wealthy low-skilled workers also employ private household workers. Freed-up low-skilled native labor will reduce the impact of immigrants. Much more importantly, however, we assume that natives are classified

discretely into two categories, high-skilled and low-skilled, and that the high-skilled earn about 1.5 times low-skilled wages. Wages fall over a more continuous distribution with some high-skilled workers earning very high wages. Given their higher opportunity costs, very high wage earners will be among the first to hire domestic helpers, and the first to supply more into the market labor force. Since high wage earners pay the most in taxes, this would bias downward our estimates of the fiscal impact of immigration. To the extent that the employers' time freed up by foreign private household workers embodies more than the average amount of high-skill labor, our effects on wages will also be underestimated.

5) Foreign private household workers typically work very long hours, longer than the typical native. The  $\alpha$  of a foreign private household worker may actually be larger than that assumed for the native population. This will imply that private household workers free up more labor than implied by our calibration and that our estimated effects are understated.

Another limitation of these calculations is that we assume that employers capture none of the surplus from hiring foreign private household workers. In fact since employers do capture some surplus, high-skilled natives are likely to be better off with immigration than suggested by the calibration.

### **4.3. Back of the Envelope Calculations**

In this subsection, we first provide some very rough evidence on the potential impact of private household workers on native employers' labor supply. We then present a back of the envelope calculation that attempts to correct some of the limitations described in the previous sub section.

Table 4 shows different female labor force participation rates for women in Israel in 2001.<sup>15</sup> Overall, women with children who employ household helpers or care givers for more than 16 hours per week have approximately 18% higher labor force participation than those who do not hire care givers. Mothers with children aged 0 to 1 are almost 30 percentage points more likely to participate in the workforce if they hire a private household worker. On the other hand women without children who hire a private household worker for more than 16 hours per week have 10 percentage points lower labor force participation.

To the extent that there is variation in the amount of domestic work across households, depending on the number and ages of children, the number of elderly in the household, the ability of other adults to participate in household production, these figures are likely to underestimate the impact of private household workers on employers' labor supply. Households with more need for domestic work are more likely to hire private household workers. The effects of this bias can be seen comparing the higher gap when disaggregating women with the gap when women are not disaggregated, for example, by age of youngest child.

On the other hand, these effects are overstated to the extent that some women hiring private household workers have an unobserved taste for work and would have chosen to work regardless.

Private household workers have the largest impact on the labor supply of women with young children. One possibility would be to target programs admitting foreign private household workers so that they could be hired only by households with

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<sup>15</sup> Table 4 does not differentiate between foreign household workers and native household workers. Israel's foreign private household workers focus on care for the elderly but Table 4 does not include household workers hired to care for the elderly.

particularly strong needs. For example, Canada and Israel both have programs allowing visas for care givers for sick and the elderly.

Table 4 indicates that 75.1% of women whose youngest child is between two and four without a private household worker are in the workforce.

This suggests a sizeable number of native childcare workers could be displaced by foreign private household workers.

This relates to the existing literature about childcare and the labor supply of women. Many empirical studies using survey data have investigated the relationship between how much individual mothers pay for childcare and their decision to enter the workforce. Blau and Robins (1988) find that decreases in childcare prices measured both through individual survey data and regional wage data for child care workers increase the likelihood of mothers entering the workforce. Connelly (1992), Ribar (1995) and Kimmel (1998) find similar results with a probit model. Most of these studies utilize selection models to control for the fact that non-working mothers usually do not report any child care costs. Although all of these studies find that decreases in child-care costs increase the likelihood of mothers' joining the labor force, the estimated child-care price elasticities of employment range widely from -0.74 to -0.2. Khananusapkul (2004) is an empirical study directly investigating the relationship between female immigration and female high-skilled labor supply across U.S. metropolitan areas. Khananusapkul (2004) does not find a strong correlation. She may find this because the great majority of low-skilled immigrants in the U.S. do not work as private household workers and the negative impact of these workers on wages for native females may swamp any positive effect in substituting for domestic production.

A fairly straightforward back of the envelope calculations can be used to examine the effect of foreign private household workers on a) relative wages among natives and b) welfare from fiscal externalities associated with the substitution for market for non-market production.

The effect of foreign private household workers on relative wages of native low-skilled and native high-skilled depends on the proportionate increase in each type of labor supply. We consider the most pessimistic case where all workers in child care centers are low-skilled. As a rough approximation of the effect on native high-skilled labor supply of private household workers we will use the 21.6 percentage point gap between labor supply of women whose youngest child is between age 2 and age 4 who do not have domestic help and who have domestic help for more than 16 hours per week.

Under this assumption, where 5% of the labor force consists of foreign household workers, high skilled labor increases by  $.216 \times 5\% = 1.08$  percentage points. Given that high-skilled natives make up about 26% of the native labor force, high-skilled labor increases by about  $1.08 / 26 = 4.1\%$ .

For low-skilled natives, we assume that each immigrant replaces a low-skilled native child care worker at a ratio of 1: 5. Although the usual staff to child ratios in childcare facilities is 1:9, we allow for the fact that some private household workers may be watching more than one child. We also assume that 75.1% of natives who hire foreign private household workers would utilize childcare centers in the absence of migration; this is the labor participation rate of women who do not hire household workers in table 4. For every 100 foreign private households hire, 75.1 will replace a low-skilled native child care worker but only at a rate of 5 to 1. Thus, 5% immigration displaces low-skilled

labor by about  $5 * 0.751 * 0.2 = 0.76$  percentage points which is about 1.0% of the low-skilled native labor force. Under a Cobb-Douglas production function where

$$\frac{W_L}{W_H} \approx \frac{h}{(1-h)}$$

and where the elasticity of substitution is one implies that the ratio of low-

skilled to high-skilled wages increases by about  $4.1\% - 1.0\% = 3.1\%$ . If we assume an elasticity of substitution of 1.5, this ratio increases by only 2.1%.

We can also perform a back of the envelope calculation to estimate the potential magnitude of the welfare gain from the fiscal externality created when native high-skill workers move from untaxed home production of domestic goods to market production of these goods. If a high-skilled native works at home, the native pays no taxes. If he or she works in the labor market and uses the proceeds to pay for a foreign private household worker, the native is taxed and the increased taxes are a positive externality for others. The externality benefit equals the amount of high-skilled labor entering the labor market times the tax rate, times the marginal cost of funds, times the wage of high-skill workers.

For example, suppose each private household worker frees up 21.6% of a high-skilled worker; suppose these high-skilled workers earn twice the average wage in the economy, which is plausible given data from Hong Kong<sup>16</sup>; suppose households face a marginal tax rate of 50%, that and the marginal cost of raising one dollar in tax revenue is 1.4 dollars. Then each private household worker creates an externality benefit equal to the amount of high-skilled labor freed up times the tax rate times the marginal cost of funds times the average wage of the high-skilled:  $0.216 * 0.5 * 1.4 * 2 = 0.31$  times the

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<sup>16</sup> Table 5 gives the monthly wage distribution of Hong Kong households hiring domestic helpers. If we assume that each household only hires one domestic helper, which may not be the case for very wealthy households, and that the average wage in each bin is halfway between the minimum and maximum of the bin while the average wage of the highest bin is 1.6 times 80,000, we find that households hiring domestic helpers earn on average 55,000 HK dollars while the average for all households is 23,000.

average wage in the economy. This implies that it is possible to raise welfare by about 1.5% by admitting 5% of the labor force as foreign private household workers.

Although our discussion above focuses on the impact on receiving countries of foreign private household workers, a very rough calculation suggests that the benefits to sending countries could be substantial. Consider the potential impact of a program that admits 5% of the U.S labor force as private household workers on a temporary non-renewable visa for 2 or 3 years. This would amount to approximately 6.2 million workers. If each worker saved or remitted \$5,000 annually, total savings or remittances to developing countries would approach \$31 billion. This is three times as large as annual US official development systems.

As discussed previously, large domestic helper programs have arisen in "new rich" countries (such as Kuwait, Hong Kong, and Singapore) rather than "old rich" countries such as the US. This difference may in part reflect inertia, since the basic elements of immigration law in many countries were set in place at a time when work opportunities for highly-educated women were limited. Moreover, transportation and communication technologies that facilitate Hong Kong style foreign domestic helper programs are a recent phenomenon. This difference may also reflect the fact that "old rich" countries have more public support for child care. Government support for childcare is much more extensive in Northern Europe than Southern Europe and anecdotal evidence suggests that illegal child care workers are much more common in Southern Europe. However, as we discuss in the next section, the scarcity of foreign household worker programs in "old rich" countries may reflect perceptions by many of

these countries that such programs would not be consistent with ethical norms. We turn to these issues in the next section.

## **5. Ethical Issues**

Subsection 5.1 discuss the time consistency issues that arise under ethical norms in which obligations to citizens of other countries change depending on how much time they have spent in the host country. Subsection 5.2 argues that the welfare of foreign private household workers, themselves, could be increased by untying their visas from specific employers, and by allowing them to work legally in situations where they are currently working illegally but their status is tolerated.

### **5.1. Time-consistency**

For all its political economy advantages, fundamental ethical issues are raised by rules restricting immigrants to domestic work and separating them from their families. The problems are compounded when visas restrict foreign private household workers to a particular employer. Long-term domestic helper programs may be inconsistent with ethical norms which require people who have lived in the society for some time to be treated in the same way as citizens. This inconsistency would not arise if ethical obligations were based on relatively immutable characteristics like race, ethnicity, or religion. (This issue would also not arise in societies where ethical obligations are universalistic, but these do not exist.) In countries where membership is based on length of residence rather than ethnicity, restricting long-term residents to domestic service with no chance of citizenship or freedom to choose another occupation seems inconsistent with ethical norms. This is particularly likely to be the case in countries with a long

history of immigration from a diverse set of countries, and a multicultural conception of identity.

Yet, this suggests a paradox. Proposition 11 suggests that there is a mix of immigration for the host country under which both low and high-skilled natives are better off than in an economy closed to migration. If migration is voluntary, standard economic reasoning suggests migrants are also better off. If this is the case, it is difficult to frame ethical objections to programs allowing immigration of foreign domestic helpers on consequentialist grounds. It is nonetheless clear that many Americans would feel it unfair to have a class of people living in America for twenty or thirty years, permanently restricted to working only as private household workers.

This points to a basic paradox with norms that require different obligations to people depending on how long they have lived in the country. Suppose Americans believe that it is unfair to restrict somebody from the Philippines, who has lived in America for twenty or thirty years, to working only in the domestic sector. Suppose also that Americans believe it is wrong to admit immigrants at the expense of the lowest-income members of American society. America would not admit low-skilled people from the Philippines, since this would either hurt low-income Americans or involve unfairly restricting the immigrants to the domestic sector.

Suppose, on the other hand, that Kuwaitis or people from Hong Kong feel that they have no obligations to people from the Philippines, even if they have lived in Kuwait or Hong Kong for twenty years. They would then be willing to establish a foreign domestic helper program. Paradoxically, people in the Philippines may actually be better off if other countries follow Kuwaiti/Hong Kong norms than American norms.

This issue is related to the time consistency problem. According to some norms, ex post it is unethical to have a two-class society in the host country, with a permanent class of long-term residents excluded from the benefits of citizenship. Applying this rule ex post seems just, but if people anticipate it ex ante, everyone may be worse off.

However, it is not clear that this situation is completely analogous to that of time consistency because even ex ante, a decision maker might not want to bind themselves. Perhaps the starkest example of the tradeoff between ex ante and ex post logic lies in intergenerational terms. In Singapore foreign domestic helpers are required to sign an agreement stipulating that they will not marry a Singaporean citizen or resident without permission from the Controller of Work Permits, that they will not become pregnant or deliver children during the validity of their work permit, and that they will not “engage in any relationship with a citizen or resident that will result in the birth of any child” (Singaporean Ministry of Manpower, 2004) Ex ante, Singapore may not want to pay for health care and education for children of immigrants. On the other hand, ex post expelling a foreign worker who has had a child with a citizen may seem cruel.<sup>17</sup> Singapore conducts inspections for foreign private household workers to ensure that they have not become pregnant. This type of step may not be acceptable in many countries with comparable income.

It is worth considering whether programs could be designed that are consistent with "American" norms ex post. In particular, one possibility is the provision of temporary, non-renewable visas -- for example, 3-year non-renewable visas. The idea would be that obligations associated with long term residency may not arise after three years. These programs would be similar to an expanded version of existing Au Pair

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<sup>17</sup> The U.S. expels non-citizen mothers of citizens as well.

programs. The US Au Pair program<sup>18</sup>, UK Au Pair Program<sup>19</sup> and Canada's Live-in Caregiver Program<sup>20</sup> all provide temporary visas.

A program of temporary non-renewable visas for foreign domestic helpers would carry some efficiency costs but would also provide some equity benefits relative to a policy under which foreign domestic helpers could stay indefinitely.

On the one hand, there are presumably benefits from learning by doing and from learning about the specifics of the job. As private household workers spend more time on the job they become more comfortable with the language, customs, and regulations of the country they are visiting, and, if they are taking care of children, they may develop a relationship with those children. A policy requiring these workers to leave the country only to be replaced by other workers certainly would have efficiency costs.

On the other hand, from the perspective of the source country, a policy of temporary migration would allow more people in the source country to earn money abroad for a period, save, and return home with enough capital to start a small business or buy a house.

Another advantage of temporary, non-renewable visas is that workers from the start are likely to have the expectation of going home. One objection to migration is the question of whether it actually helps the immigrants. From a traditional economic viewpoint, the revealed preference of the immigrant's decision to move should suggest

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<sup>18</sup> The US Au Pair program, administered by the Department of State, admits students between the ages of 18 to 26 into the US for one year under a J1 visa. The IRS estimates that there are around 12,000 au pairs in the US in any given year.

<sup>19</sup> In 2000 the UK admitted 12,900 people on Au Pair visas. Around 5,000 Au Pair's work illegally (Anderson, 2001).

<sup>20</sup> The Live-in Caregiver Program admits foreign immigrants as caregivers for children and the elderly for at least two years. Caregivers are required to live-in with the family. After two years, immigrant caregivers can apply for permanent residence status. In 2001 2,624 immigrants entered Canada through this program making up about 1% of the total number of immigrants.

that immigrants are better off. However, from a behavioral perspective, one might think that utility functions are reference dependent with the reference point depending both on previous consumption and on the consumption of peers. Under this model, immigrants may move from feeling happier that they have more goods than they used to have to feeling sad that they are poorer than the citizens around them. There is also evidence that people do not adequately foresee how their preferences will change.

With regard to the behavioral perspective of utility, this means that they are not likely to change their reference points in consumption either based on comparison to natives or the expectation that their permanent income is much higher. They are much more likely to save a high proportion of their earnings and bring them back with them to their home country. This likely will increase the economic benefit to the sending country. Instead of a small percentage of citizens leaving on a semi-permanent basis and earning much more than they would have at home, a much larger number of citizens will leave for 2 or 3 years, make some money and come home.

It is not clear whether a temporary visa program would be consistent with norms if it were constructed explicitly as a way of avoiding obligations to long-term residents.

One concern with the system of temporary, non-renewable visas is whether they could be enforced. Temporary visas may be enforceable in Hong Kong, Singapore, and the Gulf States but whether such programs are enforceable in other countries is unclear. Workers on these visas may simply go underground and stay in the country illegally, perhaps, performing other types of work and, thus, having much more conventional effects on wages and welfare. This concern could be partially addressed by having workers, employers, or employment agencies post a bond which they would forfeit if the

workers overstayed their visas. Another possibility would be for part of the workers' salary to be paid into an account which the worker could not access unless they returned home. Certainly, however, there would be some leakage.

Another way that programs could be designed to make them more politically acceptable is to restrict the right to hire foreign private household workers to households which have a particularly compelling need. Canada's program, in addition to proposals in Taiwan, allow only households with demonstrated large housework burdens (i.e. have young children or sick elderly) to employ foreign private household workers.

## ***5.2. Splitting the surplus from migration***

In assessing the welfare impact of migration of foreign domestic helpers, a key question is how the surplus from the relationship is divided between the foreign domestic helper, the employer, and the host country. In the model we assume that a certain number of foreign domestic helpers are admitted to the country and that once they are in the country they are free to choose their employer. In this case, wages are bid up to the reservation level for employers. However, in a number of cases, the terms of the migrants' visas require them to work for a specific employer. In this case, the bargaining power shifts radically towards the employer.

If governments want to improve the welfare of foreign private household workers, a key step would be to make it easier for these workers the right to change employers and to spend a period of time without an employer, searching for a job. Currently, foreign domestic helper programs in Hong Kong and Singapore and the Live-in-Caregiver program in Canada require immigrants to sign a work contract before immigrating and make their legal status contingent on being employed by that specific employer. The right

to change employers should greatly improve immigrant bargaining position vis-à-vis employers and is likely to be as important as minimum wage regulations in avoiding exploitation.<sup>21</sup> Minimum wage rules are likely quite difficult to enforce because employers can simply pressure workers to put in more hours.

Currently, some governments such as Hong Kong and Singapore, issue special visas to foreign private household workers, whereas others implicitly tolerate the practice but do not issue visas. When workers are illegal, they are more vulnerable to exploitation by their employer and will likely have more difficulty finding alternative employers. Legally recognize these workers rather than simply implicitly tolerating them, would also improve their welfare, making it easier for them to visit relatives in their home countries for example.

Governments of host countries often appropriate some of the surplus from these transactions. In Hong Kong employers of foreign domestic helpers are required to pay a levy of about 400 Hong Kong dollars a month which goes to the training of local workers. In Singapore employers pay a levy of about 345 Singaporean dollars a month. (For comparison, the minimum wage of a domestic helper in Hong Kong is 3,270 Hong Kong dollars a month and the average basic wage in Singapore in 2002 was 1,065 Singaporean dollars a month. (*Asia Pulse, 2004; Singapore Yearbook of Manpower Statistics 2002*).

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<sup>21</sup> It could be argued that giving workers the right to change employers is not much use if workers are not well-informed of their rights. However, there are often extensive networks among child care workers, for example, and information presumably spreads quickly. As long as foreign private household workers are given the opportunity to meet with others in these networks, and given the right to change employers their bargaining position should be greatly strengthened. Constable (1997) reports that in Hong Kong domestic helpers are often reluctant to press charges in cases of physical abuse, since the legal process can be very long. During the legal process, household workers cannot continue working for their employer and so earn no income and experience severe financial difficulty as they are disallowed from working for any other employer.

In the United States certain categories of diplomats and international civil servants are allowed to obtain G-5 visas for private household workers. The G-5 visa holders are subject to social security taxes and to payroll taxes for unemployment insurance. However, workers on G-5 status are eligible to collect neither social security nor unemployment insurance. The combined employer and employee side of social security taxes plus unemployment insurance rate typically amounts to approximately XX% of wages.

## **6. Conclusion**

Immigration policy of the developed economies can have a substantial impact on developing countries. In addition to raising wages for the migrant and reducing the labor supply of the developing country, migrants remit sizeable sums back home. In recent years remittances have approached 7% and 9% of GDP for Sri Lanka and the Philippines, respectively (Ratha, 2003), two leading sources of private household workers.

A number of countries that have recently become prosperous including Bahrain, Saudi Arabia, Singapore, Hong Kong, Greece, and Israel, have encouraged the migration of private household workers.

Our calibration exercise suggests that the welfare effects of private household worker immigration can be substantial. The model suggests that the admission of 5% of the labor force as foreign private household workers could potentially increase welfare among natives by as much as a 1 - 1.1% increase in GDP. This effect is more than a hundred times as large as the effects estimated by Borjas. Moreover, this type of immigration could increase the ratio of low-skilled native wages to high-skilled native wages by around 2.5%.

Poor workers in developing countries would be better off in the absence of immigration restrictions in the rich world. However, they are better off under private household worker programs than they would be either under the draconian immigration restrictions that characterized the rich world for much of the 20<sup>th</sup> century or under the current trend toward selectively encouraging migration by highly-skilled workers.

Private household worker migration addresses the key political economy issues limiting immigration in rich countries: widening native wage inequality among natives, fiscal losses and the perceived impact on native culture and crime. Private household worker programs may grow over time due to demographic, technological, and cultural trends. Augmenting private household worker migration can relieve the demographic pressures of a low birth rate, by reducing the cost of having children and caring for the elderly. Improvements in transportation and remittance technologies increase the supply of foreign domestic workers, and the expanding role of women in the workplace creates more demand.

While the globalization of household production may improve prospects for people in some poor countries and may be more acceptable to rich countries, particularly ‘new rich’ countries, than other forms of migration by low-skilled workers, it may not be consistent with ethical norms in societies where membership is defined by long-term residence. From one perspective this is paradoxical. Countries like Kuwait, which draw a sharp distinction between citizens and non-citizens, are quite willing to bring in domestic workers. In contrast other countries may find it morally repugnant to restrict long-term residents to domestic work. As a consequence they may be unwilling to admit these immigrants at all.

Temporary migration, as in au pair programs, may be consistent with these norms. Avoiding stipulations that migrants work for a particular employer would likely improve their working conditions.

Although our analysis focuses on the case of foreign private household workers, similar questions may arise for other categories of immigrants. Foreign workers are often employed in construction. It is possible that the use of foreign workers in this sector effectively augments the capital stock, and that the resulting growth in the capital stock benefits native workers at the expense of native capital owners. This could occur through two channels: first a reduction in the relative price of structures which are themselves an important component of the capital stock. To the extent that more residences are built, rents will be driven down. To the extent that more business structures are created, wages may be bid up. Second, and presumably less important, it is possible that there is substantial substitutability between capital and labor in the construction sector. To the extent that this is the case, use of cheap foreign labor in construction could free up capital to flow to other sectors of the economy.

## Appendix A – Proof of Proposition 11

Note that these proofs are done for the Cobb-Douglas case. The CES case should deliver the same results. We are currently working on amending the proofs for the CES case.

**Case 1:**  $\delta(1-\tau) < \theta$

When outcome (2) and (3) hold, high-skilled types are outside hiring all consumption of the domestic good, and immigrants are now supplying labor to the production of the general consumption good. From the sector A firm zero profit condition, we know that  $W_L = \frac{(1-\beta)(h)^\beta}{[\alpha(1-h) + \alpha\theta\pi m]^\beta}$   $W_H = \frac{\beta[\alpha(1-h) + \alpha\theta\pi m]^{1-\beta}}{(h)^{1-\beta}}$  where  $\pi$  is the proportion of immigrants working in sector A. To solve this expression for  $\pi$ , we use the market clearing condition for good C. High-skilled types demand

$$\frac{h(1-\alpha)(1-\tau)W_H}{P_C} = \frac{\delta h(1-\alpha)(1-\tau)W_H}{\theta W_L} \text{ of good C where we have made use of the fact}$$

that  $P_C = \frac{W_I}{\delta} = \frac{\theta W_L}{\delta}$ , and immigrants supply  $\alpha\delta m(1-\pi)$  units of good C. Setting

demand equal to supply and solving for  $W_L$  gives

$$W_L = \frac{(1-\beta)^{1-\beta} h^\beta [(1-\alpha)(1-\tau)\beta + 1 - \beta]^\beta}{\alpha^\beta [(1-h) + \theta m]^\beta}, W_H = \frac{\beta(\alpha(1-\beta))^{1-\beta} [(1-h) + \theta m]^{1-\beta}}{h^{1-\beta} [(1-\alpha)(1-\tau)\beta + 1 - \beta]^{1-\beta}} \text{ and}$$

$$P_C = \frac{W_I}{\delta} = \frac{\theta(1-\beta)^{1-\beta} h^\beta [(1-\alpha)(1-\tau)\beta + 1 - \beta]^\beta}{\delta\alpha^\beta [(1-h) + \theta m]^\beta}. \text{ Define } \frac{(1-\alpha)(1-\tau)\beta(1-h)}{\alpha\theta(1-\beta)} \equiv \bar{m}.$$

**Lemma A1:** Under assumption A1 and  $\delta(1-\tau) < \theta$ , at  $m = \bar{m}$  low-skilled welfare is the same as with zero immigration.

**Proof:** Given low-skilled wages and prices for all the goods, low-skilled welfare is

$$\left( \frac{(1-\tau)(\alpha(1-\beta))^{1-\beta} h^\beta [(1-\alpha)(1-\tau)\beta + 1 - \beta]^\beta}{[(1-h) + \theta m]^\beta} \right)^\alpha (1-\alpha)^{1-\alpha}. \text{ When } m = \bar{m}, \text{ low-skilled}$$

welfare simplifies to  $\left( \frac{\alpha(1-\tau)(1-\beta)h^\beta}{(1-h)^\beta} \right)^\alpha (1-\alpha)^{1-\alpha}$  which is the same as welfare with

zero immigration. ◦

**Lemma A2:** Under assumption A1 and  $\delta(1-\tau) < \theta$ , at  $m = \bar{m}$  high-skilled welfare is higher than with zero immigration.

**Proof:** High-skilled welfare is

$$\left( \frac{\alpha(1-\tau)\beta(\alpha(1-\beta))^{1-\beta} [(1-h) + \theta m]^{1-\beta}}{h^{1-\beta} [(1-\alpha)(1-\tau)\beta + 1 - \beta]^{1-\beta}} \right)^\alpha \left( \frac{\alpha\beta\delta(1-\alpha)(1-\tau)[(1-h) + \theta m]}{\theta h [(1-\alpha)(1-\tau)\beta + 1 - \beta] h} \right)^{1-\alpha}. \text{ At } m = \bar{m}$$

and after simplifying, we find that welfare before immigration is always less than welfare

after immigration if and only if  $1 < \frac{\delta\beta(1-\tau)(1-h)}{\theta(1-\beta)h}$  which when rearranged gives

$$h < \frac{\delta\beta(1-\tau)}{\theta(1-\beta) + \delta\beta(1-\tau)}. \text{ This is already assumed in assumption A1. } \circ$$

**Case 2:**  $\delta(1-\tau) \geq \theta$

When outcome (1) and (3) hold, high-skilled natives are outside hiring all consumption of the domestic good while low-skilled types outside hire for some of their domestic good production, and immigrants are only producing the hired domestic good.

Low-skilled natives purchase  $\alpha\delta m - \frac{(1-\alpha)(1-\tau)h}{P_C}$  units of good C produced by

immigrants which is just the total amount of hired outside good supplied minus the consumption of the high-skilled natives. This implies that low-skilled natives supply

$\alpha(1-h) + \alpha\delta m - \frac{(1-\alpha)(1-\tau)}{P_C}$  of labor to the outside market. Given that low-skilled

natives are outside hiring only part of their domestic good consumption,  $P_C = (1-\tau)W_L$

and given the sector A firms' zero profit condition,

$$W_L = \frac{(1-\beta)h^\beta}{\left(\alpha(1-h) + \alpha\delta m - \frac{(1-\alpha)h}{W_L}\right)^\beta} \text{ and } W_H = \frac{\beta\left(\alpha(1-h) + \alpha\delta m - \frac{(1-\alpha)h}{W_L}\right)^{1-\beta}}{h^{1-\beta}}. \text{ Solving}$$

$$\text{gives } W_L = \frac{(1-\beta)^{1-\beta}[(1-\alpha\beta)h]^\beta}{\alpha^\beta[(1-h) + \delta m]^\beta} \text{ and } W_H = \frac{\beta[\alpha(1-\beta)(1-h) + \alpha(1-\beta)\delta m]^{1-\beta}}{[(1-\alpha\beta)h]^{1-\beta}}. \text{ Now,}$$

$$\text{we redefine } \bar{m} \equiv \frac{(1-h)(1-\alpha)}{\alpha\delta(1-\beta)}$$

**Lemma A3:** Under assumption A1 and  $\delta(1-\tau) \geq \theta$ , at  $m = \bar{m}$  low-skilled welfare is the same as with zero immigration.

**Proof:** Since low-skilled natives are outside hiring only part of their domestic good consumption, they consume  $1 - \alpha$  units of the domestic good. Low-skilled welfare is,

$$\text{thus, } \left(\frac{\alpha(1-\tau)[(1-\alpha\beta)h]^\beta(1-\beta)^{1-\beta}}{\alpha^\beta[(1-h) + \delta m]^\beta}\right)^\alpha (1-\alpha)^{1-\alpha}. \text{ At } m = \bar{m} \text{ this expression is equal to}$$

welfare for low-skilled natives with zero immigration. ◦

**Lemma A4:** Under assumption A1 and  $\delta(1-\tau) \geq \theta$ , at  $m = \bar{m}$  high-skilled welfare is the higher than with zero immigration.

**Proof:** High-skilled welfare is

$$\left(\frac{\alpha(1-\tau)\beta[\alpha(1-\beta)(1-h) + \alpha(1-\beta)\delta m]^{1-\beta}}{[(1-\alpha\beta)h]^{1-\beta}}\right)^\alpha \left((1-\alpha)\frac{\alpha\beta(1-h) + \alpha\beta\delta m}{h(1-\alpha\beta)}\right)^{1-\alpha}.$$

Substituting  $m = \bar{m}$  and simplifying implies that high-skilled welfare is higher than the zero immigration case if and only if  $h < \beta$  which is already assumed in A1. ◦

By lemmas A1 and A2 when  $\delta(1-\tau) < \theta$ , there exists a level of immigration such that no native type is worse off. By lemmas A3 and A4 when  $\delta(1-\tau) \geq \theta$ , a different level of immigration exists such that no native type is worse off. ◦

## Appendix B – Proof of Proposition 12

Note that these proofs are done for the Cobb-Douglas case. The CES case should deliver the same results. We are currently working on amending the proofs for the CES case.

Section 3.5 showed that income inequality among natives increases until either outcome (1), (2), or (3) is realized. We will prove the proposition by showing that income inequality is non-decreasing when outcome (1), outcome (2), outcome (3), outcome (1) and (3), and outcome (2) and (3) hold. We do not analyze the case when outcomes (1) and (2) hold since this occurs only in the knife edge case where  $\theta = \delta(1-\tau)$ . We also do not consider the case where all 3 outcomes hold since at this point standard immigration theory applies.

**Outcome 1:** Low and high-skilled natives both outside hiring only part of their domestic good consumption, and immigrants exclusively work in producing the domestic good.

Since all natives are outside hiring only part of their domestic good consumption,  $W_H = W_L \equiv W$ . If we define  $\pi$  to be the fraction of immigrants producing domestic goods for the high types, the sector A zero profit condition implies

$$\frac{W_L}{W_H} = 1 = \frac{(1-\beta)[\alpha h + \alpha \delta \pi m]}{\beta[\alpha(1-h) + \alpha \delta(1-\pi)m]} . \text{ This implies}$$

$$\pi = \frac{\beta - h + \beta\delta m}{\delta m}, L = \alpha(1 - \beta)(1 + \delta m), H = \alpha\beta(1 + \delta m), W = \beta^{1-\beta}(1 - \beta)^\beta \text{ where } L \text{ and}$$

$H$  are the supply of outside labor of low and high-skilled types, respectively. High-skilled

income minus low-skilled income simplifies to  $\frac{\alpha(1 + \delta m)\beta W}{h} \left[ 1 - \frac{(1 - \beta)h}{\beta(1 - h)} \right]$  which is

increasing in  $m$ .

**Outcome 2:** High types are outside hiring only part of their domestic good consumption; low-skilled types do not outside hire; and immigrants work in both sectors.

Immigrant wages are  $\delta(1 - \tau)W_H$ . Since immigrants work in sector A,

$$W_L = \frac{\delta(1 - \tau)W_H}{\theta}. \text{ If } \pi \text{ is the proportion of immigrants producing the domestic good for}$$

the high-skilled, the firm A zero profit condition implies

$$\frac{W_L}{W_H} = \frac{\delta(1 - \tau)}{\theta} = \frac{(1 - \beta)[\alpha h + \alpha\delta\pi m]}{\beta[\alpha(1 - h) + \alpha\theta(1 - \pi)m]}. \text{ After solving for } \pi,$$

$$H = \alpha\beta(1 - \tau) \left[ \frac{\theta h + \delta(1 - h) + \delta\theta m}{\theta(\beta(1 - \tau) + 1 - \beta)} \right] \text{ and } L + \theta I = \frac{\alpha(1 - \beta)\theta}{\delta} \left[ \frac{\theta h + \delta(1 - h) + \delta\theta m}{\theta(\beta(1 - \tau) + 1 - \beta)} \right]. \text{ This}$$

implies that  $W_H = \beta \left[ \frac{\theta(1 - \beta)}{\beta\delta(1 - \tau)} \right]^{1-\beta}$  and  $W_L = (1 - \beta) \left[ \frac{\beta\delta(1 - \tau)}{(1 - \beta)\theta} \right]^\beta$  do not depend on  $m$ .

High-skilled income minus low-skilled income, thus, is

$$\frac{\alpha\beta(1 - \tau)}{h} \left[ \frac{\theta h + \delta(1 - h) + \delta\theta m}{\theta(\beta(1 - \tau) + 1 - \beta)} \right] W_H - \alpha W_L \text{ which is increasing in the level of immigration}$$

since both  $W_H$  and  $W_L$  do not depend on  $m$ .

**Outcome 3:** High-skilled natives outside hire all domestic good consumption; low-skilled natives do not outside hire; and immigrants exclusively produce the hired domestic good for high-skilled natives.

High-skilled natives supply a full unit of labor to the outside labor force whereas

low-skilled natives supply  $\alpha$  units.  $W_H = \frac{\beta[\alpha(1-h)]^{1-\beta}}{h^\beta}$  and  $W_L = \frac{(1-\beta)h^\beta}{[\alpha(1-h)]^\beta}$ .

Difference in income between the two types is  $\frac{\beta[\alpha(1-h)]^{1-\beta}}{h^{1-\beta}} - \frac{\alpha(1-\beta)h^\beta}{[\alpha(1-h)]^\beta}$  which is non-

decreasing in the level of immigration. Income inequality remains constant at the level elevated by prior immigrants.

**Outcome (1) and (3):** High-skilled natives outside hire all consumption of the domestic good; low-skilled natives are outside hiring only part of their domestic good consumption; and immigrants work exclusively at producing the domestic good for natives.

In order for low-skilled natives to outside hire the domestic good  $\delta(1-\tau) \geq \theta$ .

From Appendix A, we have solved for the wage equilibrium for outcomes (1) and (3)

under case 2,  $W_L = \frac{(1-\beta)^{1-\beta}[(1-\alpha\beta)h]^\beta}{\alpha^\beta[(1-h)+\delta m]^\beta}$  and  $W_H = \frac{\beta[\alpha(1-\beta)(1-h)+\alpha(1-\beta)\delta m]^{1-\beta}}{[(1-\alpha\beta)h]^{1-\beta}}$ .

Low-skilled native labor supply to the outside market is

$\alpha(1-h) + \alpha\delta m - \frac{(1-\alpha)(1-\tau)W_H}{P_C} = \frac{\alpha(1-h)(1-\beta) + \alpha\delta m(1-\beta)}{1-\alpha\beta}$ . The difference

between native type incomes is  $\frac{\beta\alpha^{1-\beta}(1-\beta)^{1-\beta}(1-h+\delta m)^{1-\beta}}{(1-\alpha\beta)^{1-\beta}h^{1-\beta}} \left[ 1 - \frac{(1-\beta)h}{\beta(1-h)} \right]$  which by

A1 is increasing in the level of immigration.

**Outcome (2) and (3):** High-skilled natives outside hire all consumption of the domestic good, low-skilled natives do not outside hire; and immigrants are employed in the sector A.

If immigrants are employed in sector A and low-skilled natives are not outside hiring,  $(1 - \tau)W_L < P_C = \frac{W_L}{\delta} = \frac{\theta W_L}{\delta}$  so  $\delta(1 - \tau) < \theta$ . The wage equilibrium has already been solved in Appendix A under case 1:  $W_L = \frac{(1 - \beta)^{1-\beta} h^\beta [(1 - \alpha)(1 - \tau)\beta + 1 - \beta]^\beta}{\alpha^\beta [(1 - h) + \theta m]^\beta}$  and  $W_H = \frac{\beta(\alpha(1 - \beta))^{1-\beta} [(1 - h) + \theta m]^{1-\beta}}{h^{1-\beta} [(1 - \alpha)(1 - \tau)\beta + 1 - \beta]^{1-\beta}}$ . High-skilled natives supply a full unit of labor to

the outside market while low-skilled natives supply  $\alpha$ . The difference in income is

$$\alpha^{1-\beta} (1 - \beta)^{1-\beta} h^\beta [(1 - \alpha)(1 - \tau)\beta + 1 - \beta] \left[ \frac{\beta [(1 - h) + \theta m]^{1-\beta}}{h [(1 - \alpha)(1 - \tau) + 1 - \beta]} - \frac{1}{[(1 - h) + \theta m]^\beta} \right]$$

which is increasing in  $m$ . In all relevant cases we have shown that income inequality is non-decreasing in the level of immigration,  $m$ . ◦

## Appendix C – Extension with Childcare Centers

In this appendix, we investigate how the existence of formal childcare centers staffed by natives affect the conclusions of our model. Childcare centers are modeled as alternative producers of good C. Thus, good C can now be either produced by the household, purchased from household workers, or purchased from childcare centers. However, in the model there is an upper limit as to how much childcare households can purchase. This limit is denoted by  $\bar{C}$ . For  $\bar{C}$  to be interesting, it must be less than  $1 - \alpha$ .  $\bar{C}$  is motivated by the limitations to the services of childcare centers. Most centers are open only during normal business hours, are closed on holidays, and refuse sick children. Households employing childcare centers must still daily drop off and pick up their children, find alternative childcare on holidays, and care for sick children themselves.

These limitations can affect household labor choice and are not applicable with a private household worker.

Childcare centers are assumed to produce good C with production function  $C_{cc} = kH^\beta (L + \theta I)^{1-\beta}$ . (In this extension, we assume that  $\varphi = \theta$  in the production function for good A so that the production function for good A is also Cobb-Douglas.) Childcare centers require the inputs of high-skilled labor at the same factor intensity as good A. Kisker et al. (1991) finds that 47% of teachers in US day care centers have completed college which is higher than the 24.1% proportion of workers with college degrees in the general economy (Kominski and Adams, 1994).

In this setting, households solve the following problem:

$$\max A^\alpha (C_{hw} + C_{cc} + L_c)^{1-\alpha} + v(g) \text{ such that } W_i(1-\tau)(1-L_c) = A + P_c C_{hw} + P_{cc} C_{cc} \text{ and } C_{cc} \leq \bar{C}$$

$C_{hw}$  and  $C_{cc}$  represent good C purchased from household workers and childcare centers respectively. To solve this maximization problem, we need to know the relationship among the prices of the domestic goods, namely, price of childcare service,  $P_{cc}$ , price of private household worker service,  $P_c$ , and price of home production of domestic good  $(1-\tau)W_i$ . We do not consider the case in which native private household workers are employed in equilibrium since this occurs rarely in the “old rich” and concentrate on the case where  $P_c > W_H(1-\tau) > P_{cc} > W_L(1-\tau)$  so that only high-skilled natives utilize childcare centers, and no one hires native private household workers.

We first solve the model without immigration. In order for

$P_c > W_H(1-\tau) > P_{cc} > W_L(1-\tau)$  to hold without any immigration, we make the following assumption:

**Assumption C1:**

$$\frac{A\alpha k\beta(1-\tau)}{A\alpha k\beta(1-\tau) + \frac{1-\beta}{\beta}(1+\bar{C})\alpha k\beta(1-\tau) + A^{1-\beta}\left(\frac{1-\beta}{\beta}\right)^\beta \bar{C}(1-\alpha)} < h < \frac{\delta\alpha k\beta(1-\tau)^2}{\delta\alpha k\beta(1-\tau)^2 + \frac{1-\beta}{\beta}(1+\bar{C})\alpha k\beta(1-\tau) + [\delta(1-\tau)]^{1-\beta}\left(\frac{1-\beta}{\beta}\right)^\beta \bar{C}(1-\alpha)}$$

where  $A = \min \left\{ \left[ k(1-\tau)\beta^\beta(1-\beta)^{1-\beta} \right]^{\frac{1}{1-\beta}}, \left[ \frac{\beta^\beta(1-\beta)^{1-\beta}}{k(1-\tau)} \right]^{\frac{1}{\beta}} \right\}$ .

With this assumption, from the household maximization problem we can find that

the amount of labor supplied to the workforce by high types is  $\alpha + \alpha\bar{C} + \frac{P_{cc}\bar{C}(1-\alpha)}{W_H(1-\tau)}$ .

This implies that our model can be solved by the following system of equations.

(1)  $\frac{W_L}{W_H} = \frac{1-\beta}{\beta} \frac{H_A}{L_A}$  - From Cobb-Douglas production functions

(2)  $\frac{H_A}{L_A} = \frac{H_{CC}}{L_{CC}}$  - From production functions of good A and childcare centers

(3)  $H_A^\beta L_A^{1-\beta} - W_H H_A - W_L L_A = 0$  - Zero profit condition for good A firms

(4)  $P_{cc} = \frac{W_H H_{CC} + W_L L_{CC}}{k H_{CC}^\beta L_{CC}^{1-\beta}} = \frac{1}{k} \left( W_H \left( \frac{H_{CC}}{L_{CC}} \right)^{1-\beta} + W_L \left( \frac{L_{CC}}{H_{CC}} \right)^\beta \right)$  - Zero profit

condition for childcare centers

(5)  $H_A + H_C = \left[ \alpha + \alpha\bar{C} + \frac{P_{cc}\bar{C}(1-\alpha)}{W_H(1-\tau)} \right] h$  - High-skilled labor market clearing

condition

(6)  $L_A + L_{CC} = \alpha(1-h)$  - Low-skilled labor market clearing condition

(7)  $k H_C^\beta L_{CC}^{1-\beta} = \bar{C}h$  - Childcare center market clearing condition.

Solving this system of equations gives the following proposition:

**Proposition C1:** If assumption C1 holds, then in the equilibrium without immigration

$z = \frac{W_L}{W_H}$  can be found as the implicit solution to the following equation:

$$z = \frac{1-\beta}{\beta} \frac{(1+\bar{C})h}{1-h} + z^{1-\beta} \left( \frac{1-\beta}{\beta} \right)^\beta \frac{\bar{C}(1-\alpha)h}{\alpha(1-h)k\beta(1-\tau)} \text{ and } \frac{\partial \left( \frac{W_L}{W_H} \right)}{\partial h} > 0.$$

**Proof:** Algebra and implicit function theorem. ◦

We now allow for immigration and assume that the level of immigration is local to zero. We again assume that  $W_I > \theta W_L$  so that immigrants do not enter sector A and work exclusively as private household workers for high-skilled natives. Natives must choose either to employ childcare centers or private household workers, but not both. This assumption is motivated by the fact that foreign private household programs usually restrict immigrants to working for only one native household.

We assume that entering immigrants extract all the surplus from their service. In equilibrium a fraction of high-skilled natives employ foreign private household workers while the rest buy childcare service. Therefore, the price of private household workers is set such that the high-skilled are indifferent between childcare service and a household worker. Formally, for high-skilled workers  $U(P_c, \bar{C}) = U(P_c, C_c^H(P_c))$  should hold where  $C_c^H$  is the high-skilled consumption of good C provided by private household workers.

**Proposition C2:** If immigration is local to zero, immigrants do not work in the formal good sector or at childcare centers, and immigrants extract all consumer surplus from

their service, then  $P_c = \frac{[W_H(1-\tau)]^{1+\frac{1}{1-\alpha}}}{\left[ (1+\bar{C})W_H(1-\tau) - \frac{\bar{C}}{k} \right]^{\frac{1}{1-\alpha}}}$  and high-skilled types who hire

domestic helpers consume  $C_{hw}^H = \frac{(1-\alpha)\left[(1+\bar{C})W_H(1-\tau) - \frac{\bar{C}}{k}\right]^{\frac{1}{1-\alpha}}}{[W_H(1-\tau)]^{\frac{1}{1-\alpha}}}$  units of the domestic

good.

**Proof:** From the non-immigration case, high-skilled households who use childcare centers receive utility

$\alpha^\alpha \left[(1+\bar{C})W_H(1-\tau) - P_{cc}\bar{C}\right]^\alpha (1-\alpha)^{1-\alpha} \frac{\left[(1+\bar{C})W_H(1-\tau) - P_{cc}\bar{C}\right]^{1-\alpha}}{[W_H(1-\tau)]^{1-\alpha}} + v(g)$ . The utility of

high-skilled households who hire a private household worker is

$\alpha^\alpha [W_H(1-\tau)]^\alpha (1-\alpha)^{1-\alpha} \frac{[W_H(1-\tau)]^{1-\alpha}}{P_c^{1-\alpha}} + v(g)$ . For high-skilled natives to be indifferent

between these two options  $\frac{(1+\bar{C})W_H(1-\tau) - P_{cc}\bar{C}}{[W_H(1-\tau)]^{1-\alpha}} = \frac{W_H(1-\tau)}{P_c^{1-\alpha}}$  must hold or

equivalently  $P_c = \frac{[W_H(1-\tau)]^{1+\frac{1}{1-\alpha}}}{\left[(1+\bar{C})W_H(1-\tau) - P_{cc}\bar{C}\right]^{\frac{1}{1-\alpha}}}$ . Given the production functions for

childcare centers and good A, the price of childcare centers  $P_{cc} = \frac{1}{k}$  if good A is the

numeraire. Solving for  $P_c$  and  $C_{hw}^H$  gives the required expressions. ◦

Given the price and demand for private household workers, we can solve for equilibrium with the following set of equations where  $\lambda$  is the proportion of high-skilled natives using childcare.

$$(1) \frac{W_L}{W_H} = \frac{1-\beta}{\beta} \frac{H_A}{L_A} \text{ - From good A production function}$$

$$(2) \frac{H_A}{L_A} = \frac{H_C}{L_C} \text{ - From childcare center production function}$$

$$(3) H_A^\beta L_A^{1-\beta} - W_H H_A - W_L L_A = 0 \text{ - Good A zero profit condition}$$

$$(4) P_{cc} = \frac{W_H H_C + W_L L_C}{k H_C^\beta L_C^{1-\beta}} = \frac{1}{k} \left( W_H \left( \frac{H_C}{L_C} \right)^{1-\beta} + W_L \left( \frac{L_C}{H_C} \right)^\beta \right) \text{ - Childcare center zero}$$

profit condition

$$(5) H_A + H_C = \left[ \alpha + \alpha \bar{C} + \frac{P_{cc} \bar{C} (1-\alpha)}{W_H (1-\tau)} \right] \lambda h + (1-\lambda)h \text{ - Market clearing condition}$$

for high-skilled native labor

$$(6) L_A + L_C = \alpha(1-h) \text{ - Market clearing condition for low-skilled native labor}$$

$$(7) k H_C^\beta L_C^{1-\beta} = \bar{C} \lambda h \text{ - Childcare center market clearing condition}$$

$$(9) C_{hw}^H (1-\lambda)h = \alpha \delta m \text{ - Market clearing condition for immigrant labor}$$

$$(10) C_{hw}^H = \frac{(1-\alpha) \left[ (1+\bar{C}) W_H (1-\tau) - \bar{C}/k \right]^{\frac{1}{1-\alpha}}}{[W_H (1-\tau)]^{\frac{1}{1-\alpha}}} \text{ - Private household worker market}$$

clearing condition.

We first simplify this system of equations to a system of two equations where

$$z = \frac{W_L}{W_H} :$$

$$\frac{\beta}{1-\beta} z = \frac{\lambda h}{1-h} + \frac{\bar{C} \lambda h}{1-h} + \lambda \left( \frac{\beta}{1-\beta} z \right)^{1-\beta} \frac{\bar{C} (1-\alpha) h}{\alpha (1-h) k \beta (1-\tau)} + \frac{(1-\lambda)h}{\alpha (1-h)} \quad (C1)$$

$$\lambda = 1 - \frac{\alpha \delta m \left[ \frac{\beta^\beta (1-\beta)^{1-\beta}}{z^{1-\beta}} (1-\tau) \right]^{\frac{1}{1-\alpha}}}{(1-\alpha) h \left[ (1+\bar{C})(1-\tau) \frac{\beta^\beta (1-\beta)^{1-\beta}}{z^{1-\beta}} - \bar{C}/k \right]^{\frac{1}{1-\alpha}}} \quad (C2)$$

$$\text{Equation C1 can be rewritten to be } \lambda = \frac{\frac{\beta}{1-\beta} z(1-h) - \frac{h}{\alpha}}{\bar{C} h + \left( \frac{\beta}{1-\beta} \right)^{1-\beta} z^{1-\beta} \frac{\bar{C} (1-\alpha) h}{\alpha k \beta (1-\tau)} + h - \frac{h}{\alpha}}, \text{ and } z$$

can be given as the implicit solution to the following equation:

$$\frac{\frac{\beta}{1-\beta}z(1-h) - \frac{h}{\alpha}}{\bar{C}h + \left(\frac{\beta}{1-\beta}\right)^{1-\beta} z^{1-\beta} \frac{\bar{C}(1-\alpha)h}{\alpha k\beta(1-\tau)} + h - \frac{h}{\alpha}} + \frac{\alpha\delta m \left[ \frac{\beta^\beta (1-\beta)^{1-\beta}}{z^{1-\beta}} (1-\tau) \right]^{\frac{1}{1-\alpha}}}{(1-\alpha)h \left[ (1+\bar{C})(1-\tau) \frac{\beta^\beta (1-\beta)^{1-\beta}}{z^{1-\beta}} - \bar{C}/k \right]^{\frac{1}{1-\alpha}}} - 1 = 0$$

(C3)

**Proposition C3:** If assumption C1 holds, then when immigration is close to zero, the

relative wage  $z = \frac{W_L}{W_H}$  is increasing in immigration.

**Proof:** For convenience, we denote the left hand side of equation C1 as  $G(z)$ . We apply

the implicit function theorem:  $\frac{\partial z}{\partial m} = -\frac{\partial G/\partial m}{\partial G/\partial z}$ . We note that  $\frac{\partial G}{\partial m} > 0$ . Next, we

investigate whether  $\frac{\partial G}{\partial z} < 0$ . Condition  $\frac{\partial G}{\partial z} < 0$  is always satisfied at  $m = 0$  if  $\frac{\partial \lambda}{\partial z}$ , found

from equation (C1), is negative. In equation (C1) we gather all terms onto the left and

denote the resulting expression by

$$H(z, \lambda) = \frac{\beta}{1-\beta}z - \frac{\lambda h}{1-h} - \frac{\bar{C}\lambda h}{1-h} - \lambda \left( \frac{\beta}{1-\beta}z \right)^{1-\beta} \frac{\bar{C}(1-\alpha)h}{\alpha(1-h)k\beta(1-\tau)} - \frac{(1-\lambda)h}{\alpha(1-h)}. \quad \partial H/\partial \lambda > 0$$

if  $\alpha + \bar{C}\alpha + \left(\frac{1-\beta}{\beta}\right)^{1-\beta} \frac{\bar{C}(1-\alpha)}{k\beta(1-\tau)} < 1$ . But the last inequality is always true, since the

left-hand side is the labor supply of the high-skilled who buys childcare, which is always

less than 1.  $\partial H/\partial z = \frac{\beta}{1-\beta} \left[ 1 - \lambda(1-\beta) \left( \frac{1-\beta}{\beta} \right)^\beta \frac{\bar{C}(1-\alpha)h}{\alpha(1-h)k\beta(1-\tau)} z^{-\beta} \right]$ . This expression

is linear in  $\lambda$  and is clearly positive if  $\lambda = 0$ . If  $\lambda = 1$  the sign of  $\partial H/\partial z$  is the same as the

sign of  $1 - (1-\beta) \left( \frac{1-\beta}{\beta} \right)^\beta \frac{\bar{C}(1-\alpha)h}{\alpha(1-h)k\beta(1-\tau)} z^{-\beta}$ . This expression is clearly positive when

$z = 0$  and is increasing in  $z$  since its derivative is always positive. Thus, this expression is

always positive for any positive value for  $z = \frac{W_L}{W_H}$ . Since  $\frac{\partial H}{\partial z}$  is positive for all

positive values of  $z$  and for all values of  $0 < \lambda < 1$ ,  $\frac{\partial H}{\partial z}$  is always positive for the

relevant range of values. Thus,  $\frac{\partial H}{\partial z} > 0$  and  $\frac{\partial H}{\partial \lambda} > 0$  implies that  $\frac{\partial \lambda}{\partial z} < 0$ .  $\frac{\partial \lambda}{\partial z} < 0$

implies that  $\frac{\partial G}{\partial z} < 0$  which implies that  $\frac{\partial z}{\partial m} = -\frac{\frac{\partial G}{\partial m}}{\frac{\partial G}{\partial z}} > 0$  when  $m$  is close to zero. ◦

The analysis for increased levels of immigration proceeds similarly as in the original model. As  $m$  increases,  $W_H$  decreases which leads to decreases in  $P_c$  and the wages of immigrants. Eventually, so many immigrants will arrive that either immigrants will begin to compete with low-skilled natives in sector A or low-skilled natives will begin hiring foreign private household workers, themselves. Once this occurs the supply of equivalent low-skilled native labor will increase, and the wages of low-skilled natives will decrease. Once low-skilled native wages and equivalent low-skilled native labor has returned to levels equivalent to the non-immigration case, welfare will have increased relative to the non-immigration case since immigrants will have allowed greater consumption of the domestic good. Thus, proposition 11 should still hold.

## References Cited:

Anderson, Bridget. “Reproductive Labor and Migration” Paper given at the Sixth Metropolis Conference, Rotterdam, 26-30. WPTC-02-01, November 2001.

Asia Pulse, “HK Keeps Minimum Wage for Foreign Domestic Helpers at Current Level”, May 12, 2004

Ballard, C. and Fullerton, D. “Distortionary Taxes and the Provision of Public Goods” *Journal of Economic Perspectives* Vol.6 , No.3, pp. 117-131, 1992.

Blau, David and Robins, Philip. “Child-care Costs and Family Labor Supply” *The Review of Economics and Statistics*. Vol. 70, pp. 374 – 381, 1988.

Blau, David. “An Economic Perspective on Child Care Policy” *Journal of Population and Social Security: Population Study*. Vol. I, Supplement, pp. 423 – 442, June 2003.  
English Language Version:  
<http://www.ipss.go.jp/English/WebJournal.files/Population/WebPopulation.html>.

Borjas, George. “The Economic Benefits from Immigration”, *Journal of Economic Perspectives*. Vol. 9, No. 2, pp. 3-22, 1995.

Borjas, George; Freeman, Richard; Katz, Larry. “How Much Do Immigration and Trade Affect Labor Market Outcomes?” *Brookings Papers on Economic Activity*. Vol. 1997, No. 1, pp. 1-90, 1997.

Borjas, George. “The Economic Analysis of Immigration” *Handbook of Labor Economics*. Edited by O. Ashenfelter and D. Card. Vol. 3A, pp. 1697 – 1760, North-Holland 1999.

Borjas, George. “The Labor Demand Curve is Downward Sloping: Reexamining the Impact of Immigration on the Labor Market” *Quarterly Journal of Economics*, Vol. 118, No. 4, pp. 1335 – 1374, 2003.

Browning, Edgar K. “On the Marginal Welfare Cost of Taxation” *The American Economic Review*, Vol. 77, No. 1 pp. 11-23, March 1987.

Commander, Simon John; Kangasniemi, Mari; and Winters, L. Alan “The Brain Drain: Curse or Boon?” *IZA Discussion Paper No. 809*, June 2003.

Connelly, Rachel. “The Effects of Child Care Costs on Married Women’s Labor Force Participation” *Review of Economics and Statistics*. Vol. 74, pp. 83-90, 1992.

Constable, Nicole. *Maid to Order in Hong Kong: Stories of Filipina Workers*. Cornell University Press, Ithaca, NY. 1997.

Cortes, Patricia. “How Much does Low-Skilled Labor Increase Consumer Surplus?” *MIT Manuscript*, November 2004.

Chiswick, Barry R. “The Effect of Americanization on the Earnings of Foreign-born Men”, *The Journal of Political Economy*. Vol. 86, No.5 pp. 897-921, 1978.

Davis, Steven and Henrekson, Magnus. "Tax Effects on Work Activity, Industry Mix, and Shadow Economy Size: Evidence from Rich-Country Comparison" *NBER Working Paper Series*, WP 10509, May 2004.

Economist Intelligence Unit. *Hong Kong Country Finance Report*, January 2004.

Ehrenreich, Barbara and Harlie Hochschild (editors) *Global Women: Nannies, Maids, and Sex Workers in the New Economy*, Metropolitan Books: New York, 2004.

Freeman, Richard and Schettkat, Ronald. "Your Money or Your Time: Marketization and Work in Advanced Economies" *Harvard University Working Paper*, 2004.

Heckman, James J.; Lochner, Lance; and Taber, Christopher "Explaining Rising Wage Inequality: Explorations with a Dynamic General Equilibrium Model of Labor Earnings with Heterogeneous Agents" *NBER Working Paper* No. 6384, 1998.

Helpman, Elhanan and Krugman, Paul. *Market Structure and Foreign Trade*. MIT Press, Cambridge, MA, 1989.

Hersch, Joni and Stratton, Leslie S. "Housework and Wages" *Journal of Human Resources*. Vol. 37, No. 1, pp. 217-229, Winter 2002.

Hong Kong Census and Statistics Department. *Thematic Household Survey Report 14*, Social Services Section, September 2002.

Hong Kong General Household Survey. *Social Data Collected by General Household Survey Special Topics Report 14*. 1996.

Hong Kong Social Welfare Department "Checklist for Requirements for Registration/Operation of Child Care Centres/Kindergartens" 2004.  
[http://www.info.gov.hk/swd/download/childcare/pro\\_har\\_cone.pdf](http://www.info.gov.hk/swd/download/childcare/pro_har_cone.pdf).

Huntington, Samuel *Who are We? The Challenges to America's National Identity* Simon and Shuster, New York, NY, 2004.

Kapur, Devesh. *The War for Global Talent: Implications for Developing Countries*. Center for Global Development and Institute for International Economics, in press, forthcoming November 2004

Katz, Lawrence F. and Autor, David H. "Changes in the Wage Structure and Earning Inequality" in O. Ashenfelter and D. Card, Eds., *Handbook of Labor Economics*, vol 3A, North-Holland, pp. 1463 – 1555, 1999.

Katz, Lawrence F. and Murphy Kevin M. "Changes in Relative Wages, 1963 – 1987: Supply and Demand Factors" *Quarterly Journal of Economics* Vol. 107, No. 1, pp. 1 – 34, 1992.

Khananuskul, Phanwadee. "Do Low-Skilled Female Immigrants Increase the Labor Supply of Skilled Native Women?" *Harvard University Working Paper*, 2004.

Kimmel, Jean. "Childcare Costs as a Barrier to Employment for Single and Married Mothers" *Review of Economics and Statistics*. Vol. 80, pp. 287 – 299, 1998.

Kisker, E.; Hofferth, S. L.; Phillips, A.; and Farquhar, E. "A Profile of Child Care Settings: Early Education and Care in 1990." Report Prepared for US Department of Education by Mathematica Policy Research 1991.

Klein, Paul and Ventura, Gustavo. "Do Migration Restrictions Matter?" Paper presented at NBER Summer Institute July 16, 2004.

Kominski, Robert and Adams, Andrea. "Educational Attainment in the United States: March 1993 and 1992", *Current Population Reports Population Characteristics*. US Department of Commerce, Economics and Statistics Administration, Bureau of the Census. P20-476, May 1994.

Kolesnikov-Jessop, Sonia "Letter from Singapore: It's so Hard to Get Good Help" *Newsweek International Edition* May 17, 2004.

Krusell, Per; Ohanian, Lee E.; Rios-Rull, Jose-Victor; Violante Giovanni L. "Capital-Skill Complementarity and Inequality": A Macroeconomic Analysis" *Econometrica* Vol. 68, No. 5, pp. 1029 – 1053, 2000.

Lam, Kit-Chun and Liu, Pak-Wai. "Earnings Divergence of Immigrants" *Journal of Labor Economics*. Vol. 20, No. 1, pp. 86-104, 2002.

Lowell, B. Lindsey and Suro, Robert. "How Many Undocumented: the Numbers behind the US – Mexico Migration Talks" *Pew Hispanic Center* March 21, 2002.

Massachusetts Office of Child Care Services. *Group Childcare and School Age Program Licensing – Section 102 CMR 7.00*. [www.qualitychildcare.org/regulations.shtml](http://www.qualitychildcare.org/regulations.shtml)

Mayda, Anna Maria. "Who is Against Immigration? A Cross-Country Investigation of Individual Attitudes towards Immigrants" *Georgetown University Working Paper*, April 2004.

Orrenius, Pia and Zavodny, Madeline. "Does Immigration Affect Wages? A look at Occupation-Level Evidence" *Federal Reserve Bank Working Paper*, June 2003.

Palmer, Phyllis. *Domesticity and Dirt: Housewives and Domestic Servants in the United States, 1920 – 1945*. Temple University Press, Philadelphia. 1989.

Ratha, Dilip “Worker’s Remittances: An Important and Stable Source of External Development Finance”, *Global Development Finance I Analysis and Statistical Appendix* pp. 157 – 175, 2003.

Ribar, David. “Structural Model of Child Care and the Labor Supply of Married Women” *Journal of Labor Economics*. Vol. 13 pp. 558 – 597, 1995.

Singapore Census of Population 1990. *Religion, Childcare, and Leisure Activities*. Statistical Release 6.

Singapore Ministry of Community Development, Youth, and Sports. “Guide to Setting up a Child Care Centre” 2004.  
<http://www.childcarelink.gov.sg/ccls/uploads/CCC%20Guide.pdf>

Singaporean Ministry of Manpower. *Singaporean Work Permit Application for a Foreign Domestic Helper Singapore Ministry of Manpower*, 2004.  
<http://www.mom.gov.sg/MOM/CDA/0,1858,961-----,00.html>

Singapore Yearbook of Manpower Statistics 2002.

Stigler, George J. “Domestic Servants in the United States 1900 – 1940”. *NBER Occasional Paper 24*, April 1946.

Stefoni, Carolina. “Mujeres Immigrantes Peruanas en Chile” CIEAP/UAEM Papeles de Población No. 33, Julio / Septiembre 2002.

Walmsley, Terrie Louise and Winters, L. Alan. “Relaxing the Restrictions on the Temporary Movements of Natural Persons: A Simulation Analysis” *CEPR Discussion Paper No. 3719*, January 2003.

Williamson, Jeffrey. “Globalization, Convergence, and History” *The Journal of Economic History*. Vol. 56, No. 2, pp. 277-306, Presented at the Fifty-Fifth Annual Meeting of the Economic History Association. (Jun., 1996), Presented at the Fifty-Fifth Annual Meeting of the Economic History Association. (Jun., 1996), Presented at the Fifty-Fifth Annual Meeting of the Economic History Association, Jun. 1996.

Williamson, Jeffrey. “Globalization, Labor Markets and Policy Backlash in the Past” *Journal of Economic Perspectives*, Vol. 12, No. 4, pp. 51-72, 1998.

**Table 1**  
**Foreign Domestic Helpers**

	% Labor Force
Kuwait 1995	19.9%
Bahrain 2001	10.1%
Saudi Arabia 2002	8.9%
Singapore 2003	7.0%
Hong Kong 2003	6.8%
Greece 2001	1.0%
Taiwan 2000	0.8%
Israel 2001	0.8%
USA 1998	0.3%

Notes:

Kuwait: 148,637 non-Kuwaiti's were employed as domestic servants in private households out of a total working population of 747,534 and total foreign working population 604,775. Source: 1995 Census Ministry of Planning.

Bahrain: 17,701 non-Bahrainis were employed in households out of a total working population of 212,070 and total foreign working population of 134,802. Source: Statistical Abstract of Bahrain 2002.

Saudi Arabia: 516,691 non-Saudis were employed in private households out of a total working population of 5,808,617 and a total foreign working population of 3,031,633. Source: Saudi Arabia Central Department of Statistics.

Singapore: 150,000 foreigners were employed as domestic helpers out of a total labor force of 2.15 million. Source: A General Guide on Employment of Foreign Domestic Helpers Ministry of Manpower and Ministry of Manpower.

Hong Kong: 237,105 foreigners were employed as domestic helpers out of a labor force of 3,487,100. Source: Hong Kong Annual Digest of Statistics and Hong Kong Census and Statistics Bureau.

Greece: 43,623 non-Greek and non-EU citizens were employed in private households out of a total labor force of 4.3 million and a non-Greek non-EU working population of 375,579. Source: Greek Population Census 2001 and LABORSTA.

Taiwan: 79,000 foreigners were employed as domestic helpers out of a total labor force of 9.5 million. Source: Cuts in Foreign-Labor Quotas Agreed, *United Daily News* August 1, 2000 and LABORSTA.

Israel: 18.8 thousand immigrants of 1990 and after were employed as domestic personnel in private households out of a total labor force of 2,503.5 thousand and a immigrants of 1990 and after working population of 828.4 thousand. Source: Statistical Abstract of Israel 2002.

USA: This figure is taken from the March 1998 CPS where the total number of non-citizens in the industry category Personal Services – Private Households is divided by the total number of people reporting to be working in an industry.

**Table 2**  
**Female Labor Force Participation Rates in 1970's and 2000's**  
**Ages 25-34**

	Hong Kong	Singapore	Bahrain <sup>1</sup>	Kuwait <sup>2</sup>	Israel <sup>3</sup>	Greece <sup>4</sup>	US	UK <sup>4</sup>	Germany <sup>5</sup>	France <sup>6</sup>	Japan	Korea
1970	39.6%	26.7%	7.6%	12.5%	44.0%	34.0%	47.5%	43.9%	53.5%	61.8%	46.1%	36.6%
2000	80.1%	79.5%	47.2%	56.1%	58.7%	64.7%	76.3%	73.5%	73.3%	68.8%	63.9%	48.9%
Difference	40.5%	52.8%	39.6%	43.6%	14.7%	30.8%	28.8%	29.6%	19.7%	6.9%	17.8%	12.3%

<sup>1</sup>Bahrain data is from 1971 and 2001 and are participation rates for females aged 25 to 44.

<sup>2</sup>Kuwait data is from 1970 and 1995 and are participation rates for females aged 25 to 44.

<sup>3</sup>Israel data is from 1972 to 2000 and are participation rates for females aged 18 to 34.

<sup>4</sup>Greece, UK, and Canada 1970 data is from 1971.

<sup>5</sup>1970 Germany data comes from Federal Republic of Germany

<sup>6</sup>France 1970 data is from 1975.

Data is unavailable for Saudi Arabia, Taiwan

Source: ILO Laborsta and Statistical Abstract of Bahrain 2002.

These labor force participation rates include foreign domestic helpers.

### Fertility Rates (Births per Woman)

	Hong Kong	Singapore	Bahrain	Kuwait	Israel	Greece	US	UK	Germany	France	Japan	Korea
1970	3.34	3.09	6.51	7.10	3.78	2.34	2.48	2.44	2.03	2.48	2.14	4.27
2000	1.02	1.44	2.84	2.67	2.84	1.32	2.13	1.68	1.35	1.88	1.36	1.43
Difference	-69.3%	-53.3%	-56.5%	-62.4%	-24.8%	-43.5%	-14.0%	-31.1%	-33.5%	-24.3%	-36.3%	-66.5%

Source: World Development Indicators. Data from Germany is for the unified Germany.

**Table 3**  
**Welfare Gains when Immigration is 5% of Native Population and  $\delta = 0.21$**   
**Welfare Calculated as Percentage of Gross Income**

	No Tax	$\tau = 20\%$		$\tau = 51.6\%$	
		MCF = 1.4	MCF = 1	MCF = 1.4	MCF = 1
Percent Change $W_L/W_H$	2.5%	2.5%	2.5%	2.5%	2.5%
High Welfare Gain	-1.4%	-0.7%	-0.9%	0.3%	0.1%
Low Welfare Gain	1.0%	1.2%	1.1%	1.6%	1.2%
Total Welfare Gain	0.0%	0.4%	0.3%	1.1%	0.8%
National Income	1.5%	1.5%	1.5%	1.5%	1.5%
$\bar{m}$	400.9%	400.9%	400.9%	400.9%	400.9%

$\bar{m}$  is the percent of immigrants relative to the native population required such that welfare is no lower than the no immigration case for all native types.

Welfare gains are the increase in income as a percentage of gross income before immigration required to compensate natives after immigration so that they are indifferent between the immigration and non-immigration cases.

Total welfare gain is calculated by knowing that the proportion of native high-skilled is 26% and that high-skilled gross income with immigration is 0.44 and low-skilled gross income with immigration is 0.23.

National income is the percent increase in gross income accruing to natives.

Immigrants are assumed to be legally restricted to only working in the domestic sector.

**Table 4**  
**Female Civilian Labor Force Participation Rates in Israel 2001**

	Age of Youngest Child				Number of Children				Total		Total
	0-1	2-4	5-9	10-14	1	2	3	4+	w/ children	w/o children	
(1) Employ household help and caregiver	78.0%	89.6%	87.4%	88.8%	85.3%	89.6%	85.6%	73.5%	86.0%	44.4%	61.5%
(2) 1-15 hours per week	73.7%	89.5%	88.4%	88.5%	83.9%	90.1%	86.2%	74.1%	85.9%	48.0%	64.2%
(3) 16+ hours per week	89.9%	96.7%	77.7% <sup>1</sup>		86.2%	90.6%	90.1%	95.1% <sup>1</sup>	89.7%	31.7%	54.2%
(4) Do not employ household help and caregiver	60.3%	75.1%	77.3%	76.6%	76.6%	75.8%		49.3%	72.0%	41.9%	54.5%
(3) - (4) Difference	29.6%	21.6%	0.4%		9.6%	14.8%	90.1%	45.8%	17.7%	-10.2%	-0.3%

<sup>1</sup> Estimate based on population of less than 2,000.

These are the percent of women in the civilian labor force in each cell.

Source: Statistical Abstract of Israel 2002.

**Table 5**  
**Domestic Worker Household Hiring Rate by Income**

Monthly Income	Rate	Workers Hired	Number
<10,000	0.0%	0.0	0.0
10,000 - 19,999	0.0%	0.0	0.0
20,000 - 29,999	0.0%	0.0	0.0
30,000 - 39,999	0.0%	0.0	0.0
40,000 - 49,999	0.0%	0.0	0.0
50,000 - 79,999	0.0%	0.0	0.0
>79,999	0.0%	0.0	0.0
Total	0.0%	0.0	0.0

Monthly Income is in Hong Kong dollars.

Rate is the percentage of domestic helpers in the respective monthly household income group.

Workers hired are the number of domestic workers hired in that category (in thousands).

Number is the number of households in that category (in thousands).

Number is calculated by assuming that each household which hires a domestic helper only hires one.

Source: Social Data Collected by General Household Survey Special Topics Report 14.