

TRADE AND IMMIGRATION: DOES IT MATTER WHERE IMMIGRANTS WORK? ^a

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Abstract

Immigrant employment often concentrates in non-traded goods sectors and many immigrants have low inter-sectoral mobility. We consider these observed characteristics of immigrant employment for the question of how immigration affects a nation's pattern of production and trade. We model an economy producing three goods; one is non-traded. Domestic labor and capital are domestically mobile but internationally immobile. Some immigrant labor is specific to the non-traded sector. Our model indicates that the output and trade effects of immigration depend importantly on the sector and nature of immigrant employment. Empirical investigation of the model's predictions indicates that trade and immigration are complements.

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Trade and Immigration: Does It Matter Where Immigrants Work?

The effect of immigration on an economy is a topic of continuing importance. Always a central issue in the US context, immigration has recently also become central in the European Union (EU) context: the expectation of potentially large flows of workers from East European accession countries raised sufficient fears about adverse labor market and government budget impacts to cause the EU-15 to block acceding countries' workers from their markets for up to seven years. Such fears underscore that the effects of immigration on an economy are not yet fully understood.¹ As Table 1 indicates, the share of migrants in the total population of most OECD countries, except France and Belgium, has been rising. These trends, and the ongoing political debate, suggest that understanding the effects of immigration on an economy has both increasing importance and increasing relevance.

A central focus of the economics literature regarding the effects of immigration has been the impact of immigration on domestic factor prices. Early studies adopted a partial equilibrium perspective to consider the implications of an immigration-induced increase in domestic labor supply for the wages of domestic workers. Such studies often found little evidence of significant wage effects.² Recent studies have instead adopted a general equilibrium, open economy, framework to suggest that the lack of significant wage effects may reflect the operation of a Rybczynski effect: the increase in labor supply is absorbed not by a change in domestic factor prices but instead by a reallocation of factors (including labor) across sectors, and hence by a change in the sectoral pattern of production. Indeed, recent research by Hansen and Slaughter (1999) finds evidence to suggest the operation of a Rybczynski effect in the context of migration flows between US states. If immigration does not materially change wages, but instead only leads to reallocation of resources across industries, then attention shifts from the effect of immigration on wages to the effect of immigration on a nation's sectoral pattern of production. How immigration affects the sectoral pattern of production is thus an important issue that has been fundamentally overlooked in the literature dealing with the effects of immigration.

¹ Borjas (1994, 1995) reviews the economic benefits of immigration.

² Friedberg and Hunt (1995) review studies dealing with wage effects of immigration.

How immigration may impact a nation's sectoral output pattern is linked to the long-standing question, in the international trade literature, of whether goods trade and international factor movements are substitutes or complements.³ In addressing this question, both the theoretical and empirical trade literatures have focused mostly on international capital mobility, and have concluded that trade and capital flows can be either substitutes or complements. However, in most trade models, whether trade and an internationally mobile factor are substitutes or complements derives directly from which factor is assumed to be employed intensively in a country's export sector. In addition to presuming a complement or substitute relationship, most analyses of international factor flows assume that the domestic and internationally mobile factors are homogenous. Hence, as in the case of capital flows, studies of international labor flows do not differentiate characteristics of immigrant labor from those of domestic labor, even if a distinction is made between workers with different levels of skill. Ignoring potentially important characteristics that differentiate immigrants from native workers precludes a more general understanding of the effects that immigration may have on an economy. In particular, differences between immigrants and native workers may have important implications for the sectoral output changes that may arise from immigration.

One observed characteristic of immigrants is that many work in relatively low-skilled service sector occupations (e.g., hotels, restaurants, domestic helpers, etc.) and are therefore, to a large extent, employed in sectors whose output is not internationally traded. Figure 1 indicates the employment concentration of non-native workers in services for several OECD countries; the fraction of non-native workers employed in service sectors exceeds 50% in all countries except Germany. To some extent, the concentration of non-native workers in services mirrors the pattern of native worker employment in services, reflecting the increasing role of services in most OECD countries. But within some service sectors the employment of foreign workers is much more concentrated than that of native workers. For

³ Whether trade and international factor movements are substitutes or complements is analyzed here in the sense of Markusen (1983): if an inflow of an internationally mobile factor raises (reduces) trade then trade and that factor are complements (substitutes). An alternative definition, first associated with Mundell (1957), concerns the relationship between goods trade, output prices, and factor prices between countries. See Wong (1986) for more discussion.

example, the OECD (2004, pp. 55) notes the sector concentration of some immigrant employment within OECD countries: “Foreigners are generally over-represented in construction, hospitality and catering, as well as in household services; that is, the proportion of foreigners working in these sectors is higher than their share of total employment.”

Another characteristic of immigrant workers is that some have low inter-sectoral mobility, due to factors such as language barriers, low skill levels, and possible illegal status, and are therefore likely to remain employed in non-traded goods sectors. For example, the OECD (2004, p. 64) reports that: “...foreigners are ...over-represented in groups at risk of poor labour market integration...” Moreover, “The extent of language ability, the presence of protected jobs and the social capital deficiency contribute to additional barriers to foreign workers. Thus, certain groups of foreign workers face serious, lasting challenges for sustainable labour market integration.”

The implications of the skewed and sector specific nature of some immigrant employment for the effect that immigration has on an economy’s sectoral pattern of output and trade, and hence also how these aspects of immigrant employment may impinge on the question of whether trade and immigration are complements or substitutes, has been largely neglected in both the economics and immigration literatures. In response, we develop in this paper a simple model of a small open economy that produces two internationally traded goods and one non-traded good. Domestic labor and capital are mobile across all three sectors. Including a non-traded good in our model recognizes that a significant fraction of immigrant employment is in non-traded goods.⁴ To capture the low inter-sectoral mobility of some immigrant workers, we assume that a fraction of new immigrants will become specific to the non-traded goods sector while the remaining fraction of new immigrants instead become “domestic-status” workers who are mobile across all three sectors. Unlike prior work, our model does not assume that immigrant labor is intensive in a country’s export, or import-competing, sector and it therefore does not, *a priori*, presume a complement or substitute relationship between trade and international labor flows. In addition,

⁴ Moreover, for many industrial countries, a high fraction of national value added derives from non-traded services sectors. It therefore seems increasingly important that trade models take account of such activity.

by allowing a given inflow of new immigrants to contain a heterogeneous mixture of workers (i.e., sector specific versus domestically mobile) our work extends prior analyses that assume immigrants and native workers are homogenous.

Having developed the theoretical predictions of our model, we empirically examine the model's implications with respect to the effect of immigration on the output of non-traded goods (services) and traded goods (exports). This analysis is conducted in a panel of OECD countries over the period from 1980 to 2001. The results indicate that trade and immigration are complements, and they underscore the potential importance of accounting for special characteristics of immigrants to more fully understand the economic effects of immigration.

I. Pertinent Literature

The theoretical trade literature has long considered the question of whether goods trade and international factor movements are complements or substitutes, and hence how the pattern of sectoral outputs may respond to international factor flows. General investigations of this question in the context of the H-O model include Mundell (1957), Markusen's (1983), Ethier and Svensson (1986), Svensson (1984), Markusen and Svensson (1985), and Wong (1986). The overall conclusion of these theoretical works is that trade and factor movements can be complements or substitutes, so resolution of the issue appears to be an empirical matter.

Analyses of the relationship between goods trade and international factor flows in a specific factors framework has focused on international capital mobility. Most analysts adopt the framework of Jones (1971), in which each sector employs a specific factor (capital) and a domestically mobile factor (labor), and assume that sector specific capital is internationally mobile. A recent example is Neary (1995), who notes that trade and capital flows are substitutes in his model as a consequence of his assuming that internationally mobile capital is used intensively in (and is specific to) the import-competing sector. Similarly, although not employing a specific factors framework, trade and international factor flows were complements in Markusen's (1983) analysis as a consequence of his

assuming that the internationally mobile factor was used intensively in the receiving country's export sector. Hence, in such models, substitutability or complementarity between trade and factor flows derives from an assumption about which traded goods sector (export or import-competing) intensively employs, or exclusively employs, the internationally mobile factor.

The implications of introducing a non-traded sector in a model with internationally mobile, but sector specific, capital was explored by Jones, Neary, and Ruane (1983). The impetus for their model was to explain the possibility of two-way capital flows between countries. Given the focus of their analysis, they did not address, nor did they intend to address, the question of whether trade and capital flows were complements or substitutes. Moreover, by having a single "tradables" sector, their model could not (by definition) address, as we do in this paper, questions about the pattern of sectoral output changes among traded goods sectors (i.e., export versus import-competing).

Given that the prior literature on capital mobility has considered the effect of capital mobility on trade when capital is sector specific, it would seem that by re-labeling capital as labor, the results obtained from the existing literature would provide a sufficient set of theoretical results to make a separate analysis of whether trade and labor flows (immigration) are substitutes or complements redundant. However, such a simple re-labeling would ignore important characteristics of immigrants and the nature of their employment, and thereby also ignore the potential implications of these special characteristics.

In particular, we will demonstrate that in contrast to prior models, trade and immigration can be complements (substitutes) in our model even when immigrant labor is not the factor used intensively in a country's export (import-competing) sector. We will also demonstrate that the presumed complement (substitute) relationship that arises from assuming that the export (import-competing) sector intensively employs an internationally mobile factor, as does prior work, depends also on the assumption that a given factor inflow consists entirely of homogeneous units of that factor. When a given factor inflow is instead allowed to consist of heterogeneous units of an internationally mobile factor, the presumed complement (substitute) relationship is no longer assured. To our knowledge, no model of international factor mobility has considered the implication of allowing a given factor inflow to consist of heterogeneous

units of the factor. Our analysis therefore complements, and significantly extends, prior analyses of both labor and capital mobility.

Most of the relevant prior literature has dealt with international capital mobility. Among the studies dealing with labor mobility, those by Djajic (1997) and Grether, de Melo, and Muller (2001) have relevance to our present study. Djajic's (1997) model of illegal immigration shares some similarity with our model in that he assumes that illegal migrants are specific to an intermediate goods sector whose output is used to produce two traded final goods. However, the focus of Djajic's model was the effect of illegal immigration on wages and hence he did not address the question of whether illegal immigration and trade are complements or substitutes in his model.

Grether, de Melo, and Muller (2001) explore the political economy of immigration in a direct-democracy framework by combining a median voter model with the traditional Jones (1971) specification in which each of two sectors employs sector specific capital and labor is domestically mobile between sectors. Whereas they do not specifically address the relationship between trade and immigration, they do find that, in a variant of the model that assumes one of the two goods is non-traded, increased immigration leaves households better off compared to the model when both goods are traded, thereby implying that a clear majority of voters would favor additional illegal immigration. This result suggests the possible importance of including a non-traded good when studying the effects of immigration.

Empirical investigations of whether trade and international factor movements are complements or substitutes have primarily focused on whether increased trade is associated with a reduction in any disparity of factor prices (usually wages) between countries, or whether increases in trade are accompanied by reductions in international labor movements. In a recent survey, Leibfritz, O'Brien, and Dumont (2003) find a variety of conclusions. They note that while some earlier empirical work offered evidence to suggest factor price equalization, and hence a substitute relationship between trade and international factor flows, more recent work has not.

Evidence for a substitute relationship between trade and international labor flows comes from authors such as Straubhaar (1988) and Molle (2001) who examine data on intra-EU trade and intra-EU

labor flows. Evidence for a complementary relationship comes from authors such as Cogneau and Tapinos (1995), who examined the relationship between trade and emigration for the specific case of Morocco, and from Richards (1994), who concluded that trade and immigration appeared to be complements in the context of Latin America

Whereas most empirical analyses have examined the complements-substitutes question by looking only at simple correlations between trade and labor movements, Wong (1988), using data for the period 1948-1983, estimated export and import functions for the US to obtain estimated Rybczynski effects with respect to changes in capital and labor. His results suggested a complementary relationship between US trade and international movements of either capital or labor.⁵

The above review of the literature indicates that the evidence regarding the relationship between trade and international factor movements is far from conclusive. Theoretically, trade and international factor flows can be complements or substitutes. Which of these relationships evidences itself in theoretical models depends largely on which traded good sector is assumed to use the internationally mobile, homogeneous, factor intensively in production.⁶ In the case of labor migration, some models that consider special cases such as illegal immigration have also modeled such migrants as sector specific. However, such models do not embrace the broader nature and characteristics of immigrant employment indicated by the data. Empirically, evidence for the nature of the relationship between trade and immigration is mixed. Many empirical investigations have considered only the case of a particular country or of a particular region. In some cases, the nature of the relationship between trade and immigration has been investigated using simple correlation analysis or has been based on casual

⁵ A number of authors have, in the context of assessing the validity of the Heckscher-Ohlin model, regressed sectoral trade or output patterns on national factor supplies for a number of industries (e.g., Bowen, 1983 and 1989, Harrigan, 1995 and 1977, Leamer, 1984). While such studies provide, for a given industry, an estimate of the change in trade or output that would arise from a change in the supply of a given factor, such results do not directly indicate how trade or output would respond at an aggregate level, and hence whether trade and a given factor are substitutes or complements at the level of an economy.

⁶ This applies to the Heckscher-Ohlin framework. See e.g. Davis and Weinstein (2002) for analysis, in a Ricardian framework, of factor mobility driven by the technological superiority of one country.

empiricism. A broader and more rigorous analysis of the trade and output responses that arise from immigration is therefore warranted.

II. The Model

To study the implications of the sector specific nature of some immigrant employment in non-traded goods sectors for the sectoral pattern of outputs, we adopt a parsimonious specification that assumes a small open economy producing three goods: an exported good (x), an import-competing good (m), and a non-traded good (n). In what follows, we often refer to the non-traded good as “services.” There are three factors of production: capital (k), domestic labor (d), and immigrant labor (i). Capital and domestic labor are freely mobile across all three sectors whereas immigrant labor only works in, and is therefore specific to, the non-traded services sector. We emphasize that “immigrant” labor refers here only to those non-native workers who are, or will become, specific to the non-traded good sector; it does not refer to all non-native workers, some of which, like native workers, are (or will be) freely mobile across all three sectors of the economy.

Let V_z denote the fixed domestic supply of factor “z,” Q_j the output in sector “j,” and a_{zj} the input requirement of factor “z” per unit of output in sector “j.” The full employment conditions for the model can then be written:

$$(1) \quad V_d = a_{dx}Q_x + a_{dm}Q_m + a_{dn}Q_n$$

$$(2) \quad V_k = a_{kx}Q_x + a_{km}Q_m + a_{kn}Q_n$$

$$(3) \quad V_i = a_{in}Q_n$$

Writing these three equations in matrix form gives:

$$(4) \quad \begin{pmatrix} a_{dx} & a_{dm} & a_{dn} \\ a_{kx} & a_{km} & a_{kn} \\ 0 & 0 & a_{in} \end{pmatrix} * \begin{pmatrix} Q_x \\ Q_m \\ Q_n \end{pmatrix} = \begin{pmatrix} V_d \\ V_k \\ V_i \end{pmatrix}$$

or more compactly

$$(5) \quad \mathbf{AQ} = \mathbf{V}.$$

We assume that production of the export good is capital-intensive, that production of the import-competing good is domestic labor-intensive, and that production of the non-traded good is the most labor intensive in terms of total labor employed per unit of capital. The ordering of capital-labor ratios across sectors is therefore assumed to be:

$$(6) \quad \frac{a_{kx}}{a_{dx}} > \frac{a_{km}}{a_{dm}} > \frac{a_{kn}}{(a_{dn} + a_{in})}$$

As written, the capital-labor ratio in the non-traded good sector appropriately measures capital relative to the total labor (domestic plus immigrant) employed in that sector. However, for later results we will also need to make an assumption about the use of capital per unit of each type of worker in the non-traded services sector. In this regard, we assume that the non-traded sector is also the most domestic labor-intensive sector, so that the entire ordering of capital-labor ratios is then assumed to be:

$$(7) \quad \frac{a_{kx}}{a_{dx}} > \frac{a_{km}}{a_{dm}} > \frac{a_{kn}}{a_{dn}} > \frac{a_{kn}}{a_{in}} > \frac{a_{kn}}{(a_{dn} + a_{in})}.^7$$

II.A The Effect of Immigration on Production and Trade

To determine the change in outputs, and by extension trade, that will arise from immigration we can totally differentiate equations (1) to (3) and solve the resulting system for the changes in outputs in terms of changes in factor supplies.⁸ Doing this yields the following comparative static equations in matrix form:

⁷ This ordering implicitly assumes immigrant workers are less productive than domestic workers in the non-traded sector, i.e., $a_{in} > a_{dn}$. This assumption does not affect the qualitative conclusions derived from the model.

⁸ We treat all output prices as parametric and therefore consider only the first order change in sectoral outputs consequent to increased immigration. In particular, the second order changes that arise from any subsequent adjustment in the price of the non-traded good is not considered. Under normal regularity conditions, the second order changes do not reverse the direction of the first order changes, but instead only affect the magnitude of the changes. Our analysis has some similarity to the earlier ‘‘Dutch Disease’’ literature which considered first order (i.e., resource re-allocation) and second order (expenditure) effects in model’s containing a tradables and a non-tradables sector (Corden and Neary, 1982). This literature shows that in no instance does the secondary effect reverse the direction of the first order change in sectoral outputs. Consideration of the second order changes arising from a change in the price of the non-traded good would be important if one were to examine the effect of immigration on factor prices; an issue for later research.

$$(8) \begin{pmatrix} dQ_x \\ dQ_m \\ dQ_n \end{pmatrix} = \begin{pmatrix} \frac{a_{km}a_{in}}{a_{in}a_{km}a_{dx} - a_{in}a_{kx}a_{dm}} & \frac{-a_{dm}a_{in}}{a_{in}a_{km}a_{dx} - a_{in}a_{kx}a_{dm}} & \frac{a_{dm}a_{kn} - a_{km}a_{dn}}{a_{in}a_{km}a_{dx} - a_{in}a_{kx}a_{dm}} \\ \frac{-a_{in}a_{kx}}{a_{in}a_{km}a_{dx} - a_{in}a_{kx}a_{dm}} & \frac{a_{in}a_{dx}}{a_{in}a_{km}a_{dx} - a_{in}a_{kx}a_{dm}} & \frac{a_{dn}a_{kx} - a_{kn}a_{dx}}{a_{in}a_{km}a_{dx} - a_{in}a_{kx}a_{dm}} \\ 0 & 0 & \frac{a_{km}a_{dx} - a_{dm}a_{kx}}{a_{in}a_{km}a_{dx} - a_{in}a_{kx}a_{dm}} \end{pmatrix} * \begin{pmatrix} dV_d \\ dV_k \\ dV_i \end{pmatrix}$$

To model immigration, we assume that an inflow of new migrants can contain a heterogeneous mix of workers. Specifically, the fraction λ of incoming foreign workers will have domestic worker status, and thus be freely mobile across all sectors, while the remaining $(1-\lambda)$ of new migrants will instead become specific to the non-traded services sector.⁹ An inflow of “I” new foreign workers therefore increases the stock of mobile domestic workers by $dV_d = \lambda I$, and increases the stock of sector specific immigrant workers by $dV_i = (1-\lambda)I$. Inserting these factor supply changes into (8), and assuming without loss of generality that $I = 1$, one obtains the following expressions for the output change in each sector arising from immigration:

$$(9) \quad \frac{dQ_x}{dV_i} = \frac{(a_{dm}a_{kn} - a_{km}a_{dn}) + I(a_{km}a_{in} + a_{km}a_{dn} - a_{dm}a_{kn})}{a_{in}(a_{km}a_{dx} - a_{kx}a_{dm})},$$

$$(10) \quad \frac{dQ_m}{dV_i} = \frac{(a_{dn}a_{kx} - a_{kn}a_{dx}) + I(-a_{in}a_{kx} - a_{dn}a_{kx} + a_{kn}a_{dx})}{a_{in}(a_{km}a_{dx} - a_{kx}a_{dm})},$$

$$(11) \quad \frac{dQ_n}{dV_i} = \frac{(1-I)(a_{km}a_{dx} - a_{kx}a_{dm})}{a_{in}(a_{km}a_{dx} - a_{kx}a_{dm})}$$

The denominator in (9) to (11) is the determinant of the factor input requirements matrix \mathbf{A} i.e., $|\mathbf{A}| = a_{in}(a_{km}a_{dx} - a_{kx}a_{dm})$ which must be non-zero. This condition requires the capital-labor ratios in the export and import-competing sectors to differ (i.e., $a_{kx}/a_{dx} \neq a_{km}/a_{dm}$). The value of this determinant is negative if, as we assume, the export sector is more capital-intensive than the import competing sector

⁹ One could label immigrants with domestic worker status as “legal” immigrants and those without domestic worker status as “illegal” immigrants. However, immigrants with domestic worker status can also be thought to be those who can more easily be absorbed into the economy because, for example, they are highly skilled or have a good command of the host nation’s language.

(i.e., $a_{kx}/a_{dx} > a_{km}/a_{dm}$). One could instead assume the import-competing sector is more capital-intensive than the export sector. However, our empirical analysis will use data on OECD countries and, for most of these countries, it is reasonable to assume that the export sector is more capital-intensive than the import-competing sector. Thus, determining the output response in each sector reduces to determining the sign of the numerator in each of the above expressions.

II.A.1 The Export Sector

The effect of immigration on the output of the export good is determined by (the negative of) the sign of the numerator in (9). After re-arrangement this numerator can be written

$$(12) \quad (a_{in} + a_{dn})a_{dm}(1-I)k_m \left[\left(\frac{s}{(1-I)} \right) - \left(1 - \frac{k_n}{k_m} \right) \right],$$

where $k_n = a_{kn}/(a_{in} + a_{dn})$ and $k_m = a_{km}/a_{dm}$ are respectively the capital-labor ratios in the non-traded and import-competing sectors and $s = a_{in}/(a_{in} + a_{dn})$ is the initial share of sector specific immigrant workers in total non-traded sector employment. The sign of (12) depends only on the relationship among the terms in square brackets.

Consider first the case where $\lambda = 0$, so that all new immigrants become specific to the non-traded sector.¹⁰ In this case, the sign of (12) is determined by the sign of the following expression:

$$(13) \quad \frac{k_n}{(1-s)} - k_m$$

By definition, $k_n/(1-s) = a_{kn}/a_{dn}$ is the ratio of capital to domestic labor employed in the non-traded sector. Expression (13) is negative, and hence (9) is positive, given our assumption (see (7)) that the import-competing sector is more capital-domestic labor intensive than the non-traded sector. Therefore, production of the export good rises when all new immigrants become specific to the non-traded sector.

¹⁰ This is like the case of examining only an increase in illegal immigrants, as in Djajic (1997).

For the more general case where $0 < \lambda < 1$, so that a new inflow of foreign workers contains both sector specific and domestic-status workers, the effect on export sector output depends, in a complicated way, on the terms in square brackets in (12). However, general insights are possible. First, we note that the ratio k_n/k_m is less than one given our assumption that the import-competing sector is more capital-intensive than the non-traded sector. This implies that the expression $(1 - (k_n/k_m))$ in (12) is positive and less than one. Given this, one can deduce that (12) is unambiguously positive, and hence that production of the export good unambiguously falls with immigration, if the employment share of sector specific immigrants in the non-traded sector exceeds the fraction of new immigrants that become sector specific, that is, if $s/(1 - \lambda) \geq 1$. This condition is more likely to be satisfied the larger is λ , that is, the larger is the fraction of new immigrants with (mobile) domestic worker status. If λ is sufficiently large, a decline in export sector production arises because the immigration induced increase in the stock of mobile domestic workers requires that these workers be absorbed mainly by the labor-intensive import-competing sector. As the import-competing sector expands, it draws capital from the export sector, reducing production of the export good.

If instead $s/(1 - \lambda) < 1$ then (12) can be negative or positive, and hence export sector output could either rise or fall with immigration. To gain further insight, we ask what conditions would make it more likely that production of the export good rises with immigration (as was the case when $\lambda = 0$). By inspecting (12) under the assumption that $s/(1 - \lambda) < 1$, one can deduce that the smaller is the ratio $s/(1 - \lambda)$, the more likely is export production to rise with immigration (since this makes (12) more likely to be negative). This in turn requires that the new inflow of foreign workers contain either a high fraction of workers who become sector specific (i.e., large $(1 - \lambda)$), or that sector specific workers are initially a relatively small fraction of total employment in the non-traded sector (small s). This suggests that countries such as the United States, who have significant total employment in non-traded goods sectors, and which also experience inflows of workers likely to be sector specific, are more likely to experience an increase in export sector output with immigration.

Another condition that would make an increase in export production more likely relates to the relative sizes of the capital-labor ratios in the non-traded and import-competing sectors. Specifically, the smaller is the ratio k_n/k_m , the more likely, other things equal, that (12) is negative, and hence the more likely that export sector output rises with immigration. This follows since the smaller is k_n/k_m the closer to unity is the term $(1 - (k_n/k_m))$. In turn, the closer to unity is this term, the more likely is $(1 - (k_n/k_m))$ to exceed $s/(1 - \lambda)$, where we recall that the latter is now assumed to be less than one. Thus, when $s/(1 - \lambda) < 1$, the larger is the divergence in capital-labor usage between the non-traded and import-competing sectors (i.e., the smaller is k_n/k_m), the more likely that export sector output rises with immigration. An alternative interpretation of this relationship is that, the smaller is k_n/k_m , the smaller can be the share $(1 - \lambda)$ of sector specific workers in any given inflow of new foreign workers and still have an increase in export sector output.

The preceding analysis of the effect of immigration on the output of the export good can be summarized as follows. When $0 < \lambda < 1$ then

$$(14) \quad \left\{ \begin{array}{l} \frac{dQ_x}{dV_i} < 0 \text{ if } \frac{s}{(1-I)} \geq 1 \\ \frac{dQ_x}{dV_i} < 0 \text{ if } \frac{s}{(1-I)} > \left(1 - \frac{k_n}{k_m}\right) \\ \frac{dQ_x}{dV_i} > 0 \text{ if } \frac{s}{(1-I)} < \left(1 - \frac{k_n}{k_m}\right). \end{array} \right.$$

When $I = 0$, then

$$(15) \quad \frac{dQ_x}{dV_i} > 0 (< 0) \text{ if } \left(\frac{k_n}{(1-s)} - k_m \right) < 0 (> 0)$$

II.A.2 The Import-competing Sector

How production of the import-competing good responds to immigration is indicated by expression (10). Re-arrangement of the numerator in (10) yields the following expression:

$$(16) \quad (a_{in} + a_{ln})a_{lx}k_x(1-I) \left[\left(1 - \frac{k_n}{k_x} \right) - \frac{s}{(1-I)} \right]$$

Comparison of (16) and (12) indicates an expected symmetry between these expressions. Like the case of export production, the sign of (16) depends in a complicated way on the relationship between the existing employment share of sector specific immigrants (s), the share of sector specific immigrants in the new wave of immigrants ($1 - \lambda$), and the capital-labor ratios in the non-traded and export sectors.

Again consider first the case for which the inflow of new foreign workers consists entirely of sector specific workers (i.e., $\lambda = 0$). In this case, the sign of (16) is determined by the sign of the following expression:

$$(17) \quad \left[k_x - \frac{k_n}{(1-s)} \right]$$

Since $k_n/(1-s) = a_{kn}/a_{dn}$ is the ratio of capital to domestic labor employed in the non-traded sector, (17) is positive given our assumption (see (7)) that the export sector is more intensive than the non-traded services sector in capital relative to domestic labor. Since (10) is then negative, production of the import-competing good falls if all new immigrants become specific to the non-traded sector. This result, together with the previous result that production of the export good rises when $\lambda = 0$, implies that trade will increase when all new immigrants become specific to the non-traded services sector. This trade effect follows since, assuming demand unchanged, a fall in the output of the domestic import-competing sector implies an increase in imports and, assuming balanced trade, also an increase in exports (which was anyway predicted when $\lambda = 0$). Hence, when all new immigrants become specific to the non-traded sector, *trade and immigration are complements*. Important is that this complementary relationship arises

in our model without assuming, as does most prior literature (e.g., Markusen (1983)), that the internationally mobile factor is used intensively in the export sector.

Now consider the more general case for which $0 < \lambda < 1$, so that some of the new immigrants will have (mobile) domestic worker status. Similar to the export sector analysis, the term $(1 - (k_n/k_x))$ in (17) is less than one since $k_n/k_x < 1$, given our assumption that the export sector is more capital-intensive than the non-traded sector. Given this, (17) will be unambiguously negative, and hence production of the import-competing good will unambiguously rise with immigration, if $s/(1 - \lambda) \geq 1$. From the export sector analysis, we found that production of the export good unambiguously falls when $s/(1 - \lambda) \geq 1$. Hence, in our model, *trade and immigration are substitutes* when the existing employment share of sector specific immigrants exceeds the share of new immigrants that become sector specific, that is, when $s/(1 - \lambda) \geq 1$.¹¹

The possibility of a substitute relationship arises in our model because we have allowed a given inflow of migrants to contain a mixture of both sector specific and domestic-status workers.¹² As found above, trade and immigration are unambiguously complements in our model if new immigrants consist entirely of sector specific workers. This underscores the importance of accounting not only for the characteristics of immigrants (e.g., skilled versus unskilled, legal versus illegal, etc.) but also for the sector and the nature (e.g. sector specificity) of employment of each type of migrant when considering the effects of immigration on an economy.

If instead $s/(1 - \lambda) < 1$ then, like the case of export production, production of the import-competing good may rise or fall with immigration. When $s/(1 - \lambda) < 1$ one can deduce, by a reasoning similar to that done for the export good, the conditions under which production of the import-competing good is likely to fall. In this regard, expression (16) is more likely to be positive, and hence production of

¹¹ This implies that trade and immigration are substitutes if no domestic workers are employed in the non-traded sector. This follows since the fraction of sector specific workers in the non-traded sector (s) would then equal unity and hence the condition for substitutability between trade and immigration, $s/(1 - \lambda) \geq 1$, would be satisfied.

¹² This again contrasts with prior work (e.g. Neary (1995)), where a substitute relationship is due to the assumption that the internationally mobile factor is intensive in, or specific to, the import-competing sector.)

the import-competing good more likely to fall, the smaller is the ratio $s/(1 - \lambda)$. Therefore, the smaller is the share of sector specific workers in total non-traded sector employment (s), or the larger is the fraction $(1 - \lambda)$ of new immigrants who will become sector specific, the more likely that production of the import competing good falls with immigration. Intuitively, the larger is the fraction of new foreign workers that become sector specific the less the inflow of new foreign workers represents an increase in the stock of mobile domestic workers, and hence the less likely is the inflow of new foreign workers to contribute to an increase in production of the import-competing good. From the export analysis we found that the smaller is $s/(1 - \lambda)$ the more likely is export production to rise with immigration. This, and the above analysis for the import-competing sector, suggests that the smaller is $s/(1 - \lambda)$ the more likely are trade and immigration to be complements.

Finally, expression (16) is also more likely to be positive, and hence production of the import-competing good more likely to fall, the smaller is the ratio k_n/k_x . Thus, the larger is the capital-labor ratio in the export sector compared to that in the non-traded sector, the more likely is production of the import-competing good to fall with immigration. The preceding discussion of output changes for the import-competing sector can be summarized as follows.

When $0 < \lambda < 1$ then

$$(18) \quad \left\{ \begin{array}{l} \frac{dQ_m}{dV_i} > 0 \text{ if } \frac{s}{(1-I)} \geq 1 \\ \frac{dQ_m}{dV_i} > 0 \text{ if } \frac{s}{(1-I)} > \left(1 - \frac{k_n}{k_x}\right) \\ \frac{dQ_m}{dV_i} < 0 \text{ if } \frac{s}{(1-I)} < \left(1 - \frac{k_n}{k_x}\right). \end{array} \right.$$

When $\lambda = 0$, then

$$(19) \quad \frac{dQ_m}{dV_i} > 0 (< 0) \text{ if } \left(k_x - \frac{k_n}{(1-s)}\right) < 0 (> 0)$$

II.A.3 The Non-Traded Goods Sector

The effect of immigration on production of the non-traded good is clear from (11) since this expression reduces to $dQ_n/dV_i = (1 - I)/a_{in}$. Therefore, production of the non-traded good rises if the new inflow of foreign workers contains at least some workers who become specific to the non-traded sector (i.e., $(1 - \lambda) > 0$), and production is unchanged if the new inflow of foreign workers instead comprises only workers with domestic worker status (i.e., $\lambda = 1$).¹³ While it is clear that production of the non-traded good must rise as long as some new immigrants become sector specific,¹⁴ whether this output expansion comes at the expense, in terms of reduced output, of the export or import-competing good depends on the fraction of new immigrants who become sector specific compared to the existing share of sector specific immigrants in non-traded sector total employment. As previously found, the higher the fraction of sector specific workers in the new wave of immigrants, and the lower the employment share of existing sector specific immigrants in the non-traded sector, the more likely is immigration to raise export sector output and to lower import competing sector output, and hence to increase trade.¹⁵

Lastly, we previously above that export and import-competing production can either rise or fall when $s/(1 - \lambda) < 1$. Although it is possible for both export and import-competing production to fall, it is not possible that both sectors experience an increase in output since this would require an increase in the use of capital in all three sectors, which is not possible given that the stock of capital is fixed in our model.¹⁶ Therefore, since production of the non-traded good must rise with any new inflow of sector specific foreign workers, one (or both) of the traded goods sectors must contract.

¹³ That production does not change in sectors that employ a specific factor when there is a rise only in the supply of a mobile factor is a feature of all specific factor models. This arises because an attempt to employ additional units of the mobile factor in such sectors is constrained by the unaltered supply of the specific factor. Instead, all output adjustment must take place in those sectors that employ only mobile factors of production.

¹⁴ Output of the non-traded good must rise if the now higher stock of sector specific workers is to be fully employed.

¹⁵ This suggests illegal immigration is more likely to increase trade, and legal immigration more likely to reduce trade, since illegal immigrants are less likely to be mobile between sectors.

¹⁶ If capital were also internationally mobile then this “capital shortage” might be relieved by an inflow of foreign capital. This could represent one channel by which immigration and capital flows could be complementary, and it

II.B Partial Amnesty for Immigrant Workers

In our model one could also think to examine the case of “partial amnesty,” in which some fraction of existing sector specific immigrant workers gain domestic worker status and thus become mobile across all sectors (e.g., by issuing official work permits to illegal immigrants or by providing training that allows immigrants to assimilate into the general pool of workers). It is clear that, in our model, converting some sector specific immigrant workers into mobile domestic workers would have the same qualitative effect as an increase in the stock of domestic workers alone. In order to absorb the increase in domestic workers the import sector would need to expand, the export sector would need to contract, and by implication, trade would be reduced. Moreover, since a partial amnesty of the existing stock of immigrants entails a reduction in the number of sector specific immigrant workers, the output of the non-traded good must fall.

III. Empirical Analysis

In this section, we explore empirically the relationships between immigration, the output of non-traded goods (services), and trade (exports). Our theoretical model suggests that, to the extent some immigrants are (become) specific to the non-traded sector, immigration will be associated with an increase in the output of non-traded goods. For exports, the effect of immigration depends on the mix of new foreign workers and the share of sector specific immigrants already working in the non-traded sectors of an economy. Our empirical analysis of exports in relation to immigration is therefore intended to identify whether the actual relationship between exports and immigration is positive or negative, and consequently whether the data reveal immigration and exports to be complements or substitutes.

suggests why trade might be found to be complementary with both immigration and international capital movements, as in Wong (1988).

III.A Model Specification

We estimate two sets of relationships: one between exports and immigration, and one between the output of services and immigration. In each case, we use GDP per capita as a control for differences in country wealth and size and, in the case of services output, also for the known relationship between services output and GDP per capita.¹⁷ We further include the square of GDP per capita to allow for the possibility of a nonlinear relationship between each dependent variable and GDP per capita.

Our data sample includes three countries (Austria, Germany, and Switzerland) that have “guest worker” programs. By definition, such programs skew the mix of incoming foreign workers toward those who will be, in the terminology of our theoretical model, “domestic-status” workers, and they may also channel employment of such immigrants into traded goods sectors. To control for this, we interact our immigration variable with a dummy for these guest-worker countries. Given the above, the relationships to be estimated take the form :

$$(20) \quad Y_{it} = \beta_0 + \beta_1 \cdot GW + \beta_2 \cdot (\text{Immigration}_{it-1}) + \beta_3 \cdot (GW \cdot \text{Immigration}_{it-1}) \\ + \beta_4 \cdot (\text{GDP per capita}_{it}) + \beta_5 \cdot (\text{GDP per capita}_{it})^2 + \varepsilon_{it}$$

The variable Y_{it} is either exports or services output in country i at time t . We use lagged immigration since we expect there to be a lagged effect between the time a migrant arrives and the subsequent impact on trade and services output. The variable GW is the dummy variable for guest-worker countries. The variable “ $GW \cdot \text{Immigration}_{it-1}$ ” is the interaction variable between the guest-worker country dummy and lagged immigration.

Our empirical analysis can be thought to be uncovering the sign of a Rybczynski effect associated with a change in a country’s *stock* of workers.¹⁸ This suggests that the appropriate specification to estimate would involve the level of output in relation to the *stock* of immigrant workers. However,

¹⁷ Across countries, GDP per capita is also highly correlated with the stock of capital per worker. Hence, GDP per capita can also be interpreted as a proxy of national capital-labor ratios.

¹⁸ Given this interpretation, one might expect our equation to also include data on the stocks of other productive factors such as capital. As noted in footnote 17, GDP per capita can be thought to proxy for these other factors.

lacking reliable data on immigrant stocks, and for statistical reasons,¹⁹ we instead estimate (20) using the change (first difference) in each dependent variable and the GDP per capita controls.

We estimate specification (20) using two different measures of the immigration variable, total immigration and net immigration (i.e., immigration minus emigration). We prefer the total immigration variable for two reasons. First, many countries in our sample do not report emigration, so limiting ourselves to net immigration would involve reduced degrees of freedom. Second, we suspect that, as with data on imports and exports of goods, the data on inflows (immigration) are likely to be more accurate than the data on outflows (emigration). The net immigration variable may therefore be subject to measurement error.

In summary, our regression model specifies the annual change in either exports or services output in relation to immigration lagged one year, an interaction variable between lagged immigration and a dummy for guest-worker program countries, the annual change in GDP per capita, and the square of the annual change in GDP per capita.²⁰

With respect to services output, the theoretical model predicts that immigration will unambiguously raise output of non-traded goods. We therefore expect a positive relationship between services output and immigration. Since we are only interested in that part of services likely to be non-traded, we limit our focus to data on non-financial services, which is further broken down into two categories: “wholesale/retail non-financial services” and “other non-financial services.”

With respect to exports, we examine total exports of goods and services as well as each component separately: exports of goods and exports of services. The theoretical model indicates that the relationship between exports and immigration depends on the share of sector specific immigrants already working in the non-traded services sector relative to the fraction of new immigrants that become sector

¹⁹ As described in the data section to follow, tests detected the presence of first order autocorrelation for both services and exports. Therefore, we correctly need to first difference before estimation.

²⁰ Our use of GDP per capita and not level of GDP was also intended to mitigate potential endogeneity issues since each dependent variable is a component of GDP. For both the services and exports regressions we could not reject the hypothesis of no correlation between GDP per capita and the error term, and we therefore concluded that this

specific, as well as the relative use of capital and labor in the export and import-competing sectors.²¹ The higher is the share of new immigrants who become specific to the non-traded sector, the more likely is there to be a positive relationship between exports and immigration. However, since either a complement or substitute relationship is theoretically possible, we have no a priori expectation for the sign of the coefficient between exports and lagged immigration.

III.B Data

Annual data on total inflows and outflows of migrants for the period 1980-2001 were taken from the OECD's Trends in International Migration Database (OECD (2002)).²² The migration data refer to permanent flows and therefore exclude tourists, etc. For the time period studied, data were available in various years for twenty OECD countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Sweden, Switzerland, the UK, and the US. Australia, Canada, France, Ireland, Italy, Portugal, the UK, and the US do not report outflows.

Data on gross domestic product, population, exports of goods and services, and the output (value added) of "wholesale/retail non-financial services" and "other non-financial services" were taken from the OECD National Accounts database. The sector "other non-financial services" includes non-business services such as public administration and health care.²³ The "wholesale/retail non-financial services" sector encompasses wholesale and retail trade as well as hotel, restaurant, and transportation activities.

source of potential endogeneity was of limited importance. First differencing can also result in model inconsistency. As we have noted, first differencing was indicated here for both theoretical and empirical reasons.

²¹ To illustrate, data on recent (legal) immigrants to England indicates that about 10% ($= (1 - \lambda)$) take employment in non-traded service sectors. The data also indicate that the share of immigrants in total service sector employment (s) is 7.8%. These data imply that $s/(1 - \lambda) = 0.078/.1 = 0.78$. Since $s/(1 - \lambda) < 1$, export and import-competing production may rise or fall with immigration. Since England also experiences significant illegal immigration, the actual fraction of new immigrants who become sector-specific may be much higher – which strengthens the case for a decline in import-competing production and an increase in export production. To say more one would need to know the capital-labor ratio in services and in import-competing production.

²² Due to some discrepancies, data on the inflows of migrants for the UK for 1990-2000 were double checked with the UK statistical office.

²³ Given the high social spending in these areas by some countries in the panel, a measure of non-public services would be ideal. Unfortunately, we were limited by data availability.

Total services output is calculated as the sum of the outputs of these two service categories. The data on GDP, exports, and services output are measured in 1995 US dollars.²⁴

Since we have panel data, we performed standard tests for cross-sectional correlation, serial correlation in the panel, and group-wise heteroscedasticity. These tests indicated first order autocorrelation in the levels of both services output and exports. We correct for these AR1 processes by using first differences in the respective data.²⁵ Tests for group-wise heteroscedasticity in the residuals using the modified Wald statistic indicated its presence. In addition, the Breusch-Pagan Lagrange Multiplier (LM) test for independence of the errors across panels indicated that the errors are not independent but are correlated across countries. Because we have an unbalanced panel, we were limited in our choice of corrective estimation techniques. We therefore used the Prais-Winsten transformation to obtain panel-corrected standard errors to account for group-wise heteroscedasticity. We further specified that the covariance matrix be calculated using all available information.²⁶

III.C Results

Tables 2a, 2b and 2c presents summary statistics for the data samples used to estimate specification (20) for services output, goods and services exports, and goods exports and services exports separately when total immigration is used as the immigration variable. Tables 3a, 3b and 3c present the corresponding information for each sample when net immigration is used as the immigration variable. The simple correlation between the annual change in services output and lagged immigration is 0.56; the correlation between the annual change in goods and services exports and lagged immigration is 0.47. The corresponding correlations for net immigration are 0.11 for total services output and 0.16 for exports of goods and services.

²⁴ Most countries needed to be rebased from their domestic currency to 1995 US dollars. The exchange rates used were taken from the International Monetary Fund's "International Financial Statistics."

²⁵ In addition, we have already discussed the appropriateness of this transformation with respect to our theoretical model.

III.C.1 Results for Services Output

The results of estimating specification (20) for each of the three categories of services output are reported in Table 4. For the regressions using total immigration (columns 1-3 in Table 4) the coefficient on lagged immigration is positive and highly significant in all cases, consistent with the prediction of the theoretical model. For the regressions that use net immigration (columns 4-6 in Table 4), the coefficient on lagged immigration is positive and highly significant for Total Services and Other Services, and is positive and significant at the 10% level for Wholesale Services. These results are also consistent with our model's prediction that non-traded goods output rises with immigration.

The coefficient on the interaction between the dummy for guest-worker countries and total immigration (columns 1-3 in Table 4) is negative and highly significant for each of the three categories of services output. When net immigration is used (columns 4-6 in Table 4) the coefficient on the interaction variable are similarly negative and highly significant except for "Wholesale Services." These results suggest that a guest worker program, which skews the mix of immigrants toward domestic-status workers, serves to offset the expansionary effects of immigration on services output – a result consistent with our theoretical model. To determine if this offset is complete, we tested the hypothesis that the sum of the immigration coefficient and the guest worker interaction coefficient is negative. When total immigration is used as the immigration variable, the hypothesis was rejected at the 5% level for all three categories of services, indicating that the negative effect of guest worker programs is not strong enough to completely offset the generally positive effect of immigration. This finding also holds, except for "Wholesale Services," when net immigration is used as the immigration variable; the hypothesis was rejected at the 5% level for "Total Services" and "Other Services" but can be rejected only at the 14% level for "Wholesale Services."

The coefficient on per capita GDP is positive, as expected, and significant in all cases except for "Other Services" when net immigration is used as the immigration variable. In addition, except again for "Other Services," when net immigration is used as the immigration variable, the coefficient on squared

²⁶ All estimations were performed using STATA's "xtpcse" routine with the "pairwise" option enabled.

GDP per capita is negative and significant. These results indicate a non-linear relationship with respect to changes in services output: changes in GDP per capita have an increasing but diminishing marginal effect on the growth of services output.

III.C.2 Results for Exports

Table 5 reports the results of estimating (20) for each of the three categories of exports. The coefficient on immigration is positive and highly significant in all cases except for “Goods and Services Exports” when net immigration is used as the immigration variable. Overall, these results indicate that exports and immigration are complements; a finding that is consistent with the predictions of our theoretical model.²⁷

As with the services output regressions, the coefficient on the guest-worker interaction variable is negative and significant when total immigration is used as the immigration variable (columns 1-3 in Table 5), and is negative and significant only in the separate “Goods Exports” and “Services Exports” regressions when net immigration is used as the immigration variable (columns 4-6 in Table 5).

Given the negative coefficient for the guest worker interaction variable, we again tested for each model the hypothesis that the sum of the immigration coefficient and the guest worker interaction coefficient is negative. When net immigration is the dependent variable we failed to reject the hypothesis in all cases, meaning that the negative effects of targeting domestic-status type immigrants creates a substitute relationship between exports and immigration in guest worker program countries. However, this conclusion is reversed when total immigration is used as the immigration variable; the hypothesis that the sum of the coefficients is negative was rejected for both “Goods Exports” and for “Goods and

²⁷ Commentators on earlier versions of our paper questioned how internal migration among EU countries would affect our results. In particular, a high fraction of immigrants to EU countries are EU nationals. Since many intra-EU migrants are, in the terminology of our model, “domestic-status” immigrants, a high fraction of such immigrants would make a substitute relationship between trade and immigration more likely. Therefore, our finding in the full sample of countries of a positive relationship between exports and immigration when the data for EU countries includes intra-EU migrants suggests a strong complementary relationship between trade and immigration. Our theoretical model would suggest that a high fraction of “domestic-status” immigrants is, other things equal, being offset by a small employment share of sector specific immigrants in non-traded goods sectors.

Services Exports.” For “Services Exports” the hypothesis could be rejected only at the 12% level. The difference in results for the two measures of immigration creates uncertainty about the true effect. The only conclusion that seems possible at this stage is that, for countries with guest worker programs, the likelihood that exports and immigration are substitutes is increased; a result that is consistent with the predictions of our theoretical model.

Finally, the coefficient on per capita GDP is positive and significant in all cases. In addition, in all cases, the coefficient on squared GDP per capita is negative and significant. As was the case for services output, this result indicates a non-linear relationship between changes in exports and changes in GDP per capita.²⁸

IV. Conclusion

This paper has presented a model of an economy with three factors of production; two traded goods and one non-traded good. The model’s purpose was to discern the output and trade effects associated with immigration when the employment of some immigrants is restricted to a non-traded goods sector. Two empirical facts regarding immigrant labor motivated the structure of our model. First, a high fraction of immigrant employment is concentrated in sectors producing non-traded goods. Second, some immigrants face significant and persistent barriers to mobility across sectors within their host country. In constructing a model that takes account of these aspects of immigrant employment, we have demonstrated that where immigrants work, and the characteristics of their employment, have important implications for the effect of immigration on a nation’s pattern of production and trade. Moreover, by allowing that a given inflow of new immigrants contains a heterogeneous mixture of foreign workers, either a complementary or a substitute relationship between trade and immigration can emerge in our model. Thus, in contrast to prior literature that has modeled an internationally mobile but domestically

²⁸ A time trend was initially included in each of our equations; in each case it was not statistically significant. Specific results are available from the authors.

sector-specific factor, a complementary (substitute) relationship can arise in our model without assuming that the internationally mobile factor is used intensively in the export (import-competing) sector.

Empirical examination of the predictions of our model in a panel of OECD countries indicated that, consistent with our model, the output of services rises with the level of immigration. In addition, we found that trade (exports) and immigration are complements. We also found that, consistent with our model, this complementary relationship between trade and immigration is reduced, and could be reversed, by immigration policies, such as guest-worker programs, that target domestic-status type immigrants and often direct the employment of such immigrants into traded goods sectors.

Our theoretical model indicated that the higher is the fraction of sector specific immigrants among new immigrants, and the lower the existing employment share of sector specific immigrants in the non-traded sector, the more likely that immigration will increase output in the export sector and decrease output in the import competing sector, and hence increase trade. Therefore, the higher is the fraction of new immigrants that become employed in (and specific to) the non-traded sector, the more probable that trade and immigration are complements. One policy implication of this relationship is that countries for which immigrant workers are presently a small share of non-traded sector employment are more likely to experience an increase in export sector output consequent to immigration, under the caveat that immigration policy does not discourage the type of (sector specific) immigrants likely to become employed in non-traded goods sectors.

Not only do we have empirical confirmation of our model, our empirical results go one step further to suggest that it not only matters where immigrants become employed, but it also matters from what country migrants arrive. Workers arriving from countries whose characteristics allow for higher integration into the domestic labor pool (e.g., common languages), or to have attained the skills to work in traded goods sectors, will reduce the positive impact on non-traded goods output and may result in trade and immigration being substitutes. In this regard, our model has implications for targeted immigration policies, such as those that encourage high-skilled labor immigration. To the extent that our results hold,

targeting only high-skilled workers may remove the potential for the complementary pro-trade benefit that would arise from the employment of sector specific immigrants in non-traded goods sectors.

Our model also suggests that integrating immigrants into the general pool of domestic workers would shift production from export to import-competing sectors and would therefore reduce trade. However, this does mean that a country should limit rather than encourage the integration of immigrant workers into its economy since these sectoral output changes say nothing about national welfare, which may be significantly enhanced by such integration, particularly when social dimensions are considered.

This paper has demonstrated the importance of taking account of both the sector and nature of immigrant employment when considering the impact of immigration. One could reinterpret the structure of our model by treating sector specific immigrants as unskilled workers and domestic-workers as skilled workers, and then easily interpret the model's predictions in this context. Of course, other interpretations of the model's structure are possible, as are extensions such as allowing for the international capital mobility. These are directions for later analysis. But, as suggested, our model offers a framework that can admit a rich set of extensions that may offer more precise insights into the economic effects of immigration.

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Table 1. Stock of immigrants as a percent of total population, 1986 and 2000

	1986	2000	Average Annual Percent Change
France	6.2	5.4	-1.0%
Belgium	8.7	8.4	-0.2%
Netherlands	3.9	4.2	0.5%
Sweden	4.7	5.4	1.0%
Canada	15.4	17.4	1.3%
Switzerland	14.5	19.3	2.0%
UK	3.2	4.3	2.2%
Luxembourg	26.4	37.6	2.5%
Germany	5.8	8.9	3.1%
Norway	2.6	4.1	3.3%
Japan	0.7	1.3	4.6%
Denmark	2.5	4.8	4.8%
US	6.2	9.3	5.0%
Austria	4.3	9.1	11.2%
Italy	1.0	2.2	12.0%

Note: for the US and Canada the figures are foreign born population as a percentage of total population. For Austria, Canada, Italy, and the US the year 2000 figures are from 1997.

Source: Author's calculations based on data from OECD (2002) - SOPEMI .

Table 2a. Summary statistics, sample for services output using total immigration

Variable	Mean	Std. Dev.	Correlations			
			Total Services	Other Services	Wholesale Services	Lagged Immigration
Total Services	13596.6	28309.9	1			
Other Services	4883.9	9217.6	0.80	1		
Wholesale Services	8712.7	21632.3	0.97	0.62	1	
Lagged Immigration	166.1	262.6	0.56	0.52	0.51	1
GDP per Capita	21297.8	4359.0	0.25	0.14	0.26	0.20

Notes: observations = 297, 1980-2000. Switzerland does not report services and is therefore excluded.

Table 2b. Summary statistics, sample for goods and services exports using total immigration

Variable	Mean	Std. Dev.	Correlations	
			Goods and Services Exports	Lagged Immigration
Goods and Services Exports	8892.9	15994.4	1	
Lagged Immigration	157.4	252.8	0.47	1
GDP per Capita	21603.7	4343.1	0.18	0.17

Notes: observations = 325, 1980-2000. All twenty countries included.

Table 2c. Summary statistics, sample for goods exports and services exports using total immigration

Variable	Mean	Std. Dev.	Correlations		
			Goods Exports	Services Exports	Lagged Immigration
Goods Exports	8195.3	14399.4	1		
Services Exports	2123.6	3754.4	0.76	1	
Lagged Immigration	192.3	289.7	0.45	0.50	1
GDP per Capita	22190.4	4512.1	0.15	0.22	0.13

Notes: observations = 227, 1980-2000. Belgium, Japan, and Norway do not report separate data on goods exports and services exports and are therefore excluded.

Table 3a. Summary statistics, sample for services output using net immigration

Variable	Mean	Std. Dev.	Correlations			
			Total Services	Other Services	Wholesale Services	Lagged Net Immigration
Total Services	8719.3	18948.5	1			
Other Services	3908.7	8300.0	0.81	1		
Wholesale Services	4810.6	13153.1	0.93	0.54	1	
Lagged Net Immigration	36.8	80.0	0.11	0.13	0.08	1
GDP per Capita	21873.3	4438.5	-0.14	-0.18	-0.09	-0.05

Notes: observations = 183, 1980-2000. Australia, Canada, France, Ireland, Italy, Portugal, New Zealand, UK, USA do not report outflows of migrants. Switzerland does not report services and is therefore excluded.

Table 3b. Summary statistics, sample for goods and services exports using net immigration

Variable	Mean	Std. Dev.	Correlations	
			Goods and Services Exports	Lagged Net Immigration
Goods and Services Exports	6395.3	11423.1	1	
Lagged Net Immigration	35.0	76.0	0.16	1
GDP per Capita	22242.0	4364.9	-0.06	-0.06

Notes: observations = 204, 1980-2000. Australia, Canada, France, Ireland, Italy, Portugal, New Zealand, UK, USA do not report outflows of migrants. All 20 countries reported data for Exports of Goods and Services.

Table 3c. Summary statistics, sample for goods exports and services exports using net immigration

Variable	Mean	Std. Dev.	Correlations		
			Goods Exports	Services Exports	Lagged Net Immigration
Goods Exports	5438.9	9773.1	1		
Services Exports	1202.7	1954.1	0.51	1	
Lagged Net Immigration	46.6	97.7	0.16	0.22	1
GDP per Capita	23310.5	4863.2	-0.15	0.02	-0.17

Notes: observations = 115, 1980-2000. Belgium, Japan, and Norway do not report separate data on goods exports and services exports. Several other countries have missing sub-category (i.e., goods versus services) data for the 1980s. Australia, Canada, France, Ireland, Italy, New Zealand, UK, USA do not report outflows of migrants.

Table 4. Regressions of services output on lagged total immigration and lagged net immigration

Variable	Total Immigration			Net Immigration		
	(1)	(2)	(3)	(4)	(5)	(6)
	Total Services	Other Services	Wholesale Services	Total Services	Other Services	Wholesale Services
Lagged immigration	90.45 (14.33)***	26.48 (4.33)***	63.98 (11.82)***	275.57 (106.95)***	129.36 (45.64)***	146.20 (79.89)*
Guest-worker x lagged immigration	-75.07 (13.63)***	-20.83 (4.24)***	-54.25 (11.35)***	-262.07 (108.36)**	-122.71 (45.60)***	-139.36 (81.33)*
GDP per capita	21.69 (4.31)***	3.11 (1.59)**	18.578 (3.49)***	12.36238 (4.55604)**	2.14651 (1.96949)	10.21587 (3.11907)**
GDP per capita squared	-0.73 (0.18)***	-0.13 (0.06)**	-0.59 (0.15)***	-0.47 (0.17)***	-0.01 (0.07)	-0.39(0.12)***
GW dummy	-1023.61 (2037.62)	-763.57 (728.20)	-260.03 (1849.09)	5,574.62 (2,708.96)**	2,119.25 (1,049.09)**	3,455.38 (2,074.40)*
Constant	-4759.07 (2441.53)*	637.62 (652.08)	-5,396.69 (2,050.41)***	-1,416.29 (2,580.26)	391.19 (1,104.56)	-1,807.47 (1,790.70)
R-Squared	0.52	0.40	0.47	0.11	0.11	0.09
Wald statistic	71.56	59.39	59.96	27.95	33.00	22.72
Observations	297	297	297	183	183	183
Countries	18	18	18	12	12	12

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Standard errors in parentheses; Immigration is lagged one period (year); Services is calculated as the total of wholesale and retail trade, and other non-financial services; The dependent and GDP per capita variables are first differenced and measured in 1995 US dollars; the coefficient of squared GDP per capita is multiplied by 100.

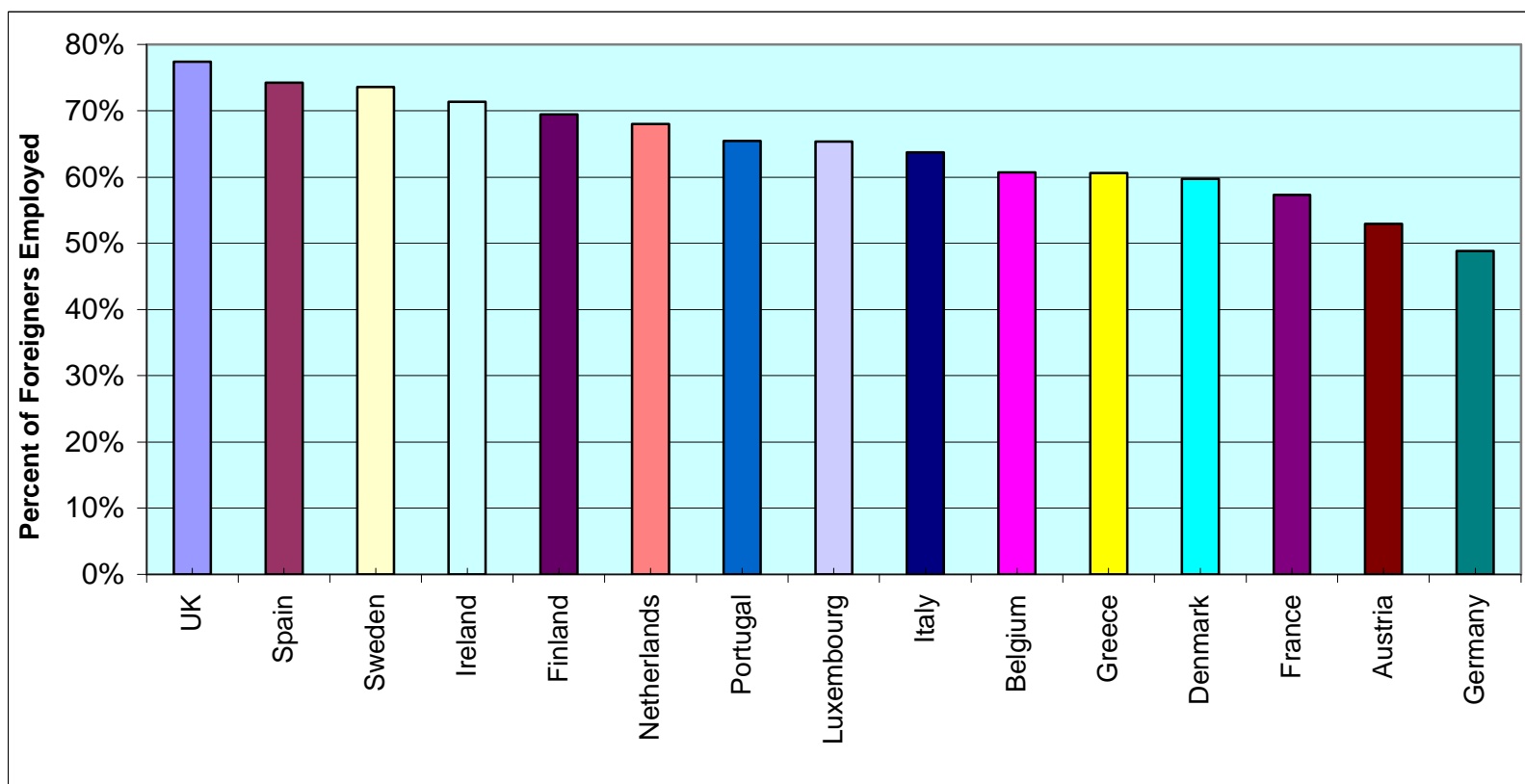
Table 5. Regressions of exports on lagged total immigration and lagged net immigration

Variable	Total Immigration			Net Immigration		
	(1)	(2)	(3)	(4)	(5)	(6)
	Goods and Services Exports	Goods Exports	Services Exports	Goods and Services Exports	Goods Exports	Services Exports
Lagged immigration	37.71 (9.41)***	27.63 (7.67)***	9.28 (1.89)***	82.96 (64.56)	78.06 (33.70)***	14.65 (4.37)***
Guest-worker x lagged immigration	-20.40 (9.16)**	-13.94 (7.84)*	-7.43 (2.31)***	-69.68268 (63.16321)	-75.28620 (31.97346)**	-11.60950 (5.89610)**
GDP per capita	16.29 (3.13)***	12.93 (3.31)***	3.02 (0.72)***	12.05 (2.53)***	7.25 (2.25)***	1.56 (0.46)***
GDP per capita squared	-0.63 (0.136)***	-0.52 (0.139)****	-0.10 (0.03)***	-0.48 (0.10)***	-0.27 (0.10)***	-0.04 (0.02)**
GW dummy	2,184.83 (1,243.10)*	2,233.94 (2,050.16)	740.05 (509.42)	7,096.13 (2,010.02)***	10,006.16 (2,813.47)***	1,452.96 (543.07)***
Constant	-4,447.59 (2,869.70)	-4,746.77 (3,419.75)	-760.62 (687.46)	-1,951.70 (2,317.36)	-4,954.71 (3,150.48)	-1,229.39 (650.45)*
R-Squared	0.36	0.32	0.41	0.16	0.22	0.21
Wald Statistic	57.4	41.02	57.16	59.92	189.05	42.28
Observations	325	227	227	204	115	115
Countries	20	16	16	13	10	10

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Standard errors in parentheses; Immigration is lagged one period (year); The dependent and GDP per capita variables are first differenced and measured in 1995 US dollars; the coefficient of squared GDP per capita multiplied by 100.

Figure 1. Share of non-native workers aged 25 to 54 employed in services, 1995



Source: OECD (2002) Employment by Industry Division