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ABSTRACT

Measuring Immigration's Effects on Labor Demand: A Reexamination of the Mariel Boatlift*

It is now well known that exogenous immigration shocks tend to have benign effects on native employment outcomes, thanks to various secondary adjustment processes made possible by flexible markets. One adjustment process that has received scant attention is that immigrants, as consumers of the goods they help produce, contribute to their own demand. We examine the effects of an immigration shock on labor demand by testing a general equilibrium model in which imperfectly substitutable native and immigrant workers spend their wages on a locally produced good. The shock induces three responses: (i) a substitution of immigrants for natives; (ii) out-migration; and (iii) stimulation of labor demand. According to (iii), native wages can fall, stay the same or rise, depending upon the strength of the shock and various product and factor market elasticities. As our test case, we reexamine the 1980 "Mariel Boatlift," using Wacziarg's "Channel Transmission" methodology. Our data set includes approximately 6,600 observations for 1979-85 from the *Current Population Survey* on workers in 9 different retail labor markets and *Survey of Buying Power* data on retail spending by consumers in Miami and four comparison cities. Our results provide a more complete explanation for why the Boatlift's overall effects on native wages in Miami were benign: Lower wages due to greater labor supply were offset by higher wages due to greater labor demand. We conclude that the demand-augmenting effect of an immigration shock is a significant secondary adjustment process that must be considered when assessing the distributional effects of immigration.

JEL Classification: J23, J61, F22

Keywords: immigration, demand, wages, transmission channels

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I. INTRODUCTION

IA. *The Benign Wage Effects of Immigration: Empirical Puzzle or Outcome of Flexible Markets?*

After roughly twenty-five years of research and a plethora of studies for different countries, it is now well established that immigration tends to have relatively benign effects on native employment outcomes at the local level and, at most, moderately adverse effects at the national level. Friedberg and Hunt's (1995) survey of the empirical literature through the early 1990s concludes that studies using spatial correlation analysis[2] indicate that a 10 percent increase in a locality's immigrant population share depresses native-born wages by usually no more than an average of 1 percent.[3] Longhi, *et al*'s (2005) recent meta-analytic assessment using 18 carefully selected papers across the international literature finds overall that a 1 percentage point increase in the fraction of immigrants in the labor force reduces wages by slightly more than 0.1%. Borjas (2003, pp. 1335) notes that "the measured impact of immigration on the wage of native workers fluctuates widely from study to study (and sometimes even within the same study) but seems to cluster around zero." In what is considered the signature study using the skill cell correlation approach,[4] Borjas (2003) estimated that a 10% increase in a skill cell's immigrant share reduces the wages of competing native workers nationwide by 3-4%, which, while statistically significant, is still a relatively modest response. However, using the same approach, Friedberg (2001) found that the huge flows of highly educated persons from the former Soviet Union to

[2] This approach involves an empirical implementation where the researcher regresses a measure of employment or wages in a given area, e.g. city or county, on the relative quantities of immigrants in that particular area. Spatial units correspond to different geographical labor markets and in most U.S. studies using this approach, spatial units are standard metropolitan statistical areas. Two often cited studies using this approach are Altonji and Card (1991) and Card (2001)

[3] More recent surveys by Dustmann and Glitz (2005), Gaston and Nelson (2001) and Card (2005) draw essentially similar types of conclusions.

[4] According to this approach, the unit of analysis is not an area, but a skill, e.g. experience and education, cell. The researcher typically regresses cell-specific native outcomes on the immigrant share in the respective skill cell.

Israel during the first half of the 1990s had no discernible impacts on native employment outcomes.

There is now strong consensus in the literature that there could be two fundamental reasons for why researchers tend to see a weak effect of immigration on native employment outcomes. First, immigrant inflows and receiving area economic conditions could be simultaneously determined: Immigration may indeed reduce native-born wages and employment rates in the receiving area, while the decision to immigrate may be driven by growing strength there. Some earlier studies may have failed to adequately control for this simultaneity, causing the estimated effects of immigration to be much smaller than they really are.[5] Second, the observed benign effects of immigration could reflect adjustments of a flexible, competitive market to an immigration shock. According to this view, an immigration shock will activate various adjustment processes and once these processes have played themselves out, real native wages will return to their pre-immigration levels. These processes could include: (i) inflows of capital to the receiving area (cf. Leamer and Levinsohn (1995)); (ii) out-migration of natives and previous immigrants in the area (cf. Borjas, *et al* (1997), Filer (1992), Card (2001), Borjas (2006) and Federman, *et al* (2006)); (iii) adjustment of interregional trade (cf. Borjas, *et al* (1992, 1997)); and (iv) the adoption of more immigrant-intensive technologies and/or economies of scale (cf. Poot *et al* (1998), Lewis (2003, 2005) and Gandal, *et al* (2004)).[6]

The evidence supporting each of the adjustment processes above turns out to be both limited and mixed. Freeman (2006) observes that there is not yet a consensus on the importance of

[5] The common solution to this problem has been to instrument the immigrant population share with the lagged share comprising pre-existing immigrants in the receiving area. This remedy has generally led to the same finding that immigration's effects on native employment outcomes are weak to nil.

[6] Furthermore, immigrants and natives could also be complements (cf. Grieco and Ray (2004)).

internal migration responses to an immigration shock.[7] Consequently, Borjas' (1994, pp. 1700) statement in his renowned expository survey of the literature that "The unresolved puzzle facing those who interpret the lack of correlation between immigration and native wages in the local labor market in terms of an economy-wide equilibrium process is clear: Why should it be that many other regional variations persist over time, but that the impact of immigration on native workers is arbitraged away immediately?" still holds true today. In fact, Longhi, *et al* (2005, pp. 473) conclude that "The challenge for further research is to identify and separate carefully the many adjustment processes that have given rise to [the observation that immigration's effect on receiving area wages is benign]."

IB. *Say's Law Applied to Immigrant Labor Supply*

Researchers have given very little attention to an adjustment process that is not mentioned above and which is the subject of this paper: The growth in local labor demand from new immigrant spending on goods and services. The question posed in this paper is: Does Say's Law apply to immigrant labor supply, i.e. does immigrant labor supply generate its own labor demand? Immigrants are, after all, consumers and it is expected that they will spend at least part of their earnings on goods and services in their new communities, including on goods and services they contribute to producing. We ask specifically: (1) How can immigration's effects on local labor demand be modeled and estimated; and (2) What is the extent of these effects and how important are they relative to other adjustment processes following an exogenous immigrant influx?

[7] It should be noted, though, that shortly after Freeman's paper was published, Borjas (2006) provided evidence from U.S. city data that secondary internal migration by natives reduces the measured effect of immigration on wages by 40 to 60 percent. Also, in an unpublished paper, Lewis (2005) does provide relatively strong evidence

There is strong justification in international trade theory for a local demand effect of international labor migration. Standard theory shows that international migration increases total world output, and thus real income, when factors move from where their marginal products are small to where their marginal products are higher. For example, while family reunification and political sentiments may motivate many persons from developing countries to migrate to the USA, they will typically move from a low wage country to a high wage country and, therefore, increase total world output. This income effect by itself will generate some small world demand effects for all factors, including the immigrants' own labor services. But, because many goods and services, such as housing and local government services, are not inter-regionally or internationally tradable, the income/consumption effect of immigrants' increased marginal productivity will tend to be concentrated in the local community where they work and reside. Because many immigrants spend a substantial portion of their higher incomes on retail goods and services, and, of course, local taxes to fund local government activities, they will effectively contribute to their own employment.

The literature on the demand-augmenting effects of immigration (hereafter called "Demand Effects") is sparse. They were first discussed in a macroeconomic context by Mishan and Needleman (1966, 1968), then suggested by Harrison (1983) as a possible reason for the benign effects of immigration on native-born workers in Australia. Greenwood and Hunt (1984) suggested that immigration can cause the nation's labor demand curve to shift out, one reason being that immigrants could boost the price and profitability of locally produced goods. In a comprehensive appraisal of the regional economics literature through the early 1990s, Greenwood (1994) suggests several channels of adjustment for the labor market when there is an

supporting the hypothesis that in markets with higher relative supply of less-skilled labor, comparable plants used immigration shock, one of those being an output demand channel. Building upon this suggestion, Greenwood and Hunt (1995) test a regional economics model of immigration which includes an output demand function and in which the number of immigrant consumers can influence the level of demand. However, they do not isolate theoretically or empirically that portion of the marginal effect of immigration attributable to higher labor demand, concluding only that “When demand and native labor supply channels of influence are taken into account, the effects on natives are almost always negligible or slightly positive” (pp. 1096).

Altonji and Card (1991) included demand effects in a model of the distributional effects of immigration, but they did not carry the demand effects from their theoretical model over to their econometric model.[8] Testing their model on data for mass immigration from the former Soviet Union to Israel, Hercowitz and Yashiv (2001) found that when immigration is allowed to raise the demand for goods and lower the relative price of imports, this delays any negative employment effect on natives by about a year. However, as with Altonji and Card (1991), Hercowitz and Yashiv did not theoretically or empirically isolate the effects of immigration on labor demand. Saiz (2003) and Ottaviano and Peri (2005) focused on the housing markets, hypothesizing that an immigration shock will be felt through higher housing or rental prices. The former study found strong evidence that immigration boosted rental prices in Miami for the first few years following the Mariel Boatlift and the latter study found that immigration boosted housing prices for U.S. SMSA’s during 1970-2000. While the last two studies indicate the existence of demand effects, such effects are not considered, either theoretically or empirically, in the context of a broader labor market model. By not treating demand effects as components of

more labor-intensive technologies.

[8] Altonji and Card present a model of the local wage and employment effects of immigration that allow for immigrants to consume a fraction of the output they produce. The model yields the prediction that when immigrants

a labor market model, these studies stop short of providing information as to how these effects contribute to the distributional effects of immigration.[9]

One recent study that does model and estimate the demand effects of immigration in the context of a broader labor market model is Bodvarsson and Van den Berg (2006), who exploited a natural experiment involving a Hispanic immigration shock to the meatpacking industry in Dawson County, Nebraska during the early 1990s. They show evidence of substantial demand effects.[10] The labor market in that test case was uniquely segmented because all immigrants worked in the export-driven manufacturing sector, but consumed in the retail sector. While this conveniently allowed Bodvarsson and Van den Berg to statistically separate the labor supply effect of immigration on wages in the manufacturing sector from the labor demand effect of immigration on wages in the retail sector, their model is not very applicable to the more common case where immigrants consume and work in the same market. Furthermore, the Nebraska test case was one of endogenous immigration (immigrants were pulled in due to wage growth in Nebraska's meatpacking industry) and Bodvarsson and Van den Berg's model was based on perfect substitution. A model where immigrants and natives are imperfect substitutes[11], there is

consume a larger proportion of the output they produce, local wages are less sensitive to exogenous immigrant inflows.

[9] We should also mention a recent unpublished study by Cortes (2006), who examines the relationship between immigration shocks and the prices of non-tradable goods. Her model allows immigrants to be consumers and derives the implication that a larger supply of unskilled immigrant labor will unambiguously depress the market price of unskilled-intensive goods. However, the lower price is due to the supply-augmenting effects of lower immigrant wages and there is no allowance made in her model for feedback effects on labor demand due to more immigrant consumption. Consequently, Cortes' model is one of product *supply* effects, not the demand effects which are the subject of this study.

[10] In that test case, over 2,500 Hispanic immigrants were hired to work in a newly-built meatpacking plant in the county seat of Lexington in late 1990. Bodvarsson and Van den Berg tested a general equilibrium model of this economy on data from Dawson County and 8 comparable counties in the region to show that throughout the 1990s, the Hispanic immigrant influx substantially increased retail wages and housing prices in Dawson County.

[11] As Chiswick (1978), Lalonde and Topel (1991) and others have suggested, in many cases of international immigration, immigrants and natives are imperfect substitutes because of differences in human capital endowments.

exogenous immigration and immigrants and natives both work and consume in the same industry would be more generalizable.

The demand effects of immigration may be viewed as one of several important processes by which a flexible labor market responds to an immigration shock. Unlike adjustments in capital and production technologies and internal migration, which tend to be longer term, demand effects are likely to happen more quickly, serving to *expedite* the process by which the real native wage returns to its pre-immigration level. We argue that the appropriate way to model and estimate these effects is by construction of a shorter term model of the labor market and a data set that provides a window sufficiently long to study the labor market's short term response to an immigration shock. Accordingly, we estimate a short term general equilibrium model of wages where imperfectly substitutable native and immigrant workers consume in the same market in which they work. We trace the effects, both theoretically and empirically, on wages when there is an exogenous immigration shock. To test our model, we reexamine the 1980 Mariel Boatlift, perhaps the most famous natural experiment involving exogenous international immigration.

II. A GENERAL EQUILIBRIUM MODEL OF NATIVE AND IMMIGRANT WAGES

The main objective of the model below is to obtain a general equilibrium measure of that part of the marginal effect on the native wage from an immigration shock which results from a stimulation of labor demand. We begin by deriving expressions for native and immigrant wages when product price is constant, then we endogenize price to immigration and derive general equilibrium expressions. Our model proceeds from the "production function" approach to studying the distributional effects of immigration, in which native-born and immigrant labor are treated as separate inputs and the derivation of wages and employment levels is based on an articulation of a production function where these inputs are imperfectly substitutable. This approach is due originally to Grossman (1982) and has been most recently utilized by Bodvarsson & Van den Berg (2006), Ottaviano and Peri (2005, 2006) and Cortes (2006).

IIA. *Partial Equilibrium Wages*

Consider a small open economy that produces a good using native labor (N) and immigrant labor (I). We want to allow for the possibility that the good's price is endogenous to the amount of immigration, so we assume that price is determined within the economy.[12] For example, this could be a retail good whose price is set by local firms in response to local market demand and supply. To keep the analysis simple, we exclude capital from the production function, which is equivalent to keeping the supply of capital perfectly elastic. Both types of labor are assumed to be imperfectly substitutable due to differences in native/immigrant human capital endowments. To capture this feature of imperfect substitutability, we assume that the employer faces the quadratic production function below:[13]

(1) $Q = \alpha_1 N - \alpha_2 N^2 + \alpha_3 I - \alpha_4 I^2 - \alpha_5 NI$,

where Q is output and α_1 through α_5 are positive coefficients. The coefficients in (1) could be such that immigrants have lower skills than natives, or *vice versa*. The important feature is that the skill endowments of natives differ from those of immigrants.[14]

[12] The good could be tradable or non-tradable, although it is more likely to be non-tradable.
[13] An example of this production function is found in Doll and Orazem (1984, pp. 128-29), who use the example of hay and grain as competitive inputs in the production of milk. Frisch (1965, pp. 59) also discusses the case of a quadratic production function in which the interaction term between two inputs is negative. Bodvarsson and Partridge (2001) use a similar equation in a study of black/white salary differentials in the National Basketball Association. In that study, black and white players are treated as imperfect substitutes for the same reason that we treat immigrants and natives as imperfect substitutes in the present model, namely, due to differences in human capital endowments.
[14] An alternative production function would be, for example, a nested CES function, which has been used by Ottaviano and Peri (2005, 2006), Cortes (2006) and others. One advantage of the CES function is that it allows for convenient estimation of factor price elasticities. A disadvantage is that it is often extremely difficult to obtain

Assume that the market price of the good is P, which for now is assumed to be exogenous (this assumption will be relaxed later), that each immigrant worker is paid a wage of W_I and each native worker is paid a wage of W_N. The employer's profits, π, are thus:

(2) $\pi = P\,[\alpha_1 N - \alpha_2 N^2 + \alpha_3 I - \alpha_4 I^2 - \alpha_5 NI] - W_N N - W_I I.$

First and second order conditions yield the following demand functions for immigrant and native labor, I^D and N^D, respectively[15]:

$$(3)\ I^D = \frac{\frac{1}{\alpha_5}(\alpha_3 - \frac{W_I}{P}) + \frac{1}{2\alpha_2}(\frac{W_N}{P} - \alpha_1)}{\frac{2\alpha_4}{\alpha_5} - \frac{\alpha_5}{2\alpha_2}},$$

$$(4)\ N^D = \frac{\frac{1}{\alpha_5}(\alpha_1 - \frac{W_N}{P}) + \frac{1}{2\alpha_4}(\frac{W_I}{P} - \alpha_3)}{\frac{2\alpha_2}{\alpha_5} - \frac{\alpha_5}{2\alpha_4}}.$$

A common assumption in previous studies is perfect inelasticity of immigrant labor supply. This is appropriate when examining immigrant supply to the entire labor market in the receiving country.[16] However, since we are studying immigration to one particular industry, it is very likely that immigrants will have employment opportunities in other industries, hence the wage elasticity of immigrant labor supply to this sector should be relatively high. We assume therefore that the supply of immigrants to this sector, θ_I, depends upon the real wage (W_I/P), a real reservation wage, V_I, and other factors influencing the decision to migrate:

closed form solutions for wages. The quadratic function, while sometimes clumsy, provides easy to sign closed form solutions. In this study, we are more interested in signing marginal effects on wages rather than obtaining expressions for factor price elasticities.

[15] Note that in both demand functions the employment of one input and the price of the other are positively related, which is consistent with the assumption of imperfect substitutability.

[16] It is plausible that international migrants who migrate for non-economic reasons will have zero reservation wages, but those who come in response to real income differentials clearly will not. It is likely that the assumption of perfect inelasticity, common to many studies, has been made more for expositional simplicity than for other reasons.

$$(5)\ \theta_I = \left(\frac{i}{V_I}\right)\left(\frac{W_I}{P}\right).$$

Expression (5) has several important features. First, the real wage is the nominal wage adjusted by the price of the good made by immigrants. This is because immigrants are assumed to spend their earnings on what they produce and their living costs are thus equivalent to the cost of that good. Second, expression (5) allows for both supply-push and demand-pull immigration. Supply-push immigration is reflected here in a rightward rotation of the labor supply curve[17] and it could be due to a lower immigrant reservation wage (V_I) or other exogenous factors, which would be reflected by an increase in the "i" parameter. These other factors could include changes in social and political conditions in the source country, changes in the receiving country's immigration policies with respect to family reunification and the admission of refugees, or increased "migrant network effects" generated by growth in the receiving country's community of migrants that hail from the destination country. Demand-pull immigration, in contrast, is a movement up the immigrant labor supply curve, induced by strengthened economic conditions in the receiving country (an increase in $\left(\frac{W_I}{P}\right)$). Suppose, for example, that there is an increase in consumer demand for the good. There will then be higher derived demand for labor and a higher nominal wage. If the nominal wage rises proportionately more than product price, new migrants will be pulled into this sector.

The supply of native labor is also assumed to depend upon the real wage and a real reservation wage V_N:

[17] It is customary to think of supply-push immigration as involving a shift in the labor supply curve rather than a rotation. The only difference between the two situations is that in the former, the labor supply curve does not come out of the origin, whereas in the latter it does. We chose not to include an intercept purely for expositional simplicity.

$$(6)\ \theta_N = \left(\frac{n}{V_N}\right)\left(\frac{W_N}{P}\right)$$

The market is assumed to be perfectly competitive and there are H employers. When the native labor market is in equilibrium, $HN^D = \theta_N$, and when the market for immigrant workers is in equilibrium, $HI^D = \theta_I$.

Now multiply equation (3) by H, set that equal to the supply of immigrants (5) and solve for the immigrant wage:

$$(7)\ W_I = \frac{\frac{HP}{\varepsilon}\left(\frac{\alpha_3}{\alpha_5} + \frac{W_N}{2\alpha_2 P} - \frac{\alpha_1}{2\alpha_2}\right)}{\left(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I}\right)},$$

where $\varepsilon = \frac{2\alpha_4}{\alpha_5} - \frac{\alpha_5}{2\alpha_2}$.

Then multiply equation (4) by H, set that equal to the supply of natives (6) and solve for the immigrant wage:

$$(8)\ W_I = 2\alpha_4\left(\frac{\phi n W_N}{V_N H} - \frac{P}{\alpha_5}\left(\alpha_1 - \frac{W_N}{P}\right)\right) + \alpha_3 P\ ,$$

where $\phi = \frac{2\alpha_2}{\alpha_5} - \frac{\alpha_5}{2\alpha_4}$.

Now equate (7) and (8) and solve for W_N. This yields the partial equilibrium native worker wage:

$$(9)\ W_N = \frac{P\left[\left(\frac{H}{\varepsilon\left(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I}\right)}\right)\left(\frac{\alpha_3}{\alpha_5} - \frac{\alpha_1}{2\alpha_2}\right) + \frac{2\alpha_1\alpha_4}{\alpha_5} - \alpha_3\right]}{2\alpha_4\left(\frac{1}{\alpha_5} + \left(\frac{n}{V_N}\right)\left(\frac{\phi}{H}\right)\right) - \left(\frac{H}{2\varepsilon\alpha_2\left(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I}\right)}\right)}.$$

If α_5 is positive and not too high[18], then $\frac{\alpha_3}{\alpha_5} > \frac{\alpha_1}{2\alpha_2}, \frac{2\alpha_1\alpha_4}{\alpha_5} > \alpha_3$ and the numerator in expression (9) will be positive. The denominator will be positive if $2\alpha_4(\frac{1}{\alpha_5} + (\frac{n}{V_N})(\frac{\phi}{H})) > (\frac{H}{2\varepsilon\alpha_2(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I})})$. In the analysis that follows, it is assumed that these very reasonable restrictions are in effect.

Differentiating equation (9) with respect to the immigrant reservation wage (V_I), we find that a lower reservation wage, by inducing supply-push immigration, will result in a lower equilibrium native wage:

$$(10)\ \frac{\partial W_N}{\partial V_I} = P\left[\frac{[(\frac{H}{\varepsilon^2(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I})^2})(\frac{\alpha_3}{\alpha_5} - \frac{\alpha_1}{2\alpha_2})(\frac{i\varepsilon}{V_I^2})]}{2\alpha_4(\frac{1}{\alpha_5} + (\frac{n}{V_N})(\frac{\phi}{H})) - (\frac{H}{2\varepsilon\alpha_2(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I})})} + \frac{[(\frac{H}{\varepsilon(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I})})(\frac{\alpha_3}{\alpha_5} - \frac{\alpha_1}{2\alpha_2}) + \frac{2\alpha_1\alpha_4}{\alpha_5} - \alpha_3]\frac{\frac{iH}{V_I^2}}{2\alpha_2\varepsilon(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I})^2}}{\left[2\alpha_4(\frac{1}{\alpha_5} + (\frac{n}{V_N})(\frac{\phi}{H})) - (\frac{H}{2\varepsilon\alpha_2(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I})})\right]^2}\right] > 0,$$

Now differentiating equation (9) with respect to the i parameter in the immigrant labor supply function, we find that supply-push immigration induced by some factor other than a lower immigrant reservation wage will lower the native wage:

$$(11)\ \frac{\partial W_N}{\partial i} = (-)P\left[\frac{[(\frac{H}{\varepsilon^2(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I})^2})(\frac{\alpha_3}{\alpha_5} - \frac{\alpha_1}{2\alpha_2})(\frac{\varepsilon}{V_I}]}{2\alpha_4(\frac{1}{\alpha_5} + (\frac{n}{V_N})(\frac{\phi}{H})) - (\frac{H}{2\varepsilon\alpha_2(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I})})} + \frac{[(\frac{H}{\varepsilon(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I})})(\frac{\alpha_3}{\alpha_5} - \frac{\alpha_1}{2\alpha_2}) + \frac{2\alpha_1\alpha_4}{\alpha_5} - \alpha_3]\frac{\frac{H}{V_I}}{2\alpha_2\varepsilon(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I})^2}]}{\left[2\alpha_4(\frac{1}{\alpha_5} + (\frac{n}{V_N})(\frac{\phi}{H})) - (\frac{H}{2\varepsilon\alpha_2(\frac{H}{\varepsilon\alpha_5} + \frac{i}{V_I})})\right]^2}\right] < 0.$$

[18] If this parameter were very high, Q < 0.

For example, an increase in the number of refugee arrivals (manifested by an increase in i) will lead to a lower native wage, all other things equal. Expressions (10) and (11) illustrate the traditional effect of immigration on the native wage, which we will call the "input substitution effect". According to this effect, greater immigrant labor supply reduces the immigrant wage and induces employers to substitute immigrants for natives. This leads to a leftward shift of the demand curve for native labor and a lower native wage.[19]

IIB. *Measuring the effects of immigration on consumer demand*

As previous research (Bodvarsson and Van den Berg (2006)) has demonstrated, the derived demand for labor is very likely to be endogenous to immigration. If immigrant workers consume the goods they produce, then changes in the supply of immigrant labor will ultimately induce changes in price and the derived demand for labor. When labor demand is endogenous to immigration, then immigration exerts a "consumer demand effect" on wages. Accordingly, the next step in our analysis is to allow for product price to be endogenous to immigrant labor supply and to derive expressions for general equilibrium wages. These expressions will allow us to separate the traditional input substitution effect from the consumer demand effect.

[19] Note that the immigrant wage in partial equilibrium is

$$W_I = \frac{P\left[\dfrac{H}{\phi(\dfrac{H}{\alpha_5\phi}+\dfrac{n}{V_N})}(\dfrac{\alpha_1}{\alpha_5}-\dfrac{\alpha_3}{2\alpha_4}) - \dfrac{H}{\varepsilon(\dfrac{H}{2\varepsilon\alpha_2})}(\dfrac{\alpha_1}{2\alpha_2}-\dfrac{\alpha_3}{\alpha_5})\right]}{\dfrac{i}{V_I(\dfrac{H}{2\varepsilon\alpha_2})} + H(\dfrac{1}{\varepsilon\alpha_5(\dfrac{H}{2\varepsilon\alpha_2})} - \dfrac{1}{2\phi\alpha_4(\dfrac{H}{\alpha_5\phi}+\dfrac{n}{V_N})})},$$

and it is inversely related to the volume of supply-push immigration.

Suppose product demand Q_{DR} depends linearly upon aggregate consumer income Y (we assume the good is normal) and, price:

(12) $Q_{DR} = \psi_1 Y - \psi_2 P$,

Product supply Q_{SR} depends linearly upon price and the two wages:

(13) $Q_{SR} = \delta_1 P - \delta_2 W_N - \delta_3 W_{I.}$

Consumers include native and immigrant workers and their incomes include wages and distributed profits. Native workers spend all their incomes locally, but immigrants remit a fraction of their incomes elsewhere. Assume that immigrants spend a fraction k (k < 1) locally. Total income spent locally is thus:

(14) $Y = W_N\theta_N + kW_I\theta_I + \lambda$,

where λ is distributed profits. When (14) is substituted into (12), we see that product demand depends on each worker group's wage and size:

(15) $Q_{DR} = \psi_1(W_N\theta_N + kW_I\theta_I + \lambda) - \psi_2 P$.

Now set (15) equal to (13) and solve for P. Equilibrium price (P*) is:

(16) $$P^* = \frac{W_N{}^*(\psi_1\theta_N{}^* + \delta_2) + W_I{}^*(k\theta_I{}^* + \delta_3) + \psi_1\lambda}{\psi_2 + \delta_1},$$

where $\theta_N^* = \frac{nW_N{}^*}{V_N P}$ and $\theta_I^* = \frac{iW_I{}^*}{V_I P}$, W_N^* and W_I^* are the partial equilibrium wages derived above, θ_N^* is native employment when the native wage is W_N^* and θ_I^* is immigrant employment when the immigrant wage is W_I^*. Expression (16) illustrates the linkage between prices and labor supply. It is not a closed form expression, though, since the right-hand side variables are equilibrium expressions and are themselves endogenous to product price. However, for illustrative purposes the expression allows one to distinguish between the different effects of exogenous immigration on retail prices. Recall that exogenous immigration can occur if the immigrant reservation wage (V_I) falls or for other reasons (i rises). Differentiating expression (16) with respect to each of these parameters, the marginal effects of exogenous immigration on price are:

$$(17)\ \frac{\partial P^*}{\partial V_I} = \frac{\frac{\partial W_N^*}{\partial V_I}(\psi_1\theta_N^* + \delta_2) + \frac{\partial \theta_N^*}{\partial V_I}(\psi_1 W_N^*) + \frac{\partial W_I^*}{\partial V_I}(k\theta_I^* + \delta_3) + \frac{\partial \theta_I^*}{\partial V_I}(kW_I^*)}{\psi_2 + \delta_1},$$

$$(18)\ \frac{\partial P^*}{\partial i} = \frac{\frac{\partial W_N^*}{\partial i}(\psi_1\theta_N^* + \delta_2) + \frac{\partial \theta_N^*}{\partial i}(\psi_1 W_N^*) + \frac{\partial W_I^*}{\partial i}(k\theta_I^* + \delta_3) + \frac{\partial \theta_I^*}{\partial i}(kW_I^*)}{\psi_2 + \delta_1}.$$

Expression (17) measures the marginal effect of immigration on product price when immigration is induced by a fall in the immigrant reservation wage. Expression (18) measures the marginal effect of immigration on product price when immigration is induced by other exogenous factors. According to the first two terms in the numerators of these expressions, price falls because immigration depresses native consumer demand. That group's demand falls because: (a) each native consumer's income falls ($\frac{\partial W_N^*}{\partial V_I} > 0$); and (b) there will be some out-migration of native consumers ($\frac{\partial \theta_N^*}{\partial V_I} > 0$). The next two terms measure the change in price attributable to changes in immigrant demand. According to the third term, price falls because each immigrant consumer has less money to spend ($\frac{\partial W_I^*}{\partial V_I} > 0$). According to the fourth term, however, price *rises* because there are now more immigrant consumers ($\frac{\partial \theta_I^*}{\partial V_I} < 0$). Therefore, immigration will result in a net increase (decrease) in price if the gain in demand due to more immigrant consumers outweighs (falls below) the loss in demand due to lower native and immigrant wages and out-migration of natives.

Substituting the partial equilibrium native and immigrant wages into (16) and solving for price, product price in general equilibrium is:

$$(19)\ P^* = \frac{\dfrac{\psi_1 \lambda}{\psi_2 + \delta_1}}{\left[1 - \left(\dfrac{(\dfrac{\psi_1 n A^2}{V_N}) + \delta_2 A + (\dfrac{kiB^2}{V_I}) + (\delta_3 B)}{\psi_2 + \delta_1}\right)\right]}, \text{ where } A = \frac{[(\dfrac{H}{\varepsilon(\dfrac{H}{\varepsilon\alpha_5} + \dfrac{i}{V_I})})(\dfrac{\alpha_3}{\alpha_5} - \dfrac{\alpha_1}{2\alpha_2}) + \dfrac{2\alpha_1\alpha_4}{\alpha_5} - \alpha_3]}{2\alpha_4(\dfrac{1}{\alpha_5} + (\dfrac{n}{V_N})(\dfrac{\phi}{H})) - (\dfrac{H}{2\varepsilon\alpha_2(\dfrac{H}{\varepsilon\alpha_5} + \dfrac{i}{V_I})})} \text{ and}$$

$$B = \frac{\left[\dfrac{H}{\phi(\dfrac{H}{\alpha_5\phi} + \dfrac{n}{V_N})}(\dfrac{\alpha_1}{\alpha_5} - \dfrac{\alpha_3}{2\alpha_4}) - \dfrac{H}{\varepsilon(\dfrac{H}{2\varepsilon\alpha_2})}(\dfrac{\alpha_1}{2\alpha_2} - \dfrac{\alpha_3}{\alpha_5})\right]}{\dfrac{i}{V_I(\dfrac{H}{2\varepsilon\alpha_2})} + H(\dfrac{1}{\varepsilon\alpha_5(\dfrac{H}{2\varepsilon\alpha_2})} - \dfrac{1}{2\phi\alpha_4(\dfrac{H}{\alpha_5\phi} + \dfrac{n}{V_N})})}.$$

In general equilibrium, how does an immigration shock affect product price? Suppose the shock is triggered by a fall in the source country wage. Then, differentiating expression (19) with respect to the immigrant reservation wage, for example, we obtain:

$$(20)\ \frac{\partial P^*}{\partial V_I} = \frac{(\dfrac{\psi_1\lambda}{(\psi_2 + \delta_1)^2})[\dfrac{\partial A}{\partial V_I}\dfrac{2\psi_1 n A}{V_N} + \dfrac{\partial A}{\partial V_I}\delta_2 + \dfrac{\partial B}{\partial V_I}(\dfrac{2kBi}{V_I} + \delta_3) - \dfrac{\partial B}{\partial V_I}\dfrac{kB^2 i}{V_I{}^2}]}{[1 - (\dfrac{\dfrac{\psi_1 n A^2}{V_N}) + (\delta_2 A) + (\dfrac{kiB^2}{V_I}) + (\delta_3 B)}{\psi_2 + \delta_1}]^2}.$$

According to expression (20), an immigration shock induces four effects on price, the first three effects contributing to a reduction in price (the out-migration of native retail consumers, the drop in each native retail consumer’s income and the drop in each immigrant retail consumer’s income, respectively) and the last effect contributing to an increase in price (an increase in the number of immigrant retail consumers). The net effect of exogenous immigration on price can thus be positive, negative or neutral.

IIC. *Wages in general equilibrium*

The general equilibrium native wage may be obtained by substituting expression (19) into expression (9):

$$(21)\quad \mathrm{W_N} = \frac{\left[\dfrac{\dfrac{\psi_1\lambda}{\psi_2+\delta_1}}{1-\left(\dfrac{\dfrac{\psi_1 nA^2}{V_N})+(\delta_2 A)+(\dfrac{kiB^2}{V_I})+(\delta_3 B)}{\psi_2+\delta_1}\right)}\right]\left[\left(\dfrac{\mathrm{H}}{\varepsilon(\dfrac{\mathrm{H}}{\varepsilon\alpha_5}+\dfrac{i}{V_I})}\right)\left(\dfrac{\alpha_3}{\alpha_5}-\dfrac{\alpha_1}{2\alpha_2}\right)+\dfrac{2\alpha_1\alpha_4}{\alpha_5}-\alpha_3\right]}{2\alpha_4\left(\dfrac{1}{\alpha_5}+\left(\dfrac{n}{V_N}\right)\left(\dfrac{\phi}{H}\right)\right)-\left(\dfrac{H}{2\varepsilon\alpha_2\left(\dfrac{\mathrm{H}}{\varepsilon\alpha_5}+\dfrac{i}{V_I}\right)}\right)},$$

and the general equilibrium immigrant wage is:

$$(22)\quad W_I = \frac{\left[\dfrac{\dfrac{\psi_1\lambda}{\psi_2+\delta_1}}{1-\left(\dfrac{(\dfrac{\psi_1 nA^2}{V_N})+(\delta_2 A)+(\dfrac{kiB^2}{V_I})+(\delta_3 B)}{\psi_2+\delta_1}\right)}\right]\left[\dfrac{H}{\phi(\dfrac{H}{\alpha_5\phi}+\dfrac{n}{V_N})}\left(\dfrac{\alpha_1}{\alpha_5}-\dfrac{\alpha_3}{2\alpha_4}\right)-\dfrac{H}{\varepsilon(\dfrac{H}{2\varepsilon\alpha_2})}\left(\dfrac{\alpha_1}{2\alpha_2}-\dfrac{\alpha_3}{\alpha_5}\right)\right]}{\dfrac{i}{V_I\left(\dfrac{H}{2\varepsilon\alpha_2}\right)}+H\left(\dfrac{1}{\varepsilon\alpha_5\left(\dfrac{H}{2\varepsilon\alpha_2}\right)}-\dfrac{1}{2\phi\alpha_4\left(\dfrac{H}{\alpha_5\phi}+\dfrac{n}{V_N}\right)}\right)}.$$

Expressions (21) and (22) have one extremely convenient feature: It is very easy to separate the input substitution effect from the consumer demand effect of an immigration shock. Differentiating the native wage, for example, with respect to the immigrant reservation wage, we find that

$$(23)\quad \frac{\partial \mathrm{W_N}}{\partial V_\mathrm{I}} = \frac{\partial P^*}{\partial V_I}A + P^*\frac{\partial A}{\partial V_I}\ ,$$

and doing the same with respect to the i parameter, we find that:

$$(24)\ \frac{\partial \mathrm{W_N}}{\partial i} = \quad \frac{\partial P^*}{\partial i} A + P^* \frac{\partial A}{\partial i} \quad .$$

For each of equations (23) and (24), in general equilibrium the ceteris paribus effect of a change in immigrant labor supply on the native wage is simply the sum of the consumer demand effect (the first term on the right hand side of each equation) and the input substitution effect (the second term on the right hand side of each equation). The consumer demand effect is the change in the native wage that occurs when an inflow of immigrants induces a change in the MRP of native labor. As noted above, this effect can be positive, negative or neutral. The input substitution effect is the change in the native wage that occurs when an inflow of immigrants induce a substitution of immigrant hires for native hires. This effect is always negative when natives and immigrants are substitutes. Therefore, in general equilibrium the native wage will rise from immigration if the consumer demand effect is sufficiently positive and the input substitution effect is relatively small. On the other hand, the native wage will always fall if the consumer demand effect is negative.

What conditions in the labor and product markets are likely to result in higher native wages when there are new migrants? Assuming that the migrant inflow is driven by weakened economic conditions in the source country, one possibility is a positive and relatively large consumer demand effect (the $-\frac{\partial B}{\partial V_I}\frac{kB^2 i}{{V_I}^2}$ term in expression (20) is relatively large). This will tend to occur if: (a) the supply of immigrant labor is relatively elastic with respect to either the immigrant reservation wage or other exogenous factors; (b) the wage elasticity of demand for immigrant labor is relatively high (immigrant retail spending power does not drop by much if there is an increase in immigrant labor supply); or (c) the wage elasticity of supply for native labor is relatively high (native out-migration and the drop in the native wage would not be high). Another factor is a relatively small input substitution effect. The input substitution effect will be relatively small if the wage elasticity of demand for immigrant labor and the wage elasticity of supply for native labor are relatively high.

Exogenous immigration will also, in general equilibrium, induce two effects on the immigrant wage:

$$(25)\ \frac{\partial W_I}{\partial V_I} = \frac{\partial P^*}{\partial V_I}B + P^*\frac{\partial B}{\partial V_I}$$

$$(26)\ \frac{\partial W_I}{\partial i} = \frac{\partial P^*}{\partial i}B + P^*\frac{\partial B}{\partial i}$$

First, there will be the consumer demand effect, which is measured by the first terms on the right-hand side of expressions (25) and (26). The demand curve for immigrant labor shifts because, working through the product demand channel, immigration alters the MRP of immigrant labor. This effect can be positive, negative or neutral. Immigration also reduces the immigrant wage because of greater competition among immigrants. This is measured by the second term on the right-hand side of each of the two expressions above. The wage can rise from immigration provided that the consumer demand effect is positive and sufficiently large.[20]

[20] The model also has an important econometric implication. Expression (9) will be a biased measure of the *ceteris paribus* effects of immigration on the native wage if there are demand effects of immigration. Suppose, for example, product price is endogenous and a researcher uses expression (9) to obtain an estimate of the complete effect of immigration on the native wage. What will be the magnitude of the estimation bias? The amount of bias (Ω) will equal precisely the difference between the partial and general equilibrium marginal effects of immigration on the wage. If supply-push immigration is triggered by a drop in the immigrant reservation wage, then the amount of bias will equal expression (9) less expression (21):

$$\Omega = P^*\frac{\partial A}{\partial V_I} - \left(\frac{\partial P^*}{\partial V_I}A + P^*\frac{\partial A}{\partial V_I}\right) = \frac{\partial P^*}{\partial V_I}A.$$

The estimation bias depends on the size and sign of the consumer demand effect. If immigration pushes up retail prices ($\frac{\partial P^*}{\partial V_I} > 0$), then expression (9) will be a negatively biased measure, meaning that it overstates the size of immigration's negative marginal effect on the native wage. In contrast, if immigration leads to lower retail prices,

III. A TEST OF THE MODEL

IIIA. *The Mariel Boatlift Test Case*

We chose as our test case the so-called "Mariel Boatlift," perhaps the most famous modern day natural experiment of exogenous international migration.[21] The Mariel Boatlift involved the migration of some 120,000 Cuban refugees on a flotilla of privately chartered boats to Miami from May to September, 1980.[22] Approximately one-half of the Mariel refugees settled permanently in the Miami metropolitan area, resulting in a 7% increase in Miami's labor force. Many who remained in Miami were absorbed by the retail goods and services, textile and apparel manufacturing and construction industries.

Card (1990) used individual micro-data for 1979-85 from the Merged Outgoing Rotation Group (MORG) samples of the Current Population Survey (CPS) to show that the Mariel influx had virtually no effect on the wages or unemployment rates of white, black, non-Cuban

then expression (9) will be positively biased. The magnitude of bias is determined in part by the size of $\frac{\partial P^*}{\partial V_I}$.
Consequently, failure to control for the consumer demand effect could thus seriously bias estimates of the *ceteris paribus* effect of exogenous immigration on native labor market outcomes.

[21]Some other famous natural experiments of exogenous immigration that have been analyzed include Hunt's (1992) study of the 1962 repatriation of French colonists from Algeria to France, Carrington and de Lima's (1996) study of the repatriation of overseas Portugese following the independence of Portugal's African colonies in 1973, Friedberg's (2001) study of Jewish migration to Israel after the fall of the Soviet Union and Suen's (2000) study of the large influx of Chinese refugees to Hong Kong.

[22] The arrival of these Cubans was the outcome of an unusual sequence of events that culminated in Fidel Castro's April 20, 1980, declaration that those wishing to migrate to the USA could freely do so from the Port of Mariel, Cuba. While the Mariel influx was very small compared to total immigration to the USA in 1980, Miamians were greatly concerned about the long term effects of the influx. These concerns are reflected in the following quotation from the August 25, 1980, issue of *Business Week* in an article titled "The New Wave of Cubans is Swamping Miami":

"The migration of 120,000 Cubans to the U.S. last Spring was just a passing spectacle for most of the country, but for Miami it is turning into a long-term nightmare. Thousands of the refugees have settled in, pushing unemployment among Florida's Gold Coast to double-digit levels and overwhelming the area's ability to provide shelter and education. These immigrants are also competing for jobs with blacks, Haitians, and union workers in the construction, restaurant, and hotel industries, and this could prolong a festering racial conflict that resulted in four days of riots earlier this year. 'There is no way this community can absorb so many people without serious socioeconomic problems,' says Paul L. Cejas, a member of the Dade County (metropolitan Miami) School Board.'' (No. 2651, August, pp. 86-88).

Hispanic, earlier Cuban immigrant and all low-skilled workers for the first 5 years following the influx.[23] Card's counterfactual included a set of four comparison labor markets (Tampa, Atlanta, Houston and Los Angeles). He suggested that the primary reason for the immigration shock's benign effects was that it triggered offsetting out-migration from the local labor market, as well as deterred prospective migrants to Miami from other U.S. cities. Card also suggested that Miami may have responded to the influx in a manner consistent with a Heckscher-Ohlin economy and the Rybczynski Theorem in that: (a) the influx stimulated the expansion in Miami of those industries producing unskilled labor-intensive goods; and (b) those unskilled labor-intensive goods were exported to product markets outside of Miami. However, Lewis (2004) showed there was no evidence to support this explanation, arguing instead that the Boatlift induced the affected industries to employ more unskilled-intensive production technologies. The absorption of the Mariels was made even easier, Card argued, by the fact that a large proportion of those working in the affected industries spoke Spanish.

While these adjustment processes may indeed have occurred, we contend that the adjustment process highlighted in this paper – demand effects – were also very likely at work[24]. Saiz (2003) provides strong evidence that the Mariel influx stimulated the Miami rental housing market. We contend that another sector – the retail goods and services sector – was also very likely to have been affected. Lewis (2004) shows evidence that, of the various Miami-area industries that absorbed the Mariels, retail industries such as hotels and motels, grocery stores experienced substantial increases in Cuban employment during the 1980s. Like rental housing,

[23] Card did find, though, that the relative earnings of Cubans dropped by a modest amount. He attributed this primarily to a drop in the mean level of skills among Cuban workers following the influx, as most of the Mariels had skill levels on average below those of other Cubans in the Miami labor market.

[24] The Boatlift may also have induced economies of scale effects. Miami experienced above-average unemployment in the very early 1980s, so the demand effect of immigration may have induced a Keynesian multiplier effect.

most or all of the Mariels needed retail goods and services such as groceries, appliances, gasoline, cars, etc.

In contrast to the Bodvarsson and Van den Berg (2006) study where immigrants worked in the export-driven meatpacking industry, but consumed retail goods and houses, we examine a sector in which many of the Mariel immigrants consumed *and* worked. In contrast to the Saiz (2003) study, which estimated the relationship between the price of one non-tradable good (rental housing) to an immigration shock, we seek to estimate the effects of a shock on a composite of wages in a much broader sector which includes both tradable and non-tradable goods -- retailing.

IIIB. *The Wacziarg Model of Channel Effects*

If a researcher were interested in estimating how an immigration shock affects the native wage, all other things equal, he/she could estimate some version of the following regression equation:

(27) $W_N = a_0 + a_1(\theta_I) + a_2(Z) + u$,

where Z is a vector of other explanatory variables that also influence the labor market outcome and u is a disturbance term. The problem is that if there are multiple mechanisms through which immigration affects the native wage, equation (27) precludes the researcher from being able to empirically distinguish between the contribution of each mechanism; the coefficient a_1 is only an estimate of the overall effect of immigration on the wage. Consequently, equation (27) is not useful in empirically distinguishing between the input substitution and consumer demand effects discussed above.

The goals of the empirical analysis below are to: (1) obtain an accurate estimate of the consumer demand effect on native wages resulting from the Mariel influx; and (2) determine the proportionate contribution of the consumer demand effect to the estimated overall effect of immigration on the native wage. To achieve these goals, we apply an econometric methodology due originally to Wacziarg (1998, 2001) and Tavares and Wacziarg (2001) that is very compatible with our theoretical model.[25] This methodology allows for the estimation of a simultaneous equations regression model in which an independent variable affects the dependent variable through different *channels*, to use Wacziarg's exact terminology. The model includes: (1) separate *channel equations*, each describing the hypothesized process by which the fundamental causal variable influences the dependent variable; and (2) an *aggregate equation* that explains the dependent variable and includes, among other determinants, each of the channel variables as explanatory variables. The overall effect of the fundamental causal variable on the dependent variable is the sum of the effects from each of the channels.

In our adaptation of Wacziarg's methodology, the dependent variable is the native wage and the two channel equations describe each of the input substitution and consumer demand effects. The stock of immigrants appears as an explanatory variable in each of the channel equations, but not in the aggregate equation which explains the native wage. Wacziarg's methodology is particularly appropriate for estimating our theoretical model because the methodology allows us to estimate the complete effect of immigration on the native wage as the sum of the effects stemming from each of the channel equations, which is precisely what the theory predicts.

[25] This methodology is based on three-stage least squares (3SLS), pioneered by Zellner and Theil (1962) and described more broadly in Theil (1971). The 3SLS method is asymptotically efficient and superior to other full-information methods when the covariance matrix is not known and the sample is large.

Furthermore, this methodology has the added advantage of allowing us to ascertain the relative contributions of the consumer demand and input substitution effects.

In order to empirically distinguish between the input substitution and consumer demand effects, we test the following two hypotheses: (1) immigration influences the demand for native labor through its effects on the immigrant wage (W_I); and (2) immigration influences the demand for native labor through its effects on retail sales per capita (P). Suppose our study of the variables W_I and P also suggests that immigration is not the only explanatory variable, that the vector of variables R also explains some of the variation in W_I, and that the vector of explanatory variables S helps to explain P. Accordingly, we estimate the simultaneous-equations regression model consisting of the following three equations:

(28) $W_N = a_0 + a_1(W_I) + a_2(P) + a_3(Z) + u$,

(29) $W_I = b_0 + b_1(\theta_I) + b_2(R) + u$,

(30) $P = c_0 + c_1(\theta_I) + c_2(S) + u.$

If our estimation procedure is consistent and the estimates are statistically significant, we will gain estimates of the relative strengths of the two channels through which immigration is hypothesized to influence wages. The effect of immigration on wages through the W_I channel is $(b_1 \cdot a_1)$ and the effect of immigration through the P channel is $(c_1 \cdot a_2)$. It follows that the total effect of immigration on the wage is $(a_2 \cdot c_1) + (a_1 \cdot b_1)$, of which the consumer demand effect accounts for the proportion $(a_2 \cdot c_1) / |((a_2 \cdot c_1) + (a_1 \cdot b_1))$. A more general description of the Wacziarg methodology is illustrated in the Appendix.

The specific regression model to be estimated in this paper consists of the following three equations:

$$(31)\ W_N = a_0 + a_1(W_I) + a_2(P) + a_3(Min) + a_4(RGDP) + a_5(T) + a_6(Rent) + u\ ,$$

$$(32)\ W_I = b_0 + b_1(\theta_I) + b_2(Birth) + b_3(Death) + b_4(Human) + b_5(Emm) + u\ ,$$

$$(33)\ P = c_0 + c_1(\theta_I) + c_2(Interest) + c_3(UN) + c_4(\lambda) + c_5(W_N) + c_6(GRGDP) + c_7(T) + u,$$

Equation (31) contains the input substitution effect and consumer demand effect variables plus four other variables, which we had designated as Z in the general equation (28). Specifically, the other factors are the city-specific minimum wage (Min), real U.S. gross domestic product (RGDP), a time trend to proxy technological progress (T), and the federal Department of Housing and Urban Development's city-specific fair market rent (Rent). The minimum wage and rent variables capture factors unique to the local labor market, such as cost of living, the policy environment, and the living amenities. U.S. GDP and the technology trend capture the overall national influences on local labor demand. In equation (32), θ_I is immigrant population share and measures Cuban immigrant density within each city. Other variables in that equation include (Birth) and (Death), the city-specific birth and death rates, respectively, (Human), the highest school grade attained, and (Emm), net emigration to each city by other native labor to determine the immigrant wage. These "other variables" capture various factors that determine the supply of native labor, such as the natural growth of population and the net inflows of labor, and the human capital component of labor. Equation (33) includes variables likely to influence overall consumer demand, including the federal funds rate (Interest), the national unemployment rate (UN), non-labor income (λ), and the growth of real U.S. gross domestic product (CRGDP). Adding (θ_I), the supply of immigrant workers, to the equation then permits us to measure the marginal effect of immigrants on consumer demand, all other things equal.

IIIC. *The Data Set*

We use data from a wide variety of sources to test the model. The principal data source consists of observations on 6,569 persons who were part of the MORG samples of the *Current Population Survey* (CPS) for 1979-85 in Miami (approximately 11% of the observations) and the same 4 comparison cities used in Card's (1990) study – Atlanta (approximately 12.5% of the observations), Tampa (11%), Houston (17%) and Los Angeles (48.5%). Since our theoretical model is of the retail labor market, the CPS observations used in our study are specifically of persons employed in 9 different retail CPS-classified categories. These categories are the following:

Grocery stores
Eating and drinking places
Department, variety and general merchandise stores
Apparel and accessories stores
Furniture and household furnishings stores
Motor vehicle dealers
Gasoline service stations
Lumber and building material retailing and hardware stores
Drug stores

Following Card's (1990) approach, we break the CPS sample down by four categories for Miami (Whites, Blacks, Cubans and Hispanics) and three categories for the other cities (Whites, Blacks and Hispanics). Because of the extremely small number of Cubans residing in the four comparison cities, the CPS includes a separate category for Cubans only for Miami. Of the 722 observations in our sample for Miami, 209 (29%) self-reported being Cuban. While this proportion is very likely larger than the true proportion of Cubans that resided in Miami during that time, it is probably a reasonable estimate of the Cuban share of the Miami retail sector, particularly since many jobs in that sector tend to be unskilled and a large portion of the Mariel immigrant pool was relatively unskilled.

To control for differences in skill levels between retail workers, we use educational attainment (measured by highest grade attended), age at the time of the survey and potential labor market experience (constructed from the sample as: age – highest grade attended – 5) as human capital controls. For our sample, the mean age of respondents is 30 years, mean grade attended is approximately 12 and mean potential labor market experience is 13 years. The respondents earned on average $4.70 per hour and approximately $160 per week before taxes and worked an average of approximately 33 hours per week. Because of the nature of the retailing industry, the sample consisted of both part time and full time workers.

The CPS does not, unfortunately, include any information on each respondent's retail spending. The Bureau of Labor Statistics' *Consumer Expenditure Survey* does have micro-data on household retail spending, but it is not broken down by city and is not available for the period under study. Therefore, we turned to another data source -- the *Survey of Buying Power* (published by *Sales and Marketing Management Magazine*) -- which provides aggregate annual sales data for each of the 9 retail categories above for each of our cities and years.[26] These data are used to proxy the "retail price" (P) variable in our theoretical model.

[26] Made available since 1948, *Survey of Buying Power* (SBP) data are sold on a subscription basis to business owners, consultants, libraries, research organizations and various public agencies. Survey information is organized within a geographic hierarchy by region, state, metropolitan area, county and by television market. We used annual SBP data for 9 basic retail store groups for each of our specific metropolitan areas. These 9 groups generally match the groups used in the *Current Population Survey*. However, some of the groups are named differently for each survey. Specifically, what the CPS calls "grocery stores" is called "food stores" in the SBP, what the CPS calls "Department stores, variety stores and general merchandise stores" is simply called "General merchandise stores" in the SBP (although the SBP definition of stores in this category includes the three subcategories used by CPS), what CPS calls "Furniture and household furnishings stores" is called "Furniture, home furnishings and appliance stores" (the CPS category does include appliances) in the SBP, what CPS calls "Motor vehicle dealers" in the CPS is called "Automotive dealers" in SBP, and what CPS calls "Lumber and building material retailing and hardware stores" is called "Building materials and hardware dealers" in SBP. These particular data were lifted from the sections of the SBP data books titled "Retail Sales by Store Group for Metropolitan Markets and all Counties." They are interpolative estimates for each year based on the *Census of Retail Trade*. The estimates for 1979-82 are based on the 1977 Census and the estimates for 1983-85 are based on the 1982 Census.

Table 1 shows year-to-year growth rates in retail sales, using the *Survey of Buying Power* data, for Miami and the comparison cities for the sample period. These data also are illustrated in Figure 1, which shows retail sales in Miami and the three other cities in the Southern region, as well as Figure 2, which compares Miami and Los Angeles. The table and figures exemplify the importance of controlling for both regional and national economic trends when doing an examination of the Mariel Boatlift's effects on the Miami economy. According to the table and figures, Miami experienced large growth rates in retail sales between 1979 and 1980 and between 1980 and 1981, but much slower growth thereafter (although sales spiked dramatically between 1983 and 1984). Miami's growth rates need to be compared to those of the other cities in order to gain proper perspective, however. Note that Miami's growth rates between 1979 and 1981 were lower than Houston's and larger than Los Angeles's. Houston's growth in retail sales was unusual for that city and very likely reflects the boom to its economy generated by the strength of the oil production and service industries around that time. Los Angeles's low growth rate may reflect softer economic conditions in that region of the country. The most appropriate comparison is thus between Miami and its two Southern sibling cities, Tampa and Atlanta. Observe that Miami's growth rates exceeded those of Atlanta and Tampa between 1979 and 1981, but were lower than Atlanta and Tampa thereafter. Therefore, taking into account Houston's oil boom and weaker growth in the West, the Mariel Boatlift may indeed have generated a boost to retail spending in the Miami area.

INSERT TABLE 1 ABOUT HERE

Dividends, interest and rents per capita for each city, obtained from the BEA website[27], are used to proxy the non-labor income variable (λ) in our theoretical model. The FRED database is the source for U.S. GDP, U.S. CPI, and federal funds rate data.[28] Monetary data are deflated using the CPI for the Southern region.[29] City unemployment rates control for general labor market conditions and were obtained from the BLS. Birth and death rates were obtained from the *Statistical Abstract of the United States*.

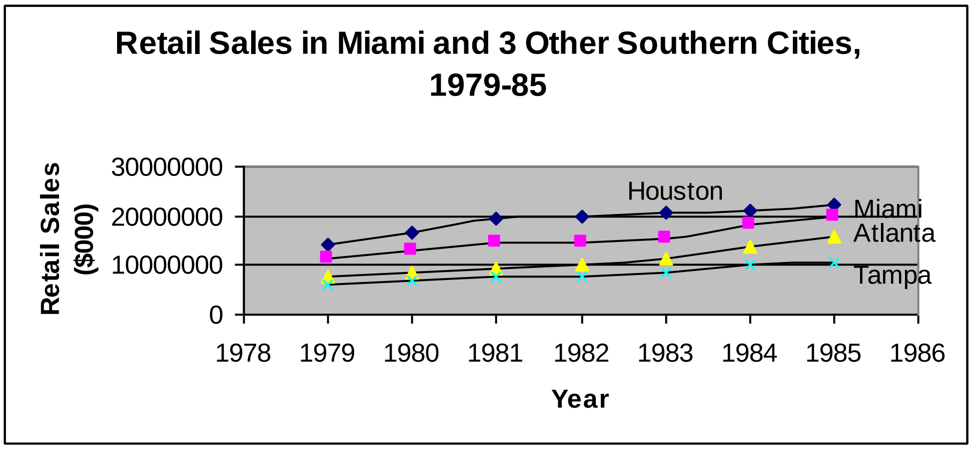

Figure 1

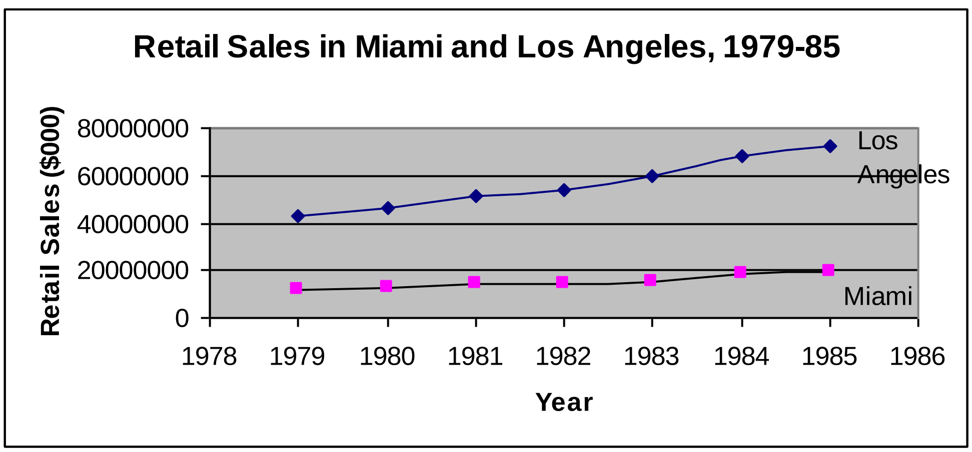

Figure 2

[27] The data for dividends, interest and rent provided on the BEA website are aggregate data, but the same website also provides city population, so we computed the per capita numbers by combining the two measures.
[28] See http://research.stlouisfed.org/fred2/.
[29] CPI data for Tampa are not available going back that far, so we chose to use the regional CPI for all 5 cities.

IIID. *Estimates from the Wacziarg Model*

As required by the Wacziarg methodology, we apply 3SLS to estimate equations (31) through (33). The model tested meets the identification criteria of instrumenting, as there are eleven exogenous variables and three endogenous variables. Since the *Survey of Buying Power* data on retail sales in each retail category are aggregate data, we chose to regress the weighted mean value of the dependent variable on the weighted mean values of the independent variables, where the weights are the fractions of Cuban, black, Hispanic or white workers. Consequently, the data set used in our regression analyses was compressed to 306 observations, where each observation is a city times year times retail category mean value.

The estimation results for equation (31) are presented in column two of Table 2. In this case the dependent variable (W_N) is the weighted average native retail wage for whites, blacks and Hispanics. The coefficient estimates for the variables included in the wage model closely match those of the existing literature on natural experiments involving exogenous international migration. Of the channel variables, the immigrant wage (W_I) has a significant negative effect on retail wages, and retail sales per capita are significantly associated with higher native retail wages. Rent is a measure of "non-retail" goods and is positively associated with native retail wages, while economic mass is inversely associated with wages at the 10 percent level. However, the native retail wage appears not to be influenced by the minimum wage or technology.

Column three of Table 2 reports the results of substituting (House Price), Freddie Mac city specific repeated home sales index, for (Rent) in equation (31), all else equal. The purpose of re-running our SEM with (House Price) is two-fold. First, we are able to check the robustness of our results using different measures of city specific "non-retail" goods in the model, as mentioned by Saiz (2007). Also, while over 90% of the Mariel immigrants rented[30], making rent an excellent consumption behaviorial variable, rent data prior to 1982 had to be extrapolated with weighted averages. The fact that the coefficients in columns two and three of Table 2 are consistent, indicates that there is no obvious measurement error with the (Rent) sequence. In fact, the result that (Rent) is significantly related to native wages and (House Price) does not make sense, given that most of the Mariels did not own their homes during the period under analysis.

INSERT TABLE 2 ABOUT HERE.

Table 3 reports the results of the first channel equation, which measures the input substitution effect. The dependent variable in equation (32) is the weighted average immigrant wage (W_I). All else equal, it is positive and significantly related to the immigrant share and the amount of human capital obtained per worker. This result would seem to indicate the existence of a positive network effect among Cubans. That is, the greater the number of Cuban immigrants as a share of the population, the greater the Cuban immigrant wage as newly arriving Cuban immigrants were able to obtain work in Miami. The immigrant wage is not affected by the other variables in the model, specifically, birth and death rates and emigration.

INSERT TABLE 3 ABOUT HERE.

Table 4 reports the results of the second channel equation, which measures the consumer demand effect. The dependent variable in equation (33) is retail sales per capita. Given that the estimated coefficient (c_1) is positive and significant, the empirical results suggest that Cuban immigrants have a direct consumer demand effect on retail sales. Greater native wages are also

[30] Saiz (2003) reported that 92% of the Mariels rented their homes.

significantly related to retail sales. Interest rates, national unemployment rates, real U.S. GDP growth, non-labor income, and the time trend do not significantly affect retail sales.

INSERT TABLE 4 ABOUT HERE.

A summary of the channel effects of Cuban immigration on the wages of all natives, white natives only, black natives only and Hispanic natives only are given in Table 5.[31] The table reports the effects of each channel on a specific native wage category and, within a category, the effect of Cuban immigration on each channel. The last column reports the product of the two coefficients. Note that the *t*-statistics for the channel effects relies on a Taylor series expansion process.[32] Results for all native workers confirm the theory in section II, as both the immigrant wage channel (input substitution effect) and the retail sales channel (consumer demand effect) have a statistically significant impact on the native wage. When both channels are added, the net effect of Cuban immigration on native wages is positive and at times significant. These results suggest that the consumer demand effect fully offsets the negative input substitution effect on wages, accounting for Card's (1990) finding that the Mariel influx had no effect on wages.

INSERT TABLE 5 ABOUT HERE.

As Table 5 also shows, the results from splitting the sample into the three unique ethnic groups are reassuringly similar to the results for all natives. There is a significantly positive consumer demand effect present for whites, blacks and Hispanics, suggesting that the new Cuban immigrants patronized shops and businesses of all ethnic backgrounds. However, the evidence suggests a significantly negative immigrant wage channel for whites, blacks and Hispanics as

[31] We generated estimates for the three specific ethnic groups so as to stay consistent with Card's (1990) study.

[32] Wacziarg (1998) states that "The t-statistics for the channel effects are obtained by computing linear approximations of the products of the parameters around the estimated parameter values, and applying the usual formula for the variance of linear functions of random variables to this linear approximation. Computing these standard errors is possible thanks to the joint estimation of all the equations in the system, which allows the derivation of the covariance matrix for all of the estimated parameters." (pp. 23)

Cubans served as substitute inputs to the three ethnic groups. As with the weighted average results with (Rent) and in line with previous authors' findings, we find that native white wages were positively effected by a higher immigrant share. On the other hand, native black and Hispanic wages were on balance not affected by the Mariel influx.

IV. CONCLUDING REMARKS

Because immigration tends to raise overall world output and not all of the increased output consists of tradable goods, we hypothesize that immigrants generate a noticeable demand effect in their new home economies. We have suspected that this demand effect helps to explain the generally benign labor market effects of immigration found in so many studies. We thus set ourselves the challenge of testing for the presence of a labor demand effect in Miami after the 1980 Mariel boatlift, an exogenous immigration surge previously studied by Card (1990) in what is now a classic study of the economic effects of immigration. Card has attributed his finding of no negative wage effect to other causes, such as the outflow of native workers when the Cuban immigrants arrived.

The theoretical model developed in this paper demonstrates that the net effect of immigration on natives wages in a local economy is ambiguous because the arrival of immigrants both depresses wages through its effect on labor supply, but raises them through its effect on labor demand. To estimate separately the supply effect, demand effect, and the net total effects of immigration on native wages, we used an econometric methodology due originally to Wacziarg (1998, 2001). Our estimates confirm that, for all native workers, the demand effect of immigration was indeed substantial in Miami's retail labor market for at least the first half-decade following the Mariel Boatlift. In fact, we found that the consumer demand effect offsets the traditional labor substitution effect of immigration. In addition, when we estimate the Boatlift's effects separately for white, black, and Hispanic native workers, we qualify the above conclusion somewhat. While we find that the effect of immigration on native black and Hispanic wages is positive but insignificant, as in the case of the overall results, the effect of immigration on native white wages is positive and significant.

We conclude, therefore, that Card's (1990) finding that the Mariel influx exerted no real effect on Miami-area wages is due to the new Cuban immigrants inducing a strong increase in the local demand for labor. This result is compatible with Bodvarsson and Van den Berg's (2006) earlier results for demand-pull immigration. The strong evidence of a consumer demand effect found here and by Bodvarsson and Van den Berg (2006) suggests that the wage effects found in previous studies of famous natural experiments involving exogenous international migration may require re-estimation. For example, since earlier researchers overlooked the possibility of a consumer demand effect, depending on how they set up their estimation models, their estimates of the ceteris paribus wage effects of immigration may be negatively biased.

Most important, our results confirm that the absence of completely costless international trade means the movement of consumers from one country to another moves the local demand for factors of production as well. Our application of the Wacziarg methodology shows that immigrants have both labor supply and labor demand effects, thus confirming that there is a "Say's Law of immigration": Immigrants do indeed spend a substantial portion of their incomes in their new home communities and thus demand at least some of the labor that they supply.

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VI. APPENDIX

A Simple Illustration of the Wacziarg Model

To understand Wacziarg's simultaneous equations method, suppose that the variable w is explained by the following function that contains three explanatory variables, x, y, and z:

(i) $w = f(x, y, z)$

Suppose also that the variables x and y are, in turn, explained by the following two functions:

(ii) $x = g(q, r)$

(iii) $y = h(q, s)$

We see then that the variable a can be explained by a three-equation model, in which the variables w, x, and y are endogenous and z, q, r, and s are exogenous.

The model to determine the variable w could have been written in a more simplified form, namely the so-called *reduced form* in which an endogenous variable is shown as exclusively a function of exogenous variables:

(iv) $w = a(z, q, r, s)$.

If the equations are linear, then the magnitude of q's influence on w is equal to the partial derivative of equation (iv) with respect to q, or w_q'.

While this reduced form model is useful as a simple representation of how w is determined, it is not very helpful if we are interested in *how* the exogenous variables influence the variable w. The model (iv) loses the information contained in equations (ii) and (iii) about how the exogenous variables q, r, and s work through the endogenous variables x and y to determine the variable w. If, for example, we already know that the variable w depends on q, but we do not know how strong is the influence of q through the variable x versus the influence of q through the variable y, then we definitely would like to see the three-equation model. We can use the three-equation model to find the magnitudes of the two channels through which q influences w. For example, in the case of linear equations, the total influence of q on w through the channel x is $(g_q' \cdot f_x')$. And, the total influence of q on w through the channel y is $(h_q' \cdot f_y')$. Together, the total effect of q on the variable w through the two channels x and y must sum to:

(v) $(g_q' \cdot f_x') + (h_q' \cdot f_y') = w_q'$.

Table # 1
Percentage Changes in Retail Sales from Preceding Year for Sample Cities, 1979-85

Year	Houston	Miami	Atlanta	Tampa	Los Angeles	Mean of Cities
1980	17.57	14.05	14.22	13.22	7.84	13.38
1981	16.97	12.13	9.69	12.08	9.07	11.99
1982	2.42	0.63	9.11	4.78	5.14	4.42
1983	3.13	6.18	8.49	9.90	11.49	7.84
1984	2.76	18.08	25.21	16.92	13.68	15.33
1985	4.4	7.26	14.06	5.30	6.73	7.55

Table #2
Estimated City Retail Wage Equation (Aggregate Equation)
Dependent Variable: Weighted Average Native Retail Wage (W_N)

	Equation (39) Rent	Equation (39b) House Price
Constant	650.61 (1.33)	598.30 (1.18)
City Minimum Wage (Min)	-0.881 (-0.01)	-5.275 (-0.04)
Immigrant Wage (W_I)	-0.372 (-5.62)**	-0.392 (-5.13)**
Retail Sales Per Capita (P)	0.239 (4.75)**	0.281 (5.85)**
U.S. Real GDP (RGDP)	-0.124 (-1.79)*	-0.129 (-1.49)
Technology (T)	13.851 (1.45)	13.225 (1.13)
Rent (Rent)	0.106 (1.79)*	
House Price (Housing Price)		0.025 (0.09)
R-Squared	0.641	0.682

Notes: Figures in parentheses are heteroskedasticity-consistent *t*-statistics.
** indicates significant at the 95% level, and * at the 90% level. There are 306 data points.

Table #3
Immigrant Wage Channel Equation
Dependent Variable: Immigrant Wage (W_I)

	Rent	House Price
Constant	-46.322 (-0.34)	-64.128 (-0.51)
Immigration (θ_I)	8.146 (3.29)**	7.897 (3.04)**
Birth Rate (Birth)	1.313 (0.28)	2.176 (0.51)
Death Rate (Death)	2.929 (0.40)	3.422 (0.49)
Human Capital (Human)	16.702 (3.11)**	17.335 (3.08)**
Emmigration (Emm)	-0.00001 (-0.04)	-0.00003 (-0.12)
R-Squared	0.790	0.801

Notes: Figures in parentheses are heteroskedasticity-consistent *t*-statistics.
** indicates significant at the 95% level, and * at the 90% level. There are 306 data points.

Table #4
Retail Sales Channel Equation
Dependent Variable: Retail Sales Per Capita (P)

	Rent	House Price
Constant	-1826.60 (-1.38)	-1877.10 (-1.93)*
Immigration (θ_I)	23.238 (5.88)**	22.006 (6.22)**
Interest Rates (Interest)	0.025 (0.003)	-0.797 (-0.11)
National Unemployment Rate (UN)	-11.468 (-0.33)	-16.035 (-0.72)
Non-Labor Income (λ)	-0.029 (-0.75)	-0.001 (-0.05)
Native Retail Wage (W_N)	3.075 (5.47)**	3.384 (7.87)**
Real GDP Growth (GRGDP)	0.361 (1.12)	0.344 (1.37)
Technology (T)	-19.524 (-0.58)	-32.873 (-1.32)
R-Squared	0.137	0.112

Notes: Figures in parentheses are heteroskedasticity-consistent *t*-statistics.
** indicates significant at the 95% level, and * at the 90% level. There are 306 data points.

Table #5
Summary of Channel Effects on Native Wages

Dependent Variable	Channel	Effect of Channel on Native Wage	Effect of Immigration on Channel	Effect of Immigration on Native Wages
Weighted Average Native Retail Wage	Immigrant Wage Channel (W_I)	-0.372 (-5.62)**	8.146 (3.29)**	-3.030 (-2.71)**
	Retail Sales Per Capita Channel (P)	0.239 (4.75)**	23.238 (5.88)**	5.553 (2.55)**
	Total Effect *t*-statistic Wald Statistic Wald *p*-value Sample Size			**2.254** (2.16)** 4.658 (0.03) 306
Weighted Average Native Retail Wage from Equation (39b)	Immigrant Wage Channel (W_I)	-0.392 (-5.13)**	7.897 (3.04)**	-3.095 (-2.36)**
	Retail Sales Per Capita Channel (P)	0.281 (5.85)**	22.006 (6.22)**	6.183 (2.37)**
	Total Effect *t*-statistic Wald Statistic Wald *p*-value Sample Size			**3.088** (1.60) 2.564 (0.109) 306
White Native Retail Wage	Immigrant Wage Channel (W_I)	-0.412 (-5.54)**	7.988 (3.23)**	-3.291 (-2.65)**
	Retail Sales Per Capita Channel (P)	0.261 (4.72)**	23.709 (5.98)**	6.108 (2.51)**
	Total Effect *t*-statistic Wald Statistic Wald *p*-value Sample Size			**2.897** (2.12)** 4.524 (0.03) 306
Black Native Retail Wage	Immigrant Wage Channel (W_I)	-0.403 (-3.05)**	7.628 (3.03)**	-3.074 (-2.03)**
	Retail Sales Per Capita Channel (P)	0.458 (5.53)**	12.931 (3.20)**	5.922 (2.52)**
	Total Effect *t*-statistic Wald Statistic Wald *p*-value Sample Size			**2.848** (0.53) 0.284 (0.59) 306
Hispanic Native Retail Wage	Immigrant Wage Channel (WI)	-1.126 (-4.38)**	8.142 (3.51)**	-9.167 (-2.34)**
	Retail Sales Per Capita Channel (P)	1.082 (7.53)**	16.809 (5.19)**	18.187 (2.67)**
	Total Effect t-statistic Wald Statistic Wald p-value Sample Size			**9.020** (0.19) 0.037 (0.84) 306