

The 9/11 Terrorist Attack and Overseas Travel to the United States: Initial Impacts and Longer-Run Recovery

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I. Introduction

The terror attacks of September 11, 2001 had an immediate and substantial impact on international travel worldwide. The attacks induced substitution away from air travel generally and caused a shift in the preferences of travelers for particular destinations. The United States in particular experienced an immediate and precipitous drop in arrivals of international visitors, particularly from those flying in from overseas. The initial drop in arrivals immediately following 9/11 in part reflected widespread concern about the safety of international air travel. Economic factors most likely also played a role in reducing travel to the United States in the aftermath of 9/11. Between 2001 and 2002, for example, the global economy experienced a recession that reduced demand for air travel generally. In addition to safety concerns and deteriorating economic conditions, the perception that U.S. visa policy became more restrictive in the wake of 9/11 may also have negatively impacted arrivals. Such perceptions prompted concern within the travel industry that the United States was becoming a less attractive travel destination and was damaging its image abroad (Alden, 2008).

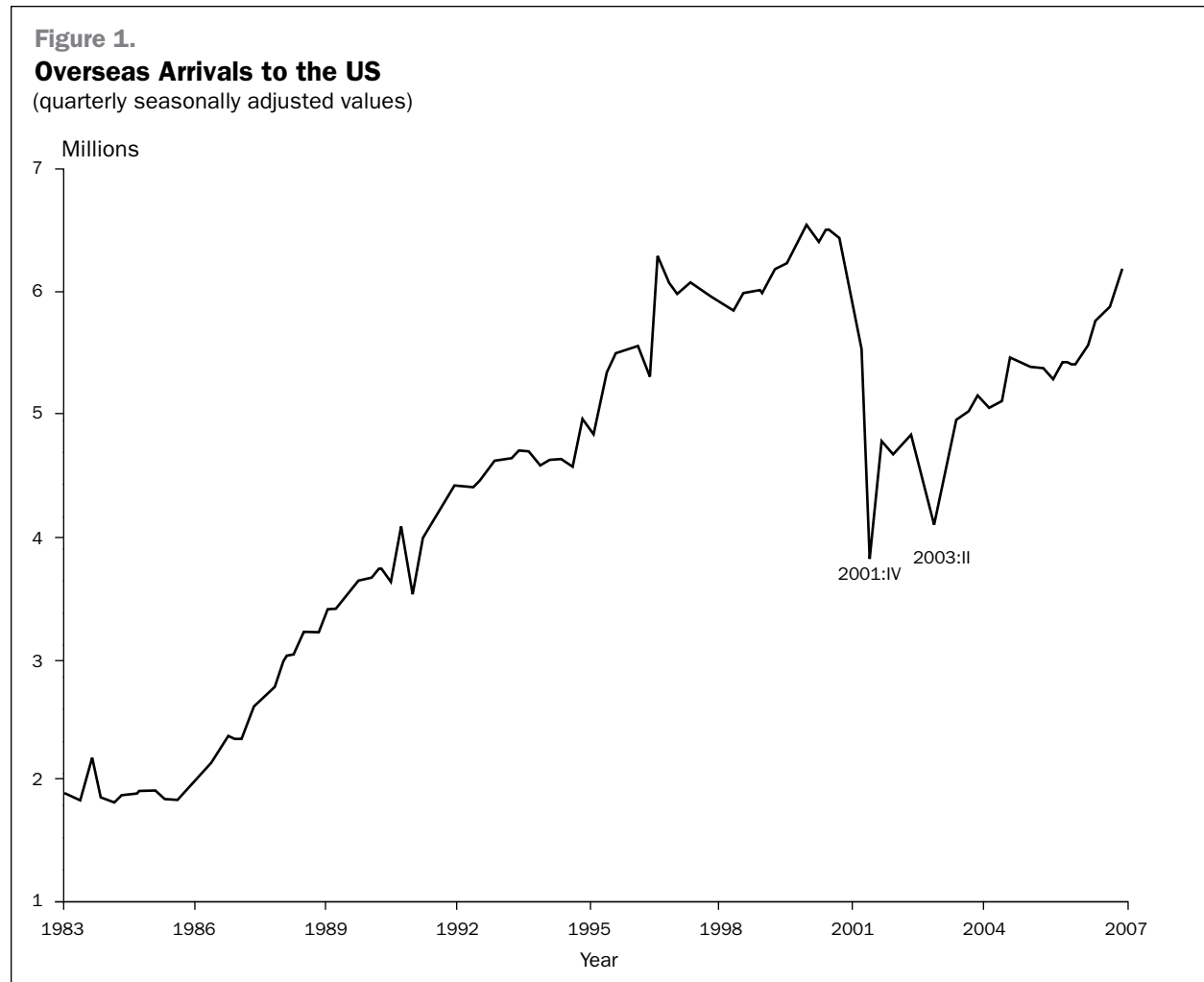
Although visa policy itself did not significantly change after 9/11, the security screening procedures that are part of the visa application process were standardized and intensified (Yale-Loehr et al., 2005). After the 9/11 attacks, for example, certain administrative procedures related to visa issuance and entry at the U.S. border were implemented as part of an enhanced travel security protocol. The security procedures related to visa issuance only affected visa applicants travelling to the United States and did not affect travelers from countries participating in the Visa Waiver Program (VWP). Moreover, while travelers from VWP and non-VWP countries were exposed to the same screening procedures upon entry to the United States, some travelers from non-VWP countries were subject to an additional layer of processing. Taken together, the fact that VWP travelers are exempt from the visa issuance procedures and are not exposed to the additional entry processing that some non-VWP arrivals undergo introduces inter-country variation that can be used to test whether the new administrative procedures actually reduced travel to the United States among travelers needing a visa.

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A recent study by Neiman and Swagel (2009) exploits this variation between VWP and non-VWP countries in order to assess the impact of the post-9/11 security environment on nonimmigrant arrivals to the United States. The results of their study indicate that, despite the new security protocol, arrivals from non-VWP countries were not significantly lower than those from VWP countries after 9/11. This finding suggests that, contrary to popular perceptions, the new security procedures did not disproportionately discourage travel from non-VWP countries. In addition to this empirical assessment, casual inspection of nonimmigrant arrivals data indicates that a general recovery began late in 2003 and continued through 2007. Figure 1 illustrates both the initial fall in total nonimmigrant arrivals between 2001 and 2002 and the subsequent recovery in late 2003. As Figure 1 shows, by 2007, total nonimmigrant arrivals had almost returned to their pre-9/11 level.³



Together, the Neiman-Swagel study coupled with the apparent recovery of nonimmigrant arrivals by 2007, implies that the procedural changes implemented after 9/11 did not significantly affect non-VWP arrivals relative to those from VWP countries. However, despite the Neiman-Swagel results and the apparent recovery in total arrivals, there are two general reasons to question this conclusion. First, the time period covered in the Neiman-Swagel study ends in September 2003,

³ Arrival data used to construct Figure 1 is that of the Department of Homeland Security and is published by the Department of Commerce's Office of Travel and Tourism Industries. These arrivals include those on B visas, the Visa Waiver Program, and student visas. The quarterly arrivals series was de-seasonalized using the Census X12 procedure. It should also be noted that, despite the apparent recovery of arrivals by 2007, one cannot say with certainty that this trend indicates that the 9/11 impacts had dissipated. The reason for this is because the counterfactual circumstance of what would have happened to arrivals in the absence of 9/11 cannot be known. In this study, we do not attempt to address this counterfactual.

which means that the post-9/11 period they examine is only two years long. Since many aspects of the new security protocol were not fully implemented until 2003, the time sample may be too restrictive to detect any effect these procedural changes may have had on nonimmigrant arrivals over time. It is conceivable, for example, that the new procedures may have had a delayed impact on arrivals from non-VWP countries. To allow for this possibility, an extended post-9/11 time frame is needed. The second issue involves the recovery in arrivals documented in Figure 1. At first glance, the fact that total nonimmigrant arrivals appear to have returned to their pre-9/11 level by 2007 suggests that the impact of the new procedures may not have been significant. Before such a conclusion can be accepted, however, it is necessary to model the recovery of arrivals from both VWP and non-VWP countries in the post-9/11 period. If the new procedures disproportionately impacted non-VWP travelers, then the post-9/11 recovery may have been slower for arrivals from non-VWP countries compared to those from VWP countries. What is needed is an econometric model that allows for separate recovery patterns between VWP and non-VWP arrivals.

In this paper, we address these gaps. In particular, we expand on the original econometric model estimated by Neiman and Swagel by using yearly data on nonimmigrant arrivals for the period 1981 to 2007. Lengthening both the pre and post-9/11 time periods enables us to more reliably estimate the overall impact of VWP status on arrivals over time and assess whether this status became more important in the post-9/11 era. To address whether the post-9/11 security protocol significantly impacted arrivals based on VWP status, we employ two estimation strategies. The first strategy involves estimating an econometric model of nonimmigrant arrivals using a specification similar to that of Neiman and Swagel but with a longer time sample. Second, we model the recovery of arrivals in the post-9/11 period for both VWP and non-VWP countries. If the post-9/11 security changes impacted countries differently depending on their VWP status, then one testable implication is that VWP arrivals should have returned to their pre-9/11 levels more quickly than did non-VWP arrivals, holding all else constant. Our results offer qualified support for this hypothesis and suggest that non-VWP countries may have been impacted by the post-9/11 security changes in a way that Neiman and Swagel's original econometric estimation might have underestimated.

The remainder of this paper is organized as follows. The next section briefly reviews the empirical literature on the impact of 9/11 on travel to the United States. The third section discusses the econometric model used in this paper. Section four presents the key findings. Finally, we conclude by noting the limitations of the analysis and discussing the possibilities for future work.

II. Theoretical Overview

The impact of 9/11 on travel and tourism flows to the United States has been evaluated in several studies. Lee et al. (2005), for example, evaluate the initial impact of the 9/11 attacks on the demand for air travel to the United States using a time series intervention model and find a significant overall drop in demand. Similarly, Blunk et al. (2006) evaluate whether post-9/11 U.S. airline travel volume returned to its pre-9/11 trend and find that it did not through 2004. A more disaggregated analysis is provided by Bonham et al. (2006) who quantify the initial impact of 9/11 on tourist arrivals to Hawaii and their subsequent recovery using a Vector Error Correction model (VECM). The results indicate that substitution away from foreign arrivals and towards U.S. citizen arrivals took place in Hawaii and that the positive shock to U.S. citizen arrivals offset the negative shock to foreign arrivals. By 2003, the Hawaiian tourism industry had fully recovered from the initial 9/11 shock. In addition to assessments of air travel, studies have also quantified the costs of 9/11 due to substitution away from air travel. Blalock et al. (2009), for example, quantify the increase in the number of auto driving fatalities due to substitution away from airline travel after 9/11.

Despite the well-documented decline in foreign arrivals to the United States after 9/11, none of these studies address the contention that the new post-9/11 security protocol may also have impacted overseas travel to the United States during this period. Although no significant legislative changes

to U.S. visa policy occurred after 9/11, several new security procedures related to visa issuance and border entry were introduced (Yale-Loehr et al., 2005).⁴ In a recent paper, Neiman and Swagel (2009) evaluate whether arrivals from non-VWP countries differed significantly from VWP countries after 9/11. Neiman and Swagel use monthly data from October 1995 to September 2003 on nonimmigrant arrivals from 62 countries, excluding Canada and Mexico, to test whether non-VWP arrivals were significantly lower than VWP arrivals in the post-9/11 period (defined as October 2001 to September 2003). After controlling for real income, real exchange rates, country and time fixed effects, they find that the decline in nonimmigrant arrivals did not differ significantly by VWP status. Substantively, this finding suggests that the new security procedures did not negatively impact travel based on VWP status.

A notable feature of the Neiman-Swagel analysis is that arrivals are analyzed only through September 2003. As discussed above, many of the post-9/11 security procedures were not implemented all at once but unfolded over time (see Footnote 4 for an example). The time period covered in the Neiman-Swagel study is likely to underestimate such changes because they occur towards the end of the time sample. Moreover, it is conceivable that differences in arrivals by VWP status may not have been detectable in the immediate aftermath of 9/11, but may have emerged over time. The primary rationale for this expectation is that changes in preferences for destination and/or travel mode due solely to the terrorist attacks may have been the dominant factor influencing nonimmigrant arrivals immediately after 9/11. Concerns about the safety of air travel may have affected travelers from VWP and non-VWP countries in a similar way immediately after 9/11, in which case the magnitude of the drop in arrivals may have been similar for both sets of countries.

Over time, however, concerns about travel safety may have dissipated as the fear of air travel or another terrorist attack grew less acute for both VWP and non-VWP travelers. A discernible difference in arrivals between VWP and non-VWP countries, therefore, may not have been evident until the initial shock of the 9/11 attacks wore off and a recovery was underway. This scenario is especially likely if many of the security policies related to visa issuance in particular were enacted gradually in the years following 9/11. Under such circumstances, it may take time to observe a difference between arrivals based on VWP status because the impact of any security policy change may not be detectable until several years after 9/11. Accordingly, if security policy impacted VWP and non-VWP arrivals differently, either due to the new visa issuance procedures or to popular perceptions that the entry process was more difficult based on VWP status, the differences may not be observed until after 2003.

To address this issue, we analyze a subset of annual overseas arrivals to the United States from 69 countries, excluding Canada and Mexico, during the period 1981 to 2007. The sample is restricted to nonimmigrant arrivals who enter the United States using either a B visa (i.e., business and tourist arrivals) or who enter via the Visa Waiver Program.⁵ These entries constitute the large majority of nonimmigrant arrivals who enter the United States on a visa or through the Visa Waiver Program, which is the main population of interest for this study.⁶ Expanding the pre and post-9/11 time

⁴ Although a comprehensive inventory of the new security procedures is beyond the scope of this paper, a thorough overview of these changes can be found in Yale-Loehr et al., (2005). Procedures enacted to screen travelers prior to entry into the United States, such as biometric identification, affected travelers from VWP and non-VWP countries alike. Most of the procedures, however, only impacted travelers from non-VWP countries. For example, one important change eliminated discretion with respect to consular face-to-face interviews. Prior to 2003, U.S. State Department consular officers had discretion to waive an interview requirement with visa applicants, but in May 2003, a directive was issued to consular officers that eliminated such discretion for almost all visa applicants. The fact that the directive was issued as late as May of 2003 is consistent with the idea that some significant security screening procedures were gradually rolled out over time. In this case, the effect of such a procedure may not be captured by the time frame considered by Neiman and Swagel (2009).

⁵ Note that we refer to "arrivals" as opposed to "people." Available data are counts of number of entries into the United States, not the number of distinct individuals who entered in a particular month or year. Arrivals thus can include multiple entries of the same person in a given time period.

⁶ International travelers who arrive on a visa must complete an I-94 form; VWP travelers must fill out an I-94W form, though this requirement is now being phased out and automated through the Electronic System for Travel Authorization (ESTA) program, which began implementation after 2007. The I-94 and I-94W forms are used to provide a record of entry into and exit out of the United States. However, the large majority of non-immigrant arrivals are Canadian and Mexican citizens who do not submit an I-94 form. I-94 arrivals can be distinguished by whether the traveler is coming for a short trip for business or pleasure reasons, and if the traveler is a "resident nonimmigrant." The latter group includes people who are not permanent immigrants but who will reside in the United States for longer than a short period of time such as foreign students, temporary workers (e.g., H1B visa holders), intra-company transferees, exchange visitors, and diplomats. Short-trip arrivals constitute almost 90% of all I-94 arrivals. Finally, note that our use of the term "overseas" indicates that we exclude from the analysis all Mexican and Canadian arrivals who fill out an I-94 form, so that only arrivals from countries with no land border with the United States are included.

frame beyond that used by Neiman and Swagel allows for a more robust estimate of the impact of the VWP program on arrivals over time.⁷ Holding all else constant, if VWP status has a positive and significant impact on arrivals in the post-9/11 period, then this would be consistent with the view that travelers from non-VWP countries responded differently to the post-9/11 security protocol than did VWP travelers.

We test this hypothesis two ways. First, we use an econometric specification similar to that of Neiman and Swagel to test if VWP status had a significant impact on arrivals in the post-9/11 period (defined here as the years 2002 to 2007). Secondly, we estimate an alternative specification that models the recovery of arrivals in the post-9/11 period. As noted previously, a general recovery in total arrivals is evident in Figure 1. If, however, the recovery in arrivals differed by VWP status, holding all else equal, then such a finding would be consistent with a delayed security policy effect. The next section outlines the empirical estimation strategy in more detail.

III. Econometric Specification

To evaluate whether non-VWP arrivals declined more than VWP arrivals after 9/11, we analyze panel data on B visa and VWP arrivals from 69 countries for the period 1981-2007.⁸ Traditionally, the econometric specification of tourism and travel flows posits that the level of arrivals or trips is a function of various economic and demographic variables such as source-country population, per-capita income, and the real exchange rate.⁹ The approach employed here incorporates many of these variables but uses a two-pronged estimation strategy. First, we follow the approach of Neiman and Swagel and estimate a baseline model with an interaction term for VWP status and the post-9/11 environment.¹⁰ This baseline model specifies arrivals as a function of economic variables, country and time fixed effects, and dummy variables:

$$[1] \quad \ln(\text{Arrivals})_{i,t} = \alpha + \Gamma \begin{bmatrix} \text{Country}_i \\ \text{Time}_t \end{bmatrix} + \Phi \begin{bmatrix} \ln \text{GDP}_{i,t} \\ \ln \text{Xrate}_{i,t} \end{bmatrix} + \beta_1 \text{Post9/11}_{i,t} + \beta_2 \text{VWP}_{i,t} + \beta_3 (\text{Post9/11} * \text{VWP})_{i,t} + \varepsilon_{i,t} ,$$

where parameter α is the model intercept; Γ is common country and time fixed effects parameters; Φ represents coefficients on the economic control variables, natural log of real GDP and the real exchange rate; β_1 is a parameter for the post-9/11 environment dummy variable, which equals one for the years 2002 through 2007 and zero otherwise; β_2 is a parameter for VWP status, which indicates whether country i was a participant in the VWP at time t or not; β_3 is the parameter for the interaction between the post-9/11 environment and VWP status; and $\varepsilon_{i,t}$ is an error term. The key parameters of interest

⁷ Extending the time period back to 1981, which is well before the Visa Waiver Program began, is necessary in order to avoid perfect collinearity between country and time fixed effects and a country's VWP status. Introducing this variation enables us to estimate the impact of the Visa Waiver Program on arrivals in a more robust way.

⁸ Our sample, like Neiman and Swagel's sample, contains 22 VWP countries (Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, and the United Kingdom). Our and Neiman and Swagel's non-VWP country samples share in common 23 non-VWP countries (Belize, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Hungary, India, Indonesia, Iran, Israel, Jamaica, Jordan, South Korea, Malaysia, Morocco, Peru, Philippines, Poland, Romania, South Africa, Thailand, and Turkey.) Our sample also contains 24 non-VWP countries that Neiman and Swagel's sample does not have (Antigua-Barbuda, Argentina, The Bahamas, Barbados, Brazil, a China aggregate (PRC/Hong Kong/Taiwan), Dominica, Dominican Republic, Egypt, El Salvador, Guatemala, Guyana, Haiti, Honduras, Kuwait, Nicaragua, Nigeria, Pakistan, Panama, Paraguay, Saudi Arabia, Trinidad and Tobago, Uruguay, and Venezuela.) Neiman and Swagel's sample includes 16 non-VWP countries that we do not, including 10 countries of the former Soviet bloc that did not exist as independent countries prior to 1992, and 6 countries for which data on economic factors could not be obtained back to 1981.

⁹ The traditional approach is reviewed in detail in Witt and Witt (1992) and Song et al (2009). Travel flows have also been empirically analyzed using the gravity model and nested choice approaches. See Eilat and Einav (2004). Zhou et al (2004) analyze tourism arrivals to Hawaii using a cointegration approach, and they model the tourism industry supply side as well as the demand side.

¹⁰ Neiman and Swagel (2008) show how this specification can be derived from first principles in the same way that Anderson and van Wincoop (2003) derive a gravity model for analyzing trade in goods.

are parameters β_1 and β_3 , which capture the effects of the post-9/11 environment on arrivals from non-VWP and VWP countries, respectively. This specification implicitly imposes a fixed-environment assumption because it captures the average impact of the post-9/11 environment on VWP and non-VWP countries.

The specification presented in Equation (1) can be thought of as a “fixed environment” model, because it treats the change from pre- to post-9/11 environments as a one-time shift, so that the difference between VWP and non-VWP arrivals in the post-9/11 period is an average difference over the entire period.¹¹ However, if the difference between VWP and non-VWP arrivals emerges over time, then estimating the average difference between VWP and non-VWP arrivals may hide this variation. This type of averaging bias is particularly likely if the initial drop in arrivals immediately after 9/11 is similar enough in magnitude for both sets of countries that it dominates any changes that may have emerged later.

The second prong of our estimation strategy addresses this issue by estimating a quadratic time trend interaction model that explicitly allows arrivals from VWP and non-VWP countries to have separate recovery paths during the post-9/11 period. As discussed, many of the security procedures implemented after 9/11 were rolled out gradually between 2001 and 2003. Thus, differences between VWP and non-VWP arrivals may not emerge until after 2003. The quadratic time trend model allows us to test this possibility in a straightforward, empirically-minded way. If, for example, arrivals did not recover significantly between 2002 and 2007, the results from the quadratic model will indicate this. If arrivals did significantly recover during this period, the quadratic model can be expanded to include additional interactions to compare the recovery levels of VWP and non-VWP arrivals. While the econometric details and calculations of the quadratic interaction model are slightly more complicated, the model enables us to assess whether recovery levels differed between VWP and non-VWP countries. Equation (2) presents the quadratic interaction model.

$$[2] \quad \ln(\text{Arrivals})_{i,t} = \alpha + \Gamma \begin{bmatrix} \text{Country}_i \\ \text{Time}_t \end{bmatrix} + \Phi \begin{bmatrix} \ln \text{GDP}_{i,t} \\ \ln \text{Xrate}_{i,t} \end{bmatrix} + \beta_1 \text{Post9/11 Trend}_{i,t} + \beta_2 \text{Post9/11 Trend}^2_{i,t} + \beta_3 \text{VWP}_{i,t} + \beta_4 (\text{Post9/11 Trend} * \text{VWP})_{i,t} + \beta_5 (\text{Post9/11 Trend}^2 * \text{VWP})_{i,t} + \mathbf{v}_{i,t}$$

The common time, country, and economic control variables are the same as those outlined in Equation (1) above.¹² The key difference is that Equation (2) includes a quadratic time trend for the post-9/11 period (2002-2007) and interacts VWP status with these time trends. The value of the time trend equals 0 during the period 1981-2001, 1 in 2002, and increases incrementally to 6 in 2007.¹³ Equation (2) contains all the information necessary to calculate and statistically compare recovery levels for VWP and non-VWP arrivals in the post-9/11 period. The recovery levels for VWP and non-VWP arrivals are relative to their pre-2002 levels. Thus, when the VWP and non-VWP recovery levels and their confidence intervals are graphed over time, we can determine when they returned to their pre-2002 levels. These recovery levels are presented and discussed in the next section.

Before proceeding to the findings, it should be noted that before Equations (1) and (2) were estimated, several econometric diagnostic tests were performed on the data. Econometric issues that pose potential complications for estimating these equations include cross-sectional dependence of overseas travel and economic covariates, residual autocorrelation, and the presence of unit roots.

¹¹The interaction specification of Equation (1) has an interpretation that is distinct from non-interaction models. The presence of the interaction term changes the standard interpretation of coefficients on the dummy variables. In order to obtain a quantitative estimate of the actual impact of the post-9/11 environment on arrivals from VWP countries, the marginal effect of the interaction term coefficient, β_3 , is needed. We use appropriate equations to calculate this marginal effect and its adjusted variance. The formal mathematical notation for these formulas are available upon request and are presented in a separate, more technical, version of this paper.

¹²Time (year) dummy variables are included only for the years 1981-2001 and are excluded for 2002-2007 to avoid perfect collinearity and overfitting the sample data.

¹³The specification presented in Equation (2) is slightly more complicated than typical quadratic models given the additional VWP interaction terms. The substantive interpretation of the recovery levels in Equation (2) requires that the marginal effect of the quadratic term be estimated. The formulas for the calculations of these marginal effects are available upon request from the authors.

Cross-sectional dependence was found to be present in our econometric models, and we control for it, via Pesaran's (2004) recommendation, by including cross sectional averages of the economic variables in the estimating equations. We also control for the presence of residual autocorrelation using Driscoll-Kraay standard errors. Various diagnostic tests also suggest that the data are not characterized by unit root processes.¹⁴

IV. Findings

Table 1 reports the results of our econometric analysis of annual nonimmigrant arrivals for the period 1981-2007 for Equations (1) and (2).¹⁵ The results listed under the heading "Fixed-environment" specification broadly replicate the Neiman-Swagel findings. The results under the label "Quadratic trend specification" report the recovery for VWP and non-VWP arrivals in the post-9/11 time period as estimated by Equation (2). Below, we discuss the results starting with the fixed-environment model.

For the fixed-environment model, the coefficient on the variable labeled *Post-9/11 dummy* captures the impact of the post-9/11 environment on arrivals from non-VWP countries only. The specifications of Models 1 and 2 in Table 1 differ based on the inclusion or exclusion of time fixed effects, which has the effect of either dampening or increasing the estimated coefficient on the *Post-9/11 dummy* variable. Regardless of the relative magnitude, the results indicate that arrivals from non-VWP countries declined by 27 percent (in Model 1) and by 48 percent (in Model 2) relative to pre-9/11 levels. These estimates are highly statistically significant ($p < .01$), but are unsurprising given the descriptive evidence presented in Figure 1 above.

The coefficient on the *VWP dummy* in Table 1 captures the impact of a country's VWP status on arrivals in the pre-9/11 period (i.e., 1981 to 2001). Results from Models 1 and 2 suggest that, prior to 9/11 and holding all else constant, arrivals from VWP countries were roughly 11-14 percent higher on average than arrivals from non-VWP countries. The coefficients on VWP status are both positive and statistically significant ($p < .05$ in Model 1 and $p < .01$ in Model 2). Interestingly, this result is different from that found in Neiman and Swagel's study. In their analysis, the impact of VWP status on arrivals prior to 9/11 was smaller in magnitude and statistically insignificant. The main reason for this difference is due most likely to the time sample used in this study. Because our time sample extends back several years prior to the creation of the Visa Waiver Program in 1986, we reduce the collinearity between VWP status and country- and time- specific effects.¹⁶ Reducing this collinearity (which is near perfect in the Neiman-Swagel study) enables us to obtain a more robust estimate of the impact of VWP status over time. More importantly, these estimates provide a baseline for examining whether VWP status became more important in the post-9/11 period, which is this paper's main purpose. To this end, the coefficient on the interaction term labeled *Post-9/11*VWP dummy* is the key parameter of interest. This term captures whether the decline in arrivals from VWP countries was less severe than was the downturn for non-VWP countries after 9/11. The interaction coefficient is not statistically significant at conventional levels, indicating that VWP and non-VWP arrivals did not significantly differ from each other in the post-9/11 period.

¹⁴Formal diagnostic test results are available upon request.

¹⁵The results presented in Table 1 are our preferred variants of the fixed-environment and quadratic-trend specifications. Several other variants of each specification were estimated, and these results are available upon request. These variants differ from the presented estimations primarily according to the inclusion or exclusion of country-specific trend terms and time fixed effects. In most cases, the models that included country-specific trend terms indicated that such trend terms were statistically insignificant and, therefore, thought to be misspecified. As such, those results are not highlighted here.

¹⁶The original Visa Waiver Program was passed as part of the Immigration Reform and Control Act (IRCA) of 1986. Great Britain was the first country to join the VWP in 1988.

Table 1.

Econometric Results for Impact of Post-9/11 Environment on B/VWP Arrivals 1981–2007

<i>Dependent Variable: ln (Total Arrivals)</i>	Fixed-environment specification (Equation 1)		Quadratic trend specification (Equation 2)	
	Model 1	Model 2	Model 3	Model 4
In GDP.	0.574 (0.058)***	0.577 (0.058)***	0.571 (0.057)***	0.583 (0.056)***
In Real Exchange Rate	-0.337 (0.065)***	-0.333 (0.064)***	-0.338 (0.066)***	-0.337 (0.065)***
<i>Post-9/11 dummy</i>	-0.269 (0.010)***	-0.468 (0.058)***	– –	– –
<i>VWP dummy</i>	0.114 (0.035)**	0.145 (0.038)***	0.140 (0.038)***	0.110 (0.036)**
<i>Post-9/11*VWP dummy</i>	0.058 (0.041)	0.043 (0.041)	– –	– –
Marginal Effect of Post-9/11*Visa Waiver Program[†]	-0.212 (0.037)***	-0.425 (0.031)***	– –	– –
<i>Post-9/11 Trend</i>	– –	– –	-0.206 (0.028)***	-0.144 (0.023)***
<i>Post-9/11 Trend Squared</i>	– –	– –	0.017 (0.005)***	0.004 (0.002)
Marginal Effect of Trend + Trend Squared[†]	– –	– –	-0.171 (0.019)***	-0.137 (0.020)***
<i>Post-9/11 Trend*VWP dummy</i>	– –	– –	– –	-0.013 (0.012)
<i>Post-9/11 Trend Squared*VWP dummy</i>	– –	– –	– –	0.008 (0.002)**
Marginal Effect of Trend*VWP + Trend Squared*VWP[§]	– –	– –	– –	-0.134 (0.023)***
Intercept	11.642 (0.013)***	11.742 (0.029)***	11.702 (0.028)***	11.628 (0.032)***
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	No	No	Yes
N	1,863	1,863	1,863	1,863
R ² (within group).	0.57	0.56	0.56	0.57

Note: ***=statistical significance at 1% level, **at 5% level.

[†] The coefficient on the interaction term is the calculated marginal effect, which is given by the sum of the raw interaction term coefficient and the Post-9/11 coefficient. The standard error of the interaction terms is calculated based on an adjusted variance formula available upon request from the authors.

[†] The coefficient on the interaction term is the calculated marginal effect, which is given by the sum of the trend and trend squared terms. The standard error of the interaction terms is calculated based on an adjusted variance formula available upon request from the authors.

[§] The coefficient on the interaction term is the calculated marginal effect, which is given by the sum of the Trend*VWP interaction term and the Trend squared*VWP interaction term. The standard error of the interaction terms is calculated based on an adjusted variance formula available upon request from the authors.

This finding is consistent with that of Neiman and Swagel (2009), who find no statistically significant difference between VWP and non-VWP arrivals for the period spanning September 2001 to May 2003. The original Neiman-Swagel finding is thus robust to estimating a similar specification while using annual data for the period 1981-2007.

The estimates summarized in Table 1 under the fixed-environment heading can also be used to calculate the actual decline in VWP arrivals after 9/11. Results for Model 1 in Table 1 suggest that the estimated decline in VWP arrivals relative to the pre-9/11 level was roughly 21 percent and highly statistically significant. A 21 percent decline in VWP arrivals is smaller than the 27 percent estimate for non-VWP arrivals. However, these estimates are not significantly different from each other, and results for the fixed-environment specification fail to find evidence of a significant differential between VWP and non-VWP arrivals after 9/11. Again, these results are consistent with those of Neiman and Swagel.

The results from the quadratic trend specification, however, paint a more variegated picture of arrivals in the post-9/11 period. As discussed previously, significant differences between VWP and non-VWP arrivals may have emerged after 2003 when the last of the major security procedures were implemented. Prior to that, VWP and non-VWP arrivals may not have exhibited different patterns. The quadratic time trend interaction model outlined in Equation (2) permits us to estimate a recovery level for VWP and non-VWP arrivals and statistically compare them over the sample period. The key question is how quickly arrivals from VWP and non-VWP countries returned to their pre-9/11 levels. If arrivals from non-VWP countries recover more slowly than do those from VWP countries, this may be consistent with a delayed response to security procedures related to visa issuance. It should be emphasized, however, that such a finding, while consistent with such impacts, does not prove their existence, and we discuss this further in the conclusion.

Results for the quadratic time trend interaction model are summarized in Table 1 under Models 3 and 4. Model 3 first tests the validity of the quadratic specification for nonimmigrant arrivals. As such, it excludes the VWP interaction term and only reports results for the quadratic time trend, which means that this model estimates the recovery level for all arrivals regardless of VWP status. In general, if the coefficients of the quadratic term have the theoretically expected signs and are statistically significant at conventional levels, then this is considered reasonable validation of the model. Accordingly, the results from Model 3 provide evidence that the quadratic time trend model is a reasonable econometric specification. Not only are the coefficients on the *Post-9/11 trend* and *Post-9/11 Trend Squared* variables correctly signed (negative and positive, respectively), but they are both highly statistically significant ($p < .01$) at conventional levels. Substantively, the estimated coefficients suggest that the negative post-9/11 trend in arrivals eventually began to rebound during the 2002 to 2007 period, holding all other variables constant. This recovery pattern is consistent with Figure 1, which shows a similar recovery for arrivals from VWP and non-VWP countries during the same period.

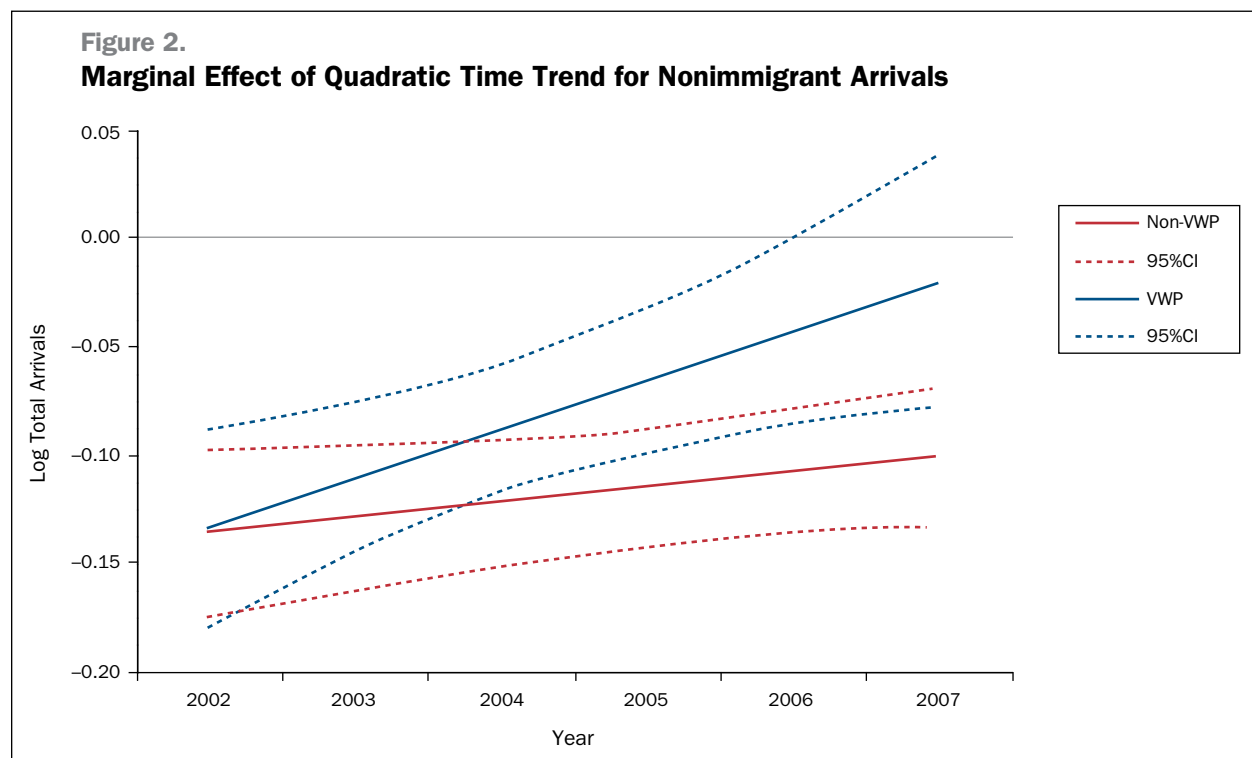
The key relationships of interest are the recovery levels of VWP and non-VWP arrivals in the post-9/11 time period. Model 4 in Table 1 provides results for the full quadratic specification that includes the VWP interaction terms. This specification enables us to statistically compare the recovery levels for VWP and non-VWP arrivals. Values for the variables labeled *Marginal Effect of Trend + Trend Squared* and *Marginal Effect of Trend*VWP + Trend Squared*VWP* give the starting values of the estimated recovery levels for non-VWP and VWP arrivals, respectively. It is important to remember that for VWP and non-VWP countries, the parameter estimates are relative to their pre-9/11 levels (i.e., prior to 2002). What is clear from the results for Model 4 is that both marginal effect estimates are negative and highly statistically significant at conventional levels. These initial results establish the foundation for the additional calculations needed to trace the recovery levels for VWP and non-VWP arrivals, which are calculated by multiplying the estimated coefficients by different values of the post-9/11 time trend (which has values 1 through 6 and corresponds to the years 2002 to 2007). The resulting point estimates and confidence intervals can then be used to compare VWP and non-VWP recovery levels against their pre-2002 levels.¹⁷

Figure 2 below graphs the results of these recovery level calculations. The blue solid line depicts the estimated recovery level for VWP countries from 2002 to 2007, and the dashed blue lines are the calculated 95 percent confidence intervals. The solid and dashed red lines are the non-VWP recovery level and 95 percent confidence intervals, respectively. Initial starting values for VWP and non-VWP

¹⁷The mathematical details of these calculations are available upon request from the authors.

countries are roughly -13 percent and -14 percent relative to the pre-2002 level. As Figure 2 illustrates, the recovery level grew for both VWP and non-VWP arrivals after 2002. The zero line on the Y axis of Figure 2 represents the pre-2002 baseline. When the upper confidence interval of the point estimates crosses the zero line, the recovery level is statistically insignificantly different from zero, and the level of arrivals has returned to its pre-2002 level, holding all other variables constant.

Visual inspection of Figure 2 indicates that VWP nonimmigrant arrivals returned to their pre-2002 level before non-VWP arrivals did. The upper confidence interval for VWP arrivals crosses the zero line in 2006. This suggests that, by 2006, arrivals from VWP countries were not significantly different from their pre-2002 average, holding all other variables constant. The results are different for non-VWP arrivals. At no point in Figure 2 does the upper confidence interval for non-VWP arrivals cross the zero threshold. Substantively, this means that non-VWP arrivals remained consistently below their pre-2002 average between 2002 and 2007. Intuitively, the difference in the recovery levels is also evident by the widening space between the slopes of the recovery trajectories for VWP and non-VWP arrivals. The gap between the two sets of countries grows because of the steepness of the VWP recovery path relative to the much flatter path for non-VWP arrivals. The evidence presented in Figure 2, therefore, indicates that VWP arrivals returned to their pre-9/11 level more quickly than did non-VWP arrivals. This evidence is consistent with the idea that travelers from non-VWP countries responded differently than travelers from VWP countries to the post-9/11 security environment, and that the resulting impact on travel to the United States may not have been statistically detectable with a shorter time sample. These general findings are also robust to the inclusion/exclusion of certain countries from the analysis.¹⁸



To give a more concrete interpretation of the results, we converted the estimated recovery levels into expected levels of arrivals by VWP status in Table 2. Converting the log recovery levels into actual numbers of arrivals gives an intuitive and straightforward interpretation of the findings. In Table 2, the VWP and non-VWP columns give the yearly expected number of arrivals associated with the recovery levels as graphed in Figure 2. For example, the expected number of VWP arrivals in 2003 based on the full-sample estimate was 111,367 and gradually increased to 122,782 in 2007. The column labeled

¹⁸Although the results of this sensitivity analysis are not reported in this paper, they are available from the authors upon request.

“% below pre-2002 base” gives the percentage degree to which arrivals in the post-9/11 period were below the base value (the pre-2002 average level). The percentages in bold font are statistically different from the pre-2002 zero base at the 5 percent significance level. The expected number of arrivals for non-VWP countries also rose gradually from 97,588 in 2002 to 101,563 in 2007, but the latter value is still below the pre-2002 baseline value of 113,034 at the 5 percent significance level. Non-VWP countries were therefore statistically below their pre-2002 levels through 2007, but VWP arrivals were not by 2006. These results differ from the results of the fixed-environment specification and are consistent with the notion that travelers from non-VWP countries may have responded differently to the post-9/11 security environment than did travelers from VWP countries.

Table 2.
Estimated Recovery of Total Nonimmigrant Arrivals Post 2001 by Visa Waiver Status

Year	VWP countries	(% below base)	Non-VWP countries	(% below base)
Pre-2002 base	125,328		113,034	
2002.	108,514	-13%	97,588	-14%
2003.	111,367	-11%	98,383	-13%
2004.	114,221	-9%	99,178	-12%
2005.	117,075	-7%	99,973	-12%
2006.	119,928	-4%	100,768	-11%
2007.	122,782	-2%	101,563	-10%

Note: Arrivals refer to the expected number of arrivals from the average country as estimated by the quadratic time function for VWP and non-VWP countries holding all other variables constant. The numbers in the table should be compared to the pre-2002 base number of arrivals for VWP and non-VWP countries.

The column labeled “% below base” indicates the degree to which the expected value of arrivals is below the pre-2002 base. Percentages in bold font indicates that the difference is statistically significant at a significance level of $p < .05$.

V. Conclusion

The results presented in this paper provide some evidence that nonimmigrant travelers to the U.S. may have responded differently to the post-9/11 security environment according to VWP status. This finding is at odds with the results of Neiman and Swagel (2009), who find no significant difference in arrivals by VWP status after 9/11. The post-9/11 time frame utilized in the Neiman-Swagel study covered monthly data between 2001 and 2003. The last of the new administrative procedures pertaining to security, however, were not implemented until late 2003, which may not have allowed for enough time to detect differences in arrivals by VWP status. The longer time sample used in this paper allows us to expand on Neiman and Swagel’s approach in two ways. First, we are able to replicate their results using the fixed-environment assumption of their econometric model. Even with the expanded time sample, the fixed environment model confirms the original Neiman-Swagel finding. Secondly, and more importantly, however, the expanded time sample enables us to incorporate the recovery in arrivals that took place after 2003 into our econometric model. When we estimate this model, the results indicate that differences in recovery levels by VWP status are evident in the expanded post-9/11 period.

By explicitly modeling the recovery in arrivals that took place after 2002, we are able to compare how quickly the recovery occurred for both VWP and non-VWP countries, holding all other factors constant. The fact that VWP arrivals returned to their pre-9/11 level by 2006 while non-VWP arrivals did not is consistent with the idea that the post-9/11 environment may have impacted sending countries differently. This result provides a potentially more nuanced amendment to the original Neiman-Swagel findings. Although we validate their original finding by showing that the level of arrivals did not differ significantly by VWP status in the post-9/11 environment, this does not mean that no differences are evident. Rather, we argue that the relative recovery levels, which is not addressed

by the fixed-environment model, is where the differences emerge. The results presented here are consistent with this expectation.

Despite our findings, it is necessary to note an important caveat. It is possible that the arrivals recovery gap that we found might also be due to systematic change in relative preferences of VWP versus non-VWP potential travelers that had nothing to do with changes in security procedures. Such preferences may be simple matters of taste that are evident in the data, but are not captured or closely related to the variables used to estimate our econometric models. Under this scenario, preferences of non-VWP travelers to come to the United States may not have recovered to the same extent as preferences of VWP travelers. Empirically, we cannot determine what part of the recovery gap is due to reactions to enhanced security procedures, systematic divergence in preferences unrelated to these considerations, or any other factor that may have varied systematically between these two groups of countries.

This point notwithstanding, the results provide evidence that the recovery level of arrivals from VWP and non-VWP countries did differ significantly in the post-9/11 period by 2006. This suggests that the fixed-environment model may be masking differences in arrival patterns that occurred later in the post-9/11 period. To build confidence in our interpretation of these results, however, additional data on the security procedures implemented after 9/11 are needed. Data that might be useful include country-specific visa refusal rates, the admission denial rate at the border, and wait times for a visa interview with a consular officer. If these data were available as explanatory variables for a sufficiently long time sample across a large sample of countries, then more robust empirical tests could be estimated. Future work could use such data to more accurately pinpoint how specific procedures impact travel to the United States.

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