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# Tourism and Economic Development: Evidence from Mexico's Coastline†

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*Tourism is a fast-growing services sector in developing countries. This paper combines a rich collection of Mexican microdata with a quantitative spatial equilibrium model and a new empirical strategy to study the long-term economic consequences of tourism both locally and in the aggregate. We find that tourism causes large and significant local economic gains relative to less touristic regions that are in part driven by significant positive spillovers on manufacturing. In the aggregate, however, these local spillovers are largely offset by reductions in agglomeration economies among less touristic regions, so that the national gains from trade in tourism are mainly driven by a classical market integration effect.* (*JEL* L60, L83, O14, O18, R11, Z31, Z32)

A conventional view in the literature on economic growth and development is that the production of traded goods is subject to dynamic productivity improvements, whereas the services sector is perceived to be more stagnant.[1] In line with this view, the locus of agglomeration economies is generally assumed to be the manufacturing sector, rather than services. This asymmetry has important implications for the growth strategies of developing countries, and whether they should prioritize the development of traded goods producing sectors. At the same time, there is relatively little empirical evidence on the economic consequences of the development of the services sector in developing countries, and whether the reallocation of factors of production into services can give rise to adverse long-term effects both locally and in the aggregate.[2]

This paper sets out to study the economic consequences of tourism, a fast-growing services sector in developing countries. Tourism involves the export of otherwise non-traded local services by temporarily moving consumers across space, rather than

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[1] This view is in the tradition of Baumol (1967). See Herrendorf, Rogerson, and Valentinyi (2014) for a review of the recent literature, and McMillan and Rodrik (2011) for an analysis in the context of developing countries.

[2] See, for example, Copeland (1991) for an early theoretical discussion of tourism as a potential "Dutch disease."

shipping goods. This form of trade has become an important channel of globalization. Tourism exports of developing countries have grown at an average annual rate of 11 percent over the period 1982–2012. In the past decade, they exceeded manufacturing exports for 40 percent of developing countries, and agricultural exports for one-half of them. Unsurprisingly in this context, tourism has attracted widespread policy attention.[3]

Our study is based on the empirical context of Mexico, a country where tourism has grown to become an important economic force starting in the 1950s and 1960s. Since the development of tourism in Mexico has been driven by both international and domestic tourism flows, we set out to study the consequences of both cross-border and inter-regional tourism integration, and decompose the gains from tourism into an international and domestic component. Given the historical context, our theoretical framework incorporates tax-financed government investments that facilitate the development of tourism. It also explicitly captures the possibility that the development of the services sector due to tourism may have adverse long-run consequences by introducing different sources of local production externalities. By altering the scale of production across sectors, both locally and in the aggregate, tourism can have different implications for productivity. If, following the standard assumption, agglomeration economies mainly operate within the manufacturing sector, the aggregate gains from tourism can be diminished or overturned compared to the neoclassical gains from tourism trade. On the other hand, if spillovers also operate at the cross-sector level, that is from the development of services to traded goods, then the gains from tourism can be reinforced. Building on the tools developed in single-sector frameworks, we develop a model and methodology to investigate these cross-sectoral interactions, and quantify their implications both at the local level and in the aggregate.

In answering these questions, the paper contributes to the growing empirical literature that exploits within-country variation to credibly identify the effects of economic shocks on relative regional economic outcomes (e.g., Autor, Dorn, and Hanson 2013; Mian and Sufi 2009; Topalova 2010). While certainly of interest in its own right, this approach generally does not allow to shed light on the corresponding aggregate implications, as those are being soaked up by the intercept or time fixed effects. This shortcoming is particularly acute when the objective is to estimate long-run effects, as workers over time are mobile to arbitrage away regional variation in real incomes.[4] To make progress on this trade-off, we combine an empirical analysis that exploits within-country variation with a quantitative spatial equilibrium model. This allows us to explore the aggregate implications that are consistent with the observed local effects, and to quantify the underlying channels.

At the center of the analysis lies the construction of a rich collection of microdata. We assemble a database containing (i) municipality-level hotel revenues, employment, population, wages, and output by sector from the Mexican Censos Económicos in 1998 and 2008 and the Mexican population censuses in 2000 and 2010; (ii) a long time series of population census data for consistent spatial units

[3]Figures are based on UNCTAD statistics (http://unctad.org/en/pages/Statistics.aspx). See, e.g., Hawkins and Mann (2007) for a review of tourism policies.

[4]This limitation and the need for a more structured approach to get at general equilibrium (GE) effects has been highlighted by, for example, Kline and Moretti (2014), Donaldson and Hornbeck (2016), and Caliendo, Dvorkin, and Parro (2015).

going back to 1921; (iii) a geographic information systems (GIS) database including remote sensing satellite data at a resolution of 30 × 30 meter pixels covering roughly 9,500 km of Mexican coastline during the 1980s and 1990s; (iv) local public finance data on investments in tourism development at the municipality level; and (v) panel data on bilateral tourism exports and relative prices covering 115 countries over the period 1990–2011.

Armed with this database, the analysis proceeds in two parts. In the first part, we provide empirical evidence on the local effects of tourism on current-day municipality-level population, employment, local GDP by sector, and Mincerized wages. Tourism in Mexico has had more than half a century to materialize into today's observed distribution of regional economic outcomes. In this context, our empirical strategy aims to use cross-sectional variation to capture the long-term effects of tourism exposure on relative regional economic outcomes. To do so convincingly, we exploit geological, oceanographic, and archaeological variation in ex ante local tourism attractiveness across the Mexican coastline. We take inspiration from the tourism management literature arguing that variation in tourism activity is to a large extent determined by the presence and quality of a specific set of local natural and cultural characteristics (Weaver and Oppermann 2000, Leatherman 1997). Using the GIS and satellite data, we construct measures of beach quality, such as the presence of nearby offshore islands or the fraction of onshore coastline covered by picturesque white sand, and obtain information on the presence of pre-Hispanic archaeological ruins across Mexican municipalities.

In the reduced-form regressions (outcomes on tourism attractiveness), the identifying assumption is that the presence of nearby islands, the fraction of coastline covered by white sand, or the presence of archaeological ruins do not affect local economic outcomes relative to other coastal locations except through their effect on local tourism attractiveness. We assess the validity of this assumption in several ways. We report how point estimates are affected by the inclusion of predetermined municipality controls, and estimate placebo falsification tests in periods before beach tourism had become a discernible economic force in Mexico. We also verify the extent to which our measures of tourism attractiveness are correlated with current-day estimates of residential amenities, and corroborate the cross-sectional results with shorter-term panel variation using the interaction of national tourist arrivals to Mexico with local measures of tourism attractiveness.

Using this design, we find that variation in local tourism attractiveness has strong and significant positive effects on municipality total employment, population, local GDP, and wages relative to less touristic regions. When using the measures of tourism attractiveness as instruments for the sum of municipality hotel revenues, we find that a 10 percent increase in local hotel revenues leads to a 2.5 percent increase in municipality total employment, and a 4 percent increase in nominal municipality GDP in today's cross section of Mexican municipalities. These effects are in part driven by sizable local multiplier effects on manufacturing. We find that a 10 percent increase in local hotel revenues leads to a 3.9 percent increase in local manufacturing GDP. This effect holds for manufacturing sectors that are not intensively used as inputs in the production of tourism-related services.

When estimating these local effects in the IV specification, we impose additional assumptions compared to the reduced-form regressions. The IV's exclusion restriction is that variation in ex ante tourism attractiveness affects local outcomes only through its effect on local tourism activity. However, it is likely that attractiveness increases public investment in local tourism development, and it could be the case that these investments affect local outcomes not only through their intended effect of increasing tourism activity. We use additional data on local public investments in tourism to further investigate this channel empirically, and to inform the role of public investments in tourism as part of the structure of our model. We also note that the observed positive effect of tourism on local manufacturing production does not by itself provide prima facie evidence for positive productivity spillovers from tourism development onto manufacturing. In a world with trade costs, labor mobility, and input-output linkages, the net effect of tourism development on local manufacturing is a priori ambiguous and could be positive through neoclassical demand linkages alone.

In the second part of the paper, we then investigate these channels and shed light on their aggregate implications through the lens of a quantitative spatial equilibrium model. We build on the theoretical framework developed by Allen and Arkolakis (2014), Ahlfeldt et al. (2015), and Redding (2016), and extend it in several dimensions to capture the economic forces that are relevant in our context. In addition to trade in goods and migration across regions, the model features trade in tourism-related services via traveling consumers across regions and countries, input-output linkages between tourism, manufacturing, and non-traded services, public tax-financed capital investments as inputs to tourism development, and local production externalities.

We allow for manufacturing production to be subject to both within- and cross-sector spillovers. The within-sector spillover is the standard source of agglomeration economies in economic geography models, and captures the extent to which a larger scale in local manufacturing production is beneficial for manufacturing productivity. In its presence, reducing the scale of manufacturing as the economy reallocates factors toward services leads to adverse productivity effects in the aggregate. This adverse effect works in the opposite direction of the neoclassical gains from falling frictions to tourism trade. On the other hand, the cross-sector spillover captures the extent to which a larger scale of the local services sector affects traded sector productivity. By increasing local services production, the development of tourism may generate long-run positive spillovers on traded goods production by, for example, improving access to business services for local firms, such as finance, accounting, or consulting, by loosening local credit constraints directly (through tourism revenues), or by facilitating contacts and business networks.[5] In the presence of such cross-sectoral agglomeration economies, tourism can give rise to gains in manufacturing productivity that would not have occurred otherwise.

To quantify these forces, we estimate the model parameters, and calibrate the model to current-day Mexico as a reference equilibrium. In particular, we estimate the intensity of the within- and cross-sector spillovers using an approach that combines model-based indirect inference with the exclusion restrictions of our instrumental variables (IVs). We find that both within- and cross-sector agglomeration economies are necessary to rationalize the observed local effects of tourism on

[5] See Francois and Hoekman (2010) for a review of the link between services trade and economic performance in other sectors.

Mexican regions, after accounting for a host of neoclassical GE linkages between tourism and manufacturing that the model captures. In addition to the conventional within-manufacturing agglomeration economies, we find that tourism, through its effect on the development of the local services sector, leads to positive spillovers on local traded goods production.

Armed with the calibrated model, we proceed to explore general equilibrium counterfactuals. We find that tourism causes significant gains to the average Mexican household that are in the order of 4.6 percent of household consumption after taking into account the cost of tax-financed investments in Mexican tourism development over the past decades. About 40 percent of these gains are driven by international tourism, and the remainder by domestic tourism across Mexican regions. Turning to the underlying channels, we find that about 60 percent of the observed effect on local GDP can be explained by neoclassical forces, including the direct effect due to local tourism expenditures and indirect effects on other sectors through migration and input-output linkages. The remainder of the local effect on GDP is driven by gains in local manufacturing activity due to both cross- and within-sector agglomeration forces. In the aggregate, however, we find that these spillover effects contribute relatively little (about one-tenth) to the estimated welfare gains. That is, while the presence of within- and cross-sector spillovers reinforce one another leading to the large observed reallocations of economic activity toward touristic regions, we find that they largely offset one another at the aggregate level, so that the aggregate gains from trade in tourism are mainly driven by a classical market integration effect.

Finally, an interesting difference emerges when we focus on the gains from international-only tourism. In this case, we find that the gains from tourism integration are somewhat dampened compared to what they would have been in the absence of agglomeration forces. In regions relatively more affected by international tourism, the reduction in the within-manufacturing scale effect outweighs the gains from the local expansion in services. In a framework featuring both within- and cross-sector agglomeration forces, we find that this result is driven by differences in the initial sectoral composition of the regions most affected by international tourism compared to domestic tourism. As a result, the gains from opening up to international tourism in the absence of agglomeration economies would be slightly larger (2.4 percent) compared to the gains that we estimate (1.8 percent).

This paper relates and contributes to the recent literature on trade and development (e.g., Topalova 2010; Donaldson 2018; Atkin, Faber, and Gonzalez-Navarro 2018). Relative to the existing literature, we focus on tourism, an important and fast-growing but so far understudied facet of globalization in developing countries. There is a small existing empirical literature that has analyzed cross-country data to shed light on the determinants and consequences of tourism.[6] In contrast, this paper leverages within-country variation to estimate the long-run effects of tourism on

[6] Eilat and Einav (2004) use panel data on bilateral tourism flows over time to estimate the effect of factors such as political risk or exchange rates on bilateral tourism demand. Sequeira and Maçãs Nunes (2008) use country-level panel data to estimate the effect of tourism specialization on country growth. Arezki, Cherif, and Piotrowski (2009) regress average country-level growth rates over the period 1980–2002 on a measure of tourism specialization in a cross section of 127 countries, and use the list of UN World Heritage sites as an instrumental variable for tourism specialization. More recently, McGregor and Wills (2017) use variation in surfing conditions to estimate positive local effects on nighttime lights.

both local and aggregate economic outcomes. The paper also relates to the literature that studies possible "Dutch disease" effects associated with natural resource booms by comparing regional outcomes within countries (e.g., Caselli and Michaels 2013, Allcott and Keniston 2018). Both the methodology we propose and the focus on tourism as a special kind of natural resource boom differ from the existing literature, but the economic questions are closely related.

Methodologically, the paper follows a recent but growing literature that uses quantitative spatial equilibrium models to analyze the welfare consequences of aggregate or local shocks, taking into account the frictions to trade and mobility between regions within countries (e.g., Redding 2016; Caliendo et al. 2018; Monte, Redding, and Rossi-Hansberg 2018; Bryan and Morten 2015; Caliendo, Dvorkin, and Parro 2015; Fajgelbaum et al. 2019; Adao, Arkolakis, and Esposito 2017; and Galle, Rodríguez-Clare, and Yi 2014).[7] We build on the framework developed by Allen and Arkolakis (2014) and Redding (2016) and extend the model and methodology in several dimensions to study the role of within- and cross-sector agglomeration externalities, a novel dimension in this class of quantitative frameworks. We combine the structure of the model with observed empirical moments to identify the strength of the agglomeration forces, close to the approach followed in a one-sector model in Ahlfeldt et al. (2015). Finally, our approach combines empirical estimates of the local effects with a more structured approach to get at general equilibrium effects, following recent work by Kline and Moretti (2014) and Donaldson and Hornbeck (2016).

The remainder of the paper proceeds as follows. Section I describes the background of tourism in Mexico and the data. Section II presents the empirical evidence on tourism's local effects. Section III presents the theoretical framework that guides the welfare analysis. Section IV presents the model calibration and the counterfactual analysis. Section V concludes.

## I. Background and Data

### A. *Tourism in Mexico*

According to Mexico's national accounts, tourism activity in Mexico has grown to account for about 10 percent of total GDP in recent years. The bulk of this activity is driven by coastal tourism: as reported in Table 1, two-thirds of total hotel revenues in Mexico are located in the 150 coastal municipalities (accounting for 14 percent of Mexico's population). Beach tourism started to emerge in Mexico during the 1950s and 1960s, about three decades after a devastating civil war had ended in the 1920s. By that time, the first generation of Mexican tourist destinations, such as the colonial port city of Acapulco on the Pacific coast and the border city of Tijuana in the North, started to emerge and to become popular in Hollywood and among the international jet set. The next generation of Mexican destinations for beach tourism appeared during the 1970s and 1980s, that witnessed the emergence of the Yucatan peninsula (e.g., Cancun) and other popular contemporary destinations such as

[7] Work by Ahlfeldt et al. (2015) and Allen, Arkolakis, and Li (2016) also follow closely related approaches, but focus on spatial equilibria within cities rather than within countries.

Table 1—Beach Tourism in Mexico

| | Number of municipalities | Sum of hotel revenues in 1998 and 2008 (thousands of pesos) | Share of national hotel revenues 1998 and 2008 |
|---|---|---|---|
| Inland municipalities | 2,305 | 46,070,000 | 0.365 |
| Coastal municipalities | 150 | 80,130,000 | 0.635 |

*Source:* Censos Económicos for 1998 and 2008

Los Cabos, Ixtapa, or Huatulco. As we further discuss in Section IIC, tourism development in Mexico, as in many other countries, was facilitated by significant public investments in local tourism infrastructure.

By 2014, Mexico received 29 million foreign visitors. According to the Mexican Secretariat for Tourism (SECTUR), this number was close to zero before the 1960s. US Americans account for the largest share of foreign tourists in Mexico (57 percent), followed by Canadians (14 percent) and Britons (3 percent). As is the case for most countries in the world, the majority of tourism activity in Mexico today is driven by domestic inter-regional visitors rather than international ones, with a share of roughly 80 to 20 percent in terms of revenues over recent decades according to the Mexican tourism satellite account. In this empirical context, our analysis sets out to quantify the gains from both domestic tourism integration across regions within Mexico and international tourism integration across borders, and to decompose the overall effect into its domestic and international components. Finally, tourism revenues in Mexico can be divided into different types of expenditure. According to the tourism satellite account, 13 percent are spent on artisanals and other goods, and the rest of tourist expenditure goes to local services, with accommodation (hotels and other temporary accommodation), restaurants, and transportation as the three main categories.

## B. *Data*

This subsection provides a brief overview of the main datasets used in the analysis. Online Appendix Table A.1 provides descriptive statistics and Figure 1 depicts the satellite and GIS data. Online Appendix Section 2 provides a more detailed description of the data and construction of variables.

We use municipality-level data from the Censos Económicos Comerciales y de Servicios to obtain local sales of hotels and other temporary accommodation (e.g., hostels) for two cross sections in 1998 and 2008. We combine this information with data from the Censos Económicos for the same years on total municipality GDP, total municipality wage bill, and GDP broken up by sector of activity. In the analysis, we interpret differences in log hotel sales across municipalities as effectively capturing proportional differences in total local tourism expenditures. The reason is that the available data for other tourist expenditures, such as restaurants or transport, do not distinguish between sales to local residents versus visiting nonresidents. The underlying assumption is that hotel sales are a constant share of tourist expenditure. As we discuss in Section IIC, we also examine this assumption using available data over time and across destinations (see online Appendix Tables A.2 and A.10).

We use IPUMS microdata from the Mexican Population Census in 2000 and 2010 to construct municipality-level total population and employment, as well

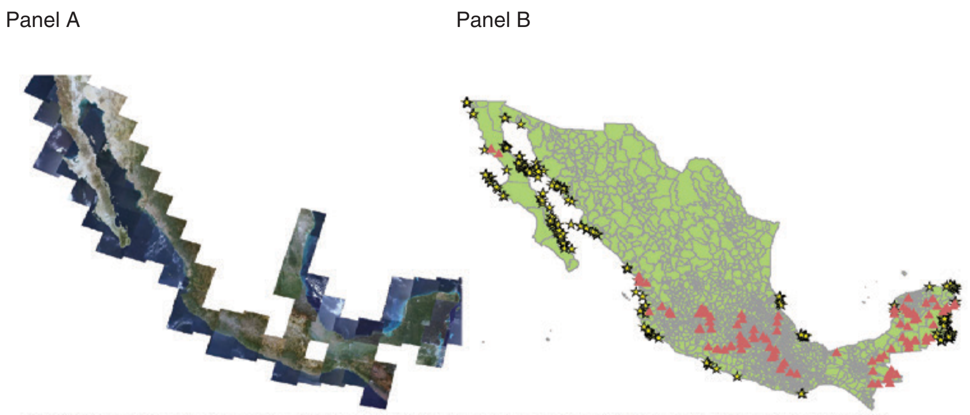


Figure 1. Beach Characteristics along the Coastline and Archaeological Ruins in Mexico

*Notes:* Panel A displays the remote sensing satellite data covering the Mexican coastline at a resolution of 30 × 30 meters. In panel B, the stars indicate the location of islands within 5 km from the Mexican coastline, and the triangles indicate the location of pre-Hispanic archaeological ruins. See Section I for discussion.

as individual-level wages including information on gender, education, age, and ethnicity. The IPUMS microdata provide us with 10 percent random census samples in addition to population weights that are linked to each observation. In addition to the two most recent census rounds, we use historical Mexican population census data for the years 1921, 1930, 1940, and 1950 in order to estimate a set of placebo falsification tests. To that end, we use INEGI's database Archivo Histórico de Localidades to construct spatial units for the year 2010 that we can trace back consistently to 1921. The historical census database provides us with municipality populations, but not employment.

The analysis also uses several GIS and satellite datasets. We use the earliest high-resolution satellite data from the Global Land Survey (GLS) 1990 dataset. The data are a consolidation of the best-quality LandSat imagery that were taken during the period of 1987–1997 over the coast of Mexico, at a resolution of 30 × 30 meter pixels and covering six different wavelength bands. When restricted to a 2 km buffer around the Mexican shoreline, these satellite data provide us with 6 raster data layers that each have approximately 52 million 30 × 30 meter pixels (panel A of Figure 1). We combine these satellite data with a number of additional GIS data layers that we obtain from the geo-statistics division of INEGI. These data include the administrative shape file of municipality boundaries for the 2010 population census, the position of the Mexican coastline, the Mexican terrestrial transportation network for the year 2009, the location of pre-Hispanic archaeological ruins, and the coordinates for each island feature within the Mexican maritime territory from the Mexican census of maritime land territory. Panel B of Figure 1 depicts the position of islands within 5 km of the Mexican coast and the location of pre-Hispanic ruins.

We obtain information on public investments in local tourism development at the municipality level from INEGI's department for public finances (Estadística de Finanzas Públicas Estatales y Municipales (EFIPEM)). This database is the most detailed available account of municipality-level public investments for federal, state, and local spending covering the period 1989–2010. For earlier years, we complement this database with historical records that we obtain from Mexico's Fondo Nacional de Fomento al Turismo (FONATUR) that provide us with information on public investments in tourism going back to the beginning of the 1960s. To estimate the tourism trade elasticity, we use data on bilateral tourism exports from the World Bank WITS database on trade in services. We link these data to information from the IMF on purchasing power parity (PPP) rates for final consumption goods across countries in order to empirically capture the relative price of local consumption for origin-destination country pairs over time. The database spans the years 1990–2011 and includes 115 origin and destination countries. Online Appendix Section 2 provides further details about the database and construction of variables.

## II. Empirical Evidence

This section uses the database described above to estimate the effects of tourism on municipality-level employment, population, wages, and local GDP by sector in today's cross section of Mexican municipalities. As well as being of interest in their own right, these local effects inform the structure and calibration of the model, and the quantification of tourism's welfare implications and underlying channels in Sections III and IV.

### A. *Empirical Strategy*

Tourism in Mexico has had more than half a century to materialize into today's observed regional economic outcomes. In this context, our aim is to exploit cross-sectional variation to capture tourism's long-term economic consequences on local economic outcomes across Mexican municipalities.[8] To estimate the effect of differences in local tourism attractiveness on relative outcomes in today's cross section of Mexican municipalities, we estimate the following baseline specification:

$$\log(y_{nt}) = \alpha_{ct} + \beta TourismAttractiveness_n + \alpha' X_{nt} + \epsilon_{nt}, \quad (1)$$

where $n$ indexes municipalities, $c$ indexes coastal versus non-coastal municipalities, and $t$ indexes census years. In our baseline specification (1), we regress the two most recent cross sections of municipality-level outcomes, $y_{nt}$, in 2000 and 2010 for outcomes computed using the population censuses, and in 1998 and 2008 for outcomes computed using the Censos Económicos, on different measures of tourism attractiveness, a vector of predetermined municipality controls, $X_{nt}$, and coast-by-period fixed effects. To address concerns about auto-correlated error terms for the same municipality over time, we cluster standard errors at the municipality level.[9] After reporting the reduced-form estimation results, we then estimate second-stage IV

[8] To see this more clearly, consider a specification of long differences: $\log(y_n^{2010}) - \log(y_n^{1950}) = \alpha_c + \beta(\log(Tourism_n^{2010}) - \log(Tourism_n^{1950})) + \epsilon_n$. Without discernible variation in tourism pre-1960 (setting $Tourism_n^{1950}$ to a constant close to zero), this can be rewritten as in (1): $\log(y_n^{2010}) = \alpha'_c + \beta\log(Tourism_n^{2010}) + \epsilon_{nc} + \log(y_n^{1950})$, with the identifying assumption that our measures of tourism attractiveness are unrelated to economic outcomes before tourism emerges. As discussed in detail below, we further assess this assumption in several ways.

[9] Clustering instead at the state level or the state-by-year level leads to slightly smaller standard errors.

point estimates using the measures of tourism attractiveness as instruments for municipality-level tourism activity in 1998 and 2008.

To exploit plausibly exogenous variation in tourism attractiveness along the Mexican coastline, we take inspiration from the tourism management literature (e.g., Weaver and Oppermann 2000, Leatherman 1997) arguing that tourism activity is to a large extent determined by the quality of a set of specific local natural and cultural amenities. We identify two criteria for touristic beach quality that we can empirically capture along the roughly 9,500 km of Mexican coastline using our GIS and satellite database: (i) the presence of a nearby offshore island, and (ii) the fraction of coastline covered by white sand beaches. In addition, we bring to bear information on the presence of pre-Hispanic archaeological ruins across Mexican municipalities to construct a third measure of tourism attractiveness.

The first measure that we construct is whether a coastal municipality has access to an offshore island within 5 km of its coastline.[10] This measure is aimed at capturing both scenic beauty, as well as the availability of popular beach activities, such as snorkeling around the island or taking a boat trip to the offshore beaches. To measure offshore islands, we use the Mexican census of maritime land territory conducted by the INEGI. To assess the sensitivity of the 5 km cutoff, we alternatively report results using islands within 10 km of the shoreline.

The second measure of tourism attractiveness is aimed at capturing the presence of picturesque white sand beaches along the Mexican coastline. Because an explicit specification of what constitutes an attractive stretch of beach in Mexico has not been formulated in the remote sensing literature, we proceed by binding our hands to the best existing ranking of Mexican beaches that we could find. That ranking refers to the "Eight Best Beaches of Mexico" published by the ranking analytics company *US News & World Report*.[11] We take these top-ranked beaches and construct a municipality-level beach quality measure using the historical satellite data. For each of the eight beaches, we start by computing the wavelength ranges for each of the six different LandSat sensors computed across the 30 m pixels covering the beach. We then classify all 30 m pixels within 100 m of the Mexican shoreline into zeros and ones depending on whether they fall within these reference wavelength ranges. Using this information, we construct the fraction of pixels that is covered by either of these eight types of high-quality beaches. To assess the sensitivity to the 100 meter range, we also report results using a 200 meter distance from the shoreline.

For the third measure of tourism attractiveness, the geo-statistics division at INEGI provided us with the location of pre-Hispanic archaeological ruins in Mexico that we depict in Figure 1. Using this information, we construct a municipality-level

[10] Our island and beach measures of tourism attractiveness have no variation across non-coastal municipalities (we set them to a constant of zero for inland regions). Given specification (1) features coast by period fixed effects, it follows that the identifying variation is purely within the coastal municipality group. For these two measures, including the full sample of Mexican municipalities increases power when estimating additional municipality controls in $X_{nct}$. As a robustness check in online Appendix Table A.14, we also allow the controls to have heterogeneous effects among coastal and non-coastal regions as discussed below.

[11] In their description (http://travel.usnews.com/Rankings/Best_Mexico_Beaches/), they write "To help you find the ideal Mexican destination for sunbathing on the sand and splashing in the waves, US News considered factors like scenery, water clarity, crowd congestion, and nearby amenities. Expert insight and user votes were also taken into account when creating this list of the country's best beaches." The eight beaches are Playa del Carmen, Tulum, Cozumel, Cancún, Acapulco, Mazatlán, Puerto Vallarta, and Los Cabos.

indicator for whether an archaeological site is present. In addition to including the three measures separately or jointly in specification (1), we also construct a continuous weighted-average standardized $z$-score of tourism attractiveness along the Mexican coastline. We give equal weight to the municipality $z$-scores of the inverse distance to the nearest island, the fraction of shoreline covered by picturesque sand and the inverse distance to the nearest pre-Hispanic, each measured in units of standard deviations relative to other coastal municipalities. Non-coastal municipalities have no variation in the standardized score of beach tourism attractiveness.

The identifying assumption in specification (1) is that the presence of nearby offshore islands, a higher fraction of coastline covered by white sand beaches or the presence of pre-Hispanic ruins affect municipality-level economic outcomes relative to other coastal locations only through their effect on local tourism attractiveness. To assess this assumption, we report the reduced-form point estimates both before and after including additional predetermined municipality controls, and test whether tourism attractiveness affects local economic outcomes during periods before beach tourism became a discernible economic force in Mexico. As we discuss in detail below, we also report a number of additional robustness checks as part of the reduced-form and the IV estimation.

## B. *Reduced-Form Estimation*

**Municipality Employment and Population:** We begin by estimating the effect of differences in local tourism attractiveness on municipality-level total employment and population. Viewed through the lens of a spatial equilibrium with labor mobility, these are two of the most informative long-term local economic outcomes: over time, workers respond to changes in local economic outcomes by moving to places with better prospects. By a revealed preference argument, location choices are thus directly informative about differences in the underlying attractiveness of regions.[12] We estimate specification (1) with log employment or log population on the left-hand side that we construct from the Mexican census microdata for 2000 and 2010.

Table 2 presents the reduced-form estimation results separately for each of the three measures of tourism attractiveness, after including them jointly, and using the average standardized score of tourism attractiveness. We estimate the effects on municipality total employment both before and after including an additional set of predetermined municipality controls. In the baseline, $X_{nct}$ in specification (1) includes the log distance to Mexico City, the log distance to the closest stretch of the US border and the log municipality area. These geographical controls are aimed to address concerns that larger municipalities that are located close to the main domestic or foreign economic centers may have both higher tourism attractiveness and more economic activity on the left-hand side of specification (1). We then report how the estimate of $\beta$ is affected after additionally including dummies for state capitals, historical cities,[13] colonial ports, and the logarithm of the average annual temperature and the average annual precipitation. Reporting point estimates before

[12] More formally, see equation (12) in the spatial equilibrium model of Section III.
[13] Following INEGI's definition of cities with a population above 20,000 in 1930.

Table 2—Reduced-Form Estimates of the Effect of Tourism Attractiveness on Municipality Employment and Population

| | log municipality employment 2000, 2010 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dependent variables: | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Nearby island dummy | 0.587 | 0.506 | | | | | 0.516 | 0.458 | |
| | (0.235) | (0.226) | | | | | (0.236) | (0.225) | |
| Onshore fraction of white beach | | | 9.028 | 9.703 | | | 8.617 | 9.459 | |
| | | | (3.738) | (3.534) | | | (4.016) | (3.776) | |
| Pre-Hispanic ruins dummy | | | | | 0.504 | 0.366 | 0.451 | 0.317 | |
| | | | | | (0.148) | (0.118) | (0.151) | (0.118) | |
| Standardized attractiveness | | | | | | | | | 0.332 |
| | | | | | | | | | (0.141) |
| log distance to US border | −0.0248 | −0.137 | −0.0283 | −0.137 | −0.0430 | −0.145 | −0.0425 | −0.151 | −0.137 |
| | (0.0579) | (0.0604) | (0.0584) | (0.0606) | (0.0585) | (0.0608) | (0.0581) | (0.0607) | (0.0606) |
| log distance to Mexico City | −0.904 | −0.820 | −0.907 | −0.821 | −0.899 | −0.814 | −0.904 | −0.822 | −0.821 |
| | (0.0341) | (0.0359) | (0.0342) | (0.0360) | (0.0342) | (0.0360) | (0.0341) | (0.0360) | (0.0360) |
| log municipality area | 0.644 | 0.615 | 0.649 | 0.619 | 0.637 | 0.610 | 0.636 | 0.611 | 0.619 |
| | (0.0210) | (0.0202) | (0.0210) | (0.0202) | (0.0211) | (0.0204) | (0.0212) | (0.0205) | (0.0202) |
| State capital dummy | | 1.635 | | 1.668 | | 1.643 | | 1.617 | 1.656 |
| | | (0.316) | | (0.313) | | (0.320) | | (0.323) | (0.317) |
| Old city dummy | | 1.886 | | 1.865 | | 1.864 | | 1.875 | 1.869 |
| | | (0.382) | | (0.382) | | (0.386) | | (0.386) | (0.384) |
| Colonial port dummy | | 1.161 | | 1.576 | | 1.562 | | 1.269 | 1.344 |
| | | (0.436) | | (0.391) | | (0.397) | | (0.439) | (0.470) |
| log average precipitation | | 0.314 | | 0.305 | | 0.302 | | 0.318 | 0.304 |
| | | (0.0534) | | (0.0530) | | (0.0529) | | (0.0535) | (0.0530) |
| log average temperature | | 0.324 | | 0.318 | | 0.311 | | 0.321 | 0.321 |
| | | (0.134) | | (0.134) | | (0.134) | | (0.134) | (0.134) |
| Year-by-coast FX | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 |
| $R^2$ | 0.400 | 0.478 | 0.399 | 0.478 | 0.401 | 0.478 | 0.403 | 0.480 | 0.477 |
| Number of municipalities | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 |
| $p$-value of joint significance test | | | | | | | 0.000 | 0.000 | |

(*Continued*)

and after adding these controls helps us document the extent to which variation in local tourism attractiveness within a given coast-by-year cell may be correlated with a number of observable predetermined confounding factors that also affect local economic outcomes.

In columns 1–6, we find that nearby islands, nicer onshore beaches, and the presence of pre-Hispanic ruins have a positive and statistically significant effect on municipality total employment, both before and after including the full set of predetermined municipality controls. In columns 7 and 8, we include the three measures of tourism attractiveness jointly, and the point estimates suggest that each of them provide independent variation affecting municipality total employment. In terms of magnitude, the estimates of the standardized score in columns 9 and 12 suggest that a one standard deviation in tourism attractiveness along the coastline leads to a 33 percent increase in total employment and a 24 percent increase in total population relative to other coastal municipalities in the cross section.[14]

[14] The difference in tourism's effect on population relative to total employment can be due to demographics (e.g., differences in the age profile and family size of the workforce), labor force participation, as well as

Table 2—Reduced-Form Estimates of the Effect of Tourism Attractiveness on Municipality Employment and Population (Continued)

| | log municipality population 2000, 2010 | | |
|---|---|---|---|
| Dependent variables: | (10) | (11) | (12) |
| Nearby island dummy | 0.448 | 0.407 | |
| | (0.231) | (0.223) | |
| Onshore fraction of white beach | 6.375 | 7.217 | |
| | (4.191) | (3.970) | |
| Pre-Hispanic ruins dummy | 0.378 | 0.258 | |
| | (0.142) | (0.114) | |
| Standardized attractiveness | | | 0.237 |
| | | | (0.136) |
| log distance to US border | 0.0299 | −0.0762 | −0.0639 |
| | (0.0574) | (0.0603) | (0.0602) |
| log distance to Mexico City | −0.879 | −0.814 | −0.813 |
| | (0.0318) | (0.0351) | (0.0351) |
| log municipality area | 0.630 | 0.608 | 0.614 |
| | (0.0206) | (0.0199) | (0.0196) |
| State capital dummy | | 1.381 | 1.417 |
| | | (0.303) | (0.298) |
| Old city dummy | | 1.697 | 1.691 |
| | | (0.365) | (0.363) |
| Colonial port dummy | | 1.192 | 1.300 |
| | | (0.409) | (0.417) |
| log average precipitation | | 0.294 | 0.282 |
| | | (0.0523) | (0.0518) |
| log average temperature | | 0.362 | 0.361 |
| | | (0.129) | (0.130) |
| Year-by-coast FX | ✓ | ✓ | ✓ |
| Observations | 4,889 | 4,889 | 4,889 |
| $R^2$ | 0.409 | 0.476 | 0.474 |
| Number of municipalities | 2,455 | 2,455 | 2,455 |
| $p$-value of joint significance test | 0.001 | 0.002 | |

*Notes:* See Section IIB for discussion. *Nearby island dummy* is an indicator whether an offshore island is within 5 km of the municipalities' coastline. *Onshore fraction of white beach* is the fraction of municipality area within 100 m of the coastline covered by white sand pixels that lie within the wavelength ranges of the 8 top-ranked Mexican beaches. *Pre-Hispanic ruins dummy* is an indicator of the presence of archaeological ruins. *Standardized attractiveness* is the average $z$-score of the inverse distance to the nearest island, the fraction of shoreline covered by picturesque sand, and the inverse distance to the nearest pre-Hispanic, each measured in units of standard deviations relative to other coastal municipalities. Standard errors are clustered at the level of municipalities.

**Municipality Wage Bill, GDP by Sector, and Wages:** To further investigate the channels underlying the positive effects on local employment and population, we explore the effect of tourism attractiveness on local production. Table 3 reports the reduced-form estimation results of the effect on the municipality-level total wage bill (labor income), GDP, GDP by sector of economic activity, and Mincerized wages, including the full set of controls. In columns 1 and 2, we find that the standardized attractiveness score has a strong and significant positive effect on local aggregate

commuting. In our model, we abstract from these adjustment margins and use information on total local employment to capture the regional effects on the workforce and economic activity.

Table 3—Reduced-Form Estimates of the Effect of Tourism Attractiveness on Municipality Wage Bill, GDP by Sector, and Wages

| | Censos Económicos 1998, 2008 | | | | | Population census 2000, 2010 |
|---|---|---|---|---|---|---|
| Dependent variables: | log labor income (1) | log GDP (2) | log GDP (w/o hotel) (3) | log GDP (Manu.) (4) | log GDP (Agri.) (5) | log wage residual (6) |
| Standardized attractiveness | 0.818 | 0.736 | 0.677 | 0.451 | 0.172 | 0.0759 |
| | (0.255) | (0.260) | (0.252) | (0.255) | (0.207) | (0.0295) |
| log distance to US border | −0.578 | −0.529 | −0.531 | −0.439 | 0.127 | −0.0901 |
| | (0.105) | (0.100) | (0.100) | (0.142) | (0.119) | (0.0102) |
| log distance to Mexico City | −1.149 | −1.222 | −1.221 | −1.475 | −0.552 | −0.0289 |
| | (0.0697) | (0.0661) | (0.0661) | (0.0843) | (0.0764) | (0.00931) |
| log municipality area | 0.762 | 0.786 | 0.783 | 0.761 | 0.808 | 0.0168 |
| | (0.0419) | (0.0394) | (0.0394) | (0.0500) | (0.0445) | (0.00656) |
| State capital dummy | 3.102 | 2.990 | 3.004 | 2.837 | 1.444 | 0.0638 |
| | (0.518) | (0.502) | (0.500) | (0.597) | (0.812) | (0.0291) |
| Old city dummy | 3.154 | 3.095 | 3.092 | 3.285 | 1.856 | 0.0920 |
| | (0.603) | (0.585) | (0.584) | (0.705) | (0.987) | (0.0322) |
| Colonial port dummy | 2.205 | 1.902 | 1.919 | 2.229 | 0.140 | −0.118 |
| | (0.712) | (0.563) | (0.516) | (0.441) | (1.164) | (0.0328) |
| log average precipitation | −0.513 | −0.489 | −0.490 | −0.840 | −0.129 | −0.113 |
| | (0.114) | (0.107) | (0.107) | (0.137) | (0.120) | (0.0113) |
| log average temperature | 0.641 | 1.255 | 1.260 | 1.644 | 2.480 | −0.00306 |
| | (0.275) | (0.254) | (0.254) | (0.339) | (0.328) | (0.0314) |
| Year-by-coast FX | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 4,596 | 4,889 | 4,889 | 4,889 | 4,889 | 5,490,558 |
| $R^2$ | 0.360 | 0.381 | 0.380 | 0.273 | 0.365 | 0.378 |
| Number of municipalities | 2,385 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 |
| $p$-value of joint significance (when included jointly) | 0.000 | 0.000 | 0.000 | 0.001 | 0.400 | 0.000 |

*Notes:* See Section IIB for discussion. *Standardized attractiveness* is the average $z$-score of the inverse distance to the nearest island, the fraction of shoreline covered by picturesque sand, and the inverse distance to the nearest pre-Hispanic, each measured in units of standard deviations relative to other coastal municipalities. *p-value of joint significance* in the last row is the $p$-value of the joint test that the three attractiveness measures have zero effect when included jointly on the right-hand side. log manufacturing and agricultural GDP measured with inverse hyperbolic sine transformation (see also online Appendix Table A.17). Regressions in the final two columns are weighted using population weights and also include controls for gender, ethnicity, and third-order polynomials for age and years of education. Standard errors are clustered at the level of municipalities.

labor income and GDP. A one standard deviation in tourism attractiveness increases the local wage bill by about 80 percent, and local GDP by 74 percent relative to less attractive regions for tourism in the cross section. When including the three measures of tourism attractiveness jointly instead of the mean standardized $z$-score, the $p$-value of the joint significance is less than 0.1 percent in the specification with the full set of controls, as reported in the final row of Table 3.

Underlying these effects on local aggregate production, we find significant positive effects of tourism attractiveness on local manufacturing GDP. A one standard deviation increase in tourism attractiveness increases local manufacturing GDP by about 40 percent, and the $p$-value of the joint significance test when including the three measures jointly instead of the standardized score is 0.1 percent. The point estimate on local agriculture is also positive, but smaller and not statistically significant for either the standardized score or when including the three measures jointly. The final column of Table 3 reports the estimate of the effect of local tourism attractiveness on average municipality Mincerized wages, after flexibly controlling for observable differences in local workforce composition (age, education, gender, and ethnicity using the microdata of the Mexican population censuses). We find that a one standard deviation increase in attractiveness increases local nominal Mincerized wages by on average 7.6 percent.

**Robustness:** Tables 2 and 3 document strong positive effects of tourism attractiveness on local employment, population, GDP, manufacturing, and wages. One potential concern is that islands, whiter beaches, or archaeological sites could affect the local economy not only through their effect on local tourism development, but also by directly influencing the residential choice of Mexican residents relative to other coastal locations. Even though we sought to be careful in constructing these measures to capture a very particular set of features of the local environment that are arguably specific to tourism attractiveness, it could be the case that they have a significant direct amenity effect on local employment and populations relative to other coastal locations.

In Table 4 and online Appendix Tables A.4–A.7, we further investigate this concern in four different ways. First, we run a placebo falsification test on the identical sample of municipalities during a period before beach tourism had become a discernible economic force in Mexico. This involves the construction of a long time series of population census data for consistent spatial units for the years 1921, 1930, 1940, and 1950, in addition to the two most recent rounds of population census data 2000 and 2010 that we use in our baseline regressions. As discussed in the data section, the historical census database provides us with municipality populations, but not employment. Table 4 reports the results of these specifications.[15] We report the results across two panels, that deal in different ways with the fact that not all municipalities report non zero populations for all census rounds between 1921–2010. Panel A uses the inverse hyperbolic sine (IHS) transformation on the left-hand side in order to not ignore zero populations in the estimation. Panel B replaces historical zero population values with the log of 1, instead. We report results both before and after controlling for access to road infrastructure in 1940, as a way to check robustness to controlling for preexisting differences in remoteness.

For all three measures of tourism attractiveness, we find slightly negative but insignificant point estimates of the effect on municipality populations before 1960, and a significant positive effect after beach tourism had emerged. The estimates on the geographical municipality controls, and controls for preexisting access to infrastructure are estimated with similar precision in both periods, giving some reassurance against the concern that the historical census population data could simply be more noisy than the more recent data. These results suggest that the oceanographic, geological, and archaeological variation that we use to construct measures of

[15] We include the basic set of geographical controls used in the previous tables rather than the complete set, as some of the controls were arguably not predetermined in the early census periods. One potential caveat to keep in mind for the pre-Hispanic ruins is that it is possible that not all archaeological sites had been discovered pre-1960s.

Table 4—Placebo Falsification Tests

| Dependent variable: | log municipality census population | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Census years: | 1921, 1930, 1940, 1950 | | 2000, 2010 | | 1921, 1930, 1940, 1950 | | 2000, 2010 | |
| | Nearby island dummy | | | | Onshore fraction of white beach | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| *Panel A. Left-hand side with inverse hyperbolic sine transformation for log population* | | | | | | | | |
| Measure of tourism attractiveness | −0.151 | −0.197 | 0.510 | 0.430 | −15.69 | −15.67 | 6.601 | 6.635 |
| | (0.350) | (0.347) | (0.233) | (0.221) | (9.458) | (9.639) | (4.031) | (3.091) |
| log distance to US border | 0.121 | 0.149 | 0.0415 | 0.0909 | 0.126 | 0.154 | 0.0386 | 0.0883 |
| | (0.0636) | (0.0635) | (0.0574) | (0.0534) | (0.0634) | (0.0632) | (0.0578) | (0.0538) |
| log distance to Mexico City | −0.419 | −0.394 | −0.878 | −0.836 | −0.413 | −0.388 | −0.880 | −0.837 |
| | (0.0574) | (0.0571) | (0.0321) | (0.0326) | (0.0574) | (0.0570) | (0.0322) | (0.0327) |
| log municipality area | 0.497 | 0.430 | 0.633 | 0.515 | 0.495 | 0.427 | 0.637 | 0.518 |
| | (0.0215) | (0.0220) | (0.0205) | (0.0205) | (0.0214) | (0.0220) | (0.0204) | (0.0205) |
| log km of major roads 1940 | | 0.117 | | 0.205 | | 0.117 | | 0.205 |
| | | (0.0116) | | (0.0113) | | (0.0116) | | (0.0113) |
| Year-by-coast FX | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 9,736 | 9,736 | 4,868 | 4,868 | 9,736 | 9,736 | 4,868 | 4,868 |
| $R^2$ | 0.231 | 0.256 | 0.400 | 0.469 | 0.234 | 0.260 | 0.399 | 0.469 |
| Number of municipalities | 2,434 | 2,434 | 2,434 | 2,434 | 2,434 | 2,434 | 2,434 | 2,434 |
| *Panel B. Left-hand side with log of 1 for 0 population* | | | | | | | | |
| Measure of tourism attractiveness | −0.144 | −0.189 | 0.510 | 0.430 | −15.62 | −15.60 | 6.601 | 6.635 |
| | (0.337) | (0.334) | (0.233) | (0.221) | (9.413) | (9.596) | (4.031) | (3.091) |
| log distance to US border | 0.116 | 0.144 | 0.0415 | 0.0909 | 0.120 | 0.149 | 0.0386 | 0.0883 |
| | (0.0607) | (0.0605) | (0.0574) | (0.0534) | (0.0605) | (0.0603) | (0.0578) | (0.0538) |
| log distance to Mexico City | −0.427 | −0.403 | −0.878 | −0.836 | −0.421 | −0.397 | −0.880 | −0.837 |
| | (0.0542) | (0.0538) | (0.0321) | (0.0326) | (0.0542) | (0.0538) | (0.0322) | (0.0327) |
| log municipality area | 0.499 | 0.431 | 0.633 | 0.515 | 0.496 | 0.429 | 0.637 | 0.518 |
| | (0.0205) | (0.0211) | (0.0205) | (0.0205) | (0.0205) | (0.0211) | (0.0204) | (0.0205) |
| log km of major roads 1940 | | 0.116 | | 0.205 | | 0.116 | | 0.205 |
| | | (0.0112) | | (0.0113) | | (0.0111) | | (0.0113) |
| Year-by-coast FX | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 9,736 | 9,736 | 4,868 | 4,868 | 9,736 | 9,736 | 4,868 | 4,868 |
| $R^2$ | 0.246 | 0.273 | 0.400 | 0.469 | 0.250 | 0.278 | 0.399 | 0.469 |
| Number of municipalities | 2,434 | 2,434 | 2,434 | 2,434 | 2,434 | 2,434 | 2,434 | 2,434 |

(*Continued*)

tourism attractiveness are unlikely to capture locational fundamentals that directly enter Mexican location choices along the coastline in a discernible way.

Second, we address the potentially remaining concern that while Mexicans may not have cared about white sand beaches, islands, or ruins when deciding where to live and work in the 1950s, their tastes may have evolved over time so that by 2000 these measures pick up significant direct amenity effects relative to other coastal locations. To this end, we verify in today's cross section of municipalities to what extent our model-based estimates of local amenities that we discuss in Section IVA (essentially local population residuals left unexplained by spatial variation in real incomes) are significantly related to the presence of islands, the fraction of white sand coverage, or the presence of pre-Hispanic ruins. Online Appendix Table A.4 reports the estimation results. Consistent with the findings of the placebo falsification test above, we find that current-day estimates of local amenities are not significantly correlated with the measures of tourism attractiveness.[16]

[16] The point estimates are −0.0238 (0.323) for the island dummy, 0.0997 (2.958) for the beach cover, and 0.183 (0.365) for the ruins dummy. We also verify that the model-based measures of local amenities are correlated with

TABLE 4—PLACEBO FALSIFICATION TESTS (CONTINUED)

| Dependent variable: | log municipality census population | | | |
|---|---|---|---|---|
| Census years: | 1921, 1930, 1940, 1950 | | 2000, 2010 | |
| | Pre-Hispanic ruins dummy | | | |
| | (9) | (10) | (11) | (12) |
| *Panel A. Left-hand side with inverse hyperbolic sine transformation for log population* | | | | |
| Measure of tourism attractiveness | −0.0152 | −0.0770 | 0.437 | 0.329 |
| | (0.234) | (0.236) | (0.142) | (0.135) |
| log distance to US border | 0.122 | 0.152 | 0.0258 | 0.0788 |
| | (0.0623) | (0.0619) | (0.0580) | (0.0540) |
| log distance to Mexico City | −0.419 | −0.395 | −0.873 | −0.832 |
| | (0.0576) | (0.0572) | (0.0322) | (0.0327) |
| log municipality area | 0.497 | 0.430 | 0.627 | 0.511 |
| | (0.0195) | (0.0205) | (0.0206) | (0.0208) |
| log km of major roads 1940 | | 0.117 | | 0.204 |
| | | (0.0114) | | (0.0113) |
| Year-by-coast FX | ✓ | ✓ | ✓ | ✓ |
| Observations | 9,736 | 9,736 | 4,868 | 4,868 |
| $R^2$ | 0.230 | 0.256 | 0.401 | 0.469 |
| Number of municipalities | 2,434 | 2,434 | 2,434 | 2,434 |
| *Panel B. Left-hand side with log of 1 for 0 population* | | | | |
| Measure of tourism attractiveness | 0.000341 | −0.0611 | 0.437 | 0.329 |
| | (0.223) | (0.225) | (0.142) | (0.135) |
| log distance to US border | 0.116 | 0.146 | 0.0258 | 0.0788 |
| | (0.0595) | (0.0591) | (0.0580) | (0.0540) |
| log distance to Mexico City | −0.427 | −0.404 | −0.873 | −0.832 |
| | (0.0544) | (0.0540) | (0.0322) | (0.0327) |
| log municipality area | 0.498 | 0.432 | 0.627 | 0.511 |
| | (0.0187) | (0.0196) | (0.0206) | (0.0208) |
| log km of major roads 1940 | | 0.116 | | 0.204 |
| | | (0.0110) | | (0.0113) |
| Year-by-coast FX | ✓ | ✓ | ✓ | ✓ |
| Observations | 9,736 | 9,736 | 4,868 | 4,868 |
| $R^2$ | 0.246 | 0.273 | 0.401 | 0.469 |
| Number of municipalities | 2,434 | 2,434 | 2,434 | 2,434 |

*Notes:* See Section IIB for discussion. *Nearby island dummy* is an indicator whether an offshore island is within 5 km of the municipalities' coastline. *Onshore fraction of white beach* is the fraction of municipality area within 100 m of the coastline covered by white sand pixels that lie within the wavelength ranges of the 8 top-ranked Mexican beaches. *Pre-Hispanic ruins dummy* is an indicator of the presence of archaeological ruins. Standard errors are clustered at the level of Mexican states.

Third, we verify whether the positive effect of tourism attractiveness on local populations in today's cross section of regions is driven by economically active Mexicans rather than pensioners, as another way to differentiate between economic incentives due to tourism versus a correlation between the attractiveness measures and local amenities for residents. As reported in online Appendix Table A.6, we find that the positive effect of tourism attractiveness on the number of municipality immigrants who are economically active is significantly less positive and close to zero among retired migrants.

direct measures, such as weather, greenness, crime, car congestion, and access to inland bodies of water or the ocean, as reported in online Appendix Table A.5.

Fourth, the results up to this point have been based on cross-sectional variation with the aim to capture the long-run effects of tourism exposure (since the 1950s) on regional economic outcomes in Mexico. In our final set of results, we corroborate the causal interpretation using shorter-term variation that is based on panel data. To this end, we exploit the long time series of municipality population data 1921–2010 described in Section I to estimate the differential effect of decadal changes in tourist arrivals to Mexico across coastal municipalities with or without nearby islands, higher or lower fractions of white sand coverage, and with or without pre-Hispanic ruins. In ordinary least squares (OLS), we interact the cross-sectional measures of attractiveness with the number of tourist arrivals to Mexico after including municipality and coast-by-period fixed effects. In a second specification, we also instrument for the number of tourist arrivals to Mexico with the log average air fare paid by US airline passengers (in constant US dollars). As reported in online Appendix Table A.7, we find that inflows of tourists to Mexico have a significantly more positive effect on local populations for municipalities with higher (instrumented) tourism potential relative to other coastal municipalities.[17] This result holds for all three measures of tourism attractiveness, and is robust to flexibly controlling for differences in trends after interacting the full set of municipality controls discussed above with census-year fixed effects.

In summary, the additional results discussed above provide some reassurance that our measures of tourism attractiveness capture a specific set of shifters to local tourism demand that do not appear to have discernible direct effects on local populations, or to be correlated with other omitted variables affecting local economic outcomes. In addition to the analysis presented here, we present further robustness results in the IV estimation that follows.

## C. *IV Estimation*

After reporting the reduced-form estimation results of tourism attractiveness on local economic outcomes, we now replace the independent variable of interest in specification (1) with a measure of local tourism activity, and use the three measures of tourism attractiveness as instrumental variables. As discussed in Section I, we address the lack of data for total local tourism expenditure by using information from the Mexican Censos Económicos on the sales of local hotels and other establishments for temporary accommodation (e.g., hostels),[18] making the assumption that accommodation constitutes a roughly constant share of tourist expenditures.[19]

[17] In particular, we find that a 10 percent increase in the arrival of tourists to Mexico leads to 1.7, 0.3, and 0.7 percentage point higher population growth for, respectively, municipalities with a nearby island, a 1 standard deviation higher fraction of white sand coverage, and the presence of pre-Hispanic ruins relative to other beach locations.

[18] We use the IHS transformation, $\log\left(HotelSales_{nct} + \left(HotelSales_{nct}^2 + 1\right)^{1/2}\right)$, in order to not ignore variation from municipalities in places with zero hotel sales. In practice, this does not affect the estimates since the identifying variation in our IV estimation stems from coastal municipalities that, except for three instances in the two cross sections, have no reported zeros for hotel sales. As discussed below, we also report results without this transformation, or after assigning the log of 1 to values of 0.

[19] Though we cannot directly verify this assumption in the cross section of municipalities, we can use available Mexican time series data to assess it. Online Appendix Table A.2 documents that accommodation expenses accounted for on average 13 percent of total Mexican tourist expenditure over the period 2003–2013, with very little

The coefficient $\beta$ in the IV estimation of specification (1), with $\log(HotelSales_{nct})$ on the right-hand side, captures the total derivative of tourism's local effect on the outcome $y_{nt}$. This includes both the direct effect of variation in local tourism sales (holding all else constant), as well as the indirect GE effects through, for example, increased demand for inputs from other sectors, immigration, or changes in local productivity due to spillovers.[20] The empirical analysis below and the quantitative model then allow us to shed light on, and decompose the channels underlying the estimated total derivatives $\hat{\beta}$.

For identification, the exclusion restriction of the IV estimation imposes additional assumptions compared to the previous reduced-form analysis. Whereas the reduced-form captures the long-term total derivative of variation in ex ante tourism attractiveness on local economic outcomes, the IV estimation also requires that all such effects operate exclusively through increased local tourism sales and their potential GE knock-on effects. For example, with the log of total municipality GDP on the left-hand side, if higher attractiveness leads to more tourism sales, and in turn more tourism activity has positive knock-on effects on manufacturing production through, e.g., input-output linkages or agglomeration forces, the IV point estimate of $\beta$ would consistently capture the sum of both direct and indirect effects. The additional concern of the IV estimation, however, is that higher ex ante tourism attractiveness may affect local outcomes not only through increased local tourism sales, but also potentially through increased public investments in tourism development that could affect local outcomes independently of tourism activity. In the following, we proceed by estimating the OLS and IV point estimates of the long-term effect of tourism sales on local economic outcomes relative to less touristic regions, and then present additional results to further investigate the role of public investments in tourism and input-output linkages.

**IV Estimation Results:** Table 5 presents the OLS and IV point estimates of the effect of tourism sales on municipality employment, population, labor income, GDP, GDP by sector, and wages, including the full set of predetermined municipality controls. For the IV estimation, we use the three measures of tourism attractiveness jointly as instrumental variables, and test whether different sources of identifying variation yield similar point estimates. In the OLS regressions, variation in log hotel sales enters positively and statistically significantly at the 1 percent level for all local economic outcomes. In the IV estimation, the effect of tourism sales is positive and statistically significant at the 1 percent level, except for local agricultural output (mirroring the results of the reduced form). According to the IV point estimates, a 10 percent increase in local tourism sales leads to a 2.5 percent increase in total employment and a 2 percent increase in population relative to less touristic regions. In terms of production, a 10 percent increase in tourism sales leads to a 4 percent

variation over time. A related concern is that hotel revenues relate differently to total local tourism expenditure in a way that is correlated with our IVs. We return to this question in the additional robustness analysis below.

[20] The estimated total derivative is $\hat{\beta} = \frac{d\log(y_{nt})}{d\log(HotelSales_{nt})} = \frac{\partial\log(y_{nt})}{\partial\log(HotelSales_{nt})} + \sum_j^J \left(\frac{\partial\log(y_{nt})}{\partial\log(X_{nt}^j)} \times \frac{d\log(X_{nt}^j)}{d\log(HotelSales_{nt})}\right)$. The first term is the direct effect of local tourism, holding all other $J$ determinants unchanged. The $X_{nt}^j$ are $J$ other determinants of the local outcome $y_{nt}$ that are affected by tourism, such as, e.g., local manufacturing production.

Table 5—IV Estimates of the Effect of Tourism Activity on Municipality Employment, Population, Wage Bill, GDP by Sector, and Wages

| | Censos Económicos 1998, 2008 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | log employment | | log labor income | | log GDP | | log GDP (w/o hotel) | |
| | OLS | Three IVs | OLS | Three IVs | OLS | Three IVs | OLS | Three IVs |
| Dependent variables: | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| log hotel sales | 0.218 | 0.245 | 0.480 | 0.475 | 0.464 | 0.404 | 0.458 | 0.380 |
| | (0.00568) | (0.0406) | (0.0104) | (0.0691) | (0.0104) | (0.0713) | (0.0106) | (0.0732) |
| log distance to US border | −0.0290 | −0.0163 | −0.364 | −0.367 | −0.299 | −0.328 | −0.304 | −0.341 |
| | (0.0416) | (0.0438) | (0.0713) | (0.0758) | (0.0691) | (0.0768) | (0.0696) | (0.0783) |
| log distance to Mexico City | −0.578 | −0.549 | −0.641 | −0.647 | −0.705 | −0.770 | −0.711 | −0.796 |
| | (0.0284) | (0.0526) | (0.0510) | (0.0876) | (0.0489) | (0.0919) | (0.0494) | (0.0944) |
| log municipality area | 0.351 | 0.318 | 0.183 | 0.190 | 0.217 | 0.290 | 0.221 | 0.316 |
| | (0.0169) | (0.0525) | (0.0323) | (0.0901) | (0.0310) | (0.0929) | (0.0313) | (0.0954) |
| State capital dummy | 0.796 | 0.689 | 1.224 | 1.247 | 1.164 | 1.403 | 1.197 | 1.508 |
| | (0.191) | (0.242) | (0.207) | (0.344) | (0.210) | (0.369) | (0.214) | (0.383) |
| Old city dummy | 1.028 | 0.924 | 1.310 | 1.332 | 1.307 | 1.537 | 1.324 | 1.624 |
| | (0.229) | (0.268) | (0.240) | (0.360) | (0.242) | (0.390) | (0.246) | (0.406) |
| Colonial port dummy | 0.699 | 0.597 | 0.829 | 0.850 | 0.548 | 0.775 | 0.551 | 0.848 |
| | (0.141) | (0.205) | (0.325) | (0.400) | (0.446) | (0.448) | (0.486) | (0.467) |
| log average precipitation | 0.263 | 0.258 | −0.629 | −0.627 | −0.578 | −0.567 | −0.577 | −0.564 |
| | (0.0402) | (0.0409) | (0.0807) | (0.0827) | (0.0760) | (0.0787) | (0.0765) | (0.0799) |
| log average temperature | 0.233 | 0.223 | 0.577 | 0.578 | 1.069 | 1.092 | 1.077 | 1.107 |
| | (0.106) | (0.107) | (0.197) | (0.197) | (0.184) | (0.188) | (0.186) | (0.191) |
| Year-by-coast FX | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 4,889 | 4,889 | 4,596 | 4,596 | 4,889 | 4,889 | 4,889 | 4,889 |
| $R^2$ | 0.682 | | 0.636 | | 0.643 | | 0.636 | |
| Number of municipalities | 2,455 | 2,455 | 2,385 | 2,385 | 2,455 | 2,455 | 2,455 | 2,455 |
| First stage $F$-statistic | | 15.13 | | 14.93 | | 15.13 | | 15.13 |
| Over-ID test $p$-value | | 0.662 | | 0.668 | | 0.302 | | 0.353 |

(*Continued*)

increase in local GDP and a 4.5 percent increase in local Mincerized wages. In line with the reduced-form estimation, the effect on total GDP is in part driven by a significant multiplier effect on local manufacturing production (a 4 percent increase). We return to the decomposition of the estimated total effect on local GDP in Section IVB, after taking into account input-output linkages and spillovers.

Reassuringly, the three IVs, which are based on distinct data sources and types of variation (geological, oceanographic, and archaeological) yield similar point estimates of the effect of local tourism sales on economic outcomes as documented by the $p$-values of the overidentification test that we report in the final row of Table 5. In addition to the results reported here, we provide further results in online Appendix Tables A.8–A.15 to investigate the robustness of the IV estimates for total employment and population to additional municipality controls for sea accessibility (flat terrain versus coastal cliffs) or local fishery potential (measured by primary ocean productivity), varying the 5 km or 100 m cutoffs in the construction of the island or beach IVs, controlling for the local crime environment, and investigating the extent to which error in our measure of local tourism sales may be systematically correlated to tourism attractiveness.[21] We also quantitatively assess the sensitivity of

[21] We also report additional checks in online Appendix Tables A.11–A.15. Online Appendix Table A.11 confirms that the estimation results are not sensitive to using the IHS transformation, since the identifying variation

Table 5—IV Estimates of the Effect of Tourism Activity on Municipality Employment, Population, Wage Bill, GDP by Sector and Wages (Continued)

| | Censos Económicos 1998, 2008 | | | | Population Census 2000, 2010 | | | |
|---|---|---|---|---|---|---|---|---|
| | log GDP (Manu) | | log GDP (Agri) | | log population | | log wage residual | |
| Dependent variables: | OLS (9) | Three IVs (10) | OLS (11) | Three IVs (12) | OLS (13) | Three IVs (14) | OLS (15) | Three IVs (16) |
| log hotel sales | 0.530 | 0.394 | 0.291 | 0.102 | 0.200 | 0.200 | 0.0220 | 0.0446 |
| | (0.0146) | (0.0939) | (0.0164) | (0.150) | (0.00564) | (0.0416) | (0.00309) | (0.00572) |
| log distance to US border | −0.181 | −0.245 | 0.267 | 0.178 | 0.0341 | 0.0341 | −0.0550 | −0.0403 |
| | (0.105) | (0.116) | (0.107) | (0.136) | (0.0427) | (0.0460) | (0.0106) | (0.00889) |
| log distance to Mexico City | −0.889 | −1.038 | −0.231 | −0.438 | −0.592 | −0.591 | 0.00860 | 0.0188 |
| | (0.0690) | (0.124) | (0.0753) | (0.180) | (0.0284) | (0.0539) | (0.0103) | (0.00943) |
| log municipality area | 0.112 | 0.278 | 0.451 | 0.683 | 0.370 | 0.370 | −0.0167 | −0.0272 |
| | (0.0428) | (0.123) | (0.0435) | (0.186) | (0.0171) | (0.0540) | (0.00833) | (0.00756) |
| State capital dummy | 0.736 | 1.278 | 0.287 | 1.043 | 0.627 | 0.627 | 0.0233 | −0.0183 |
| | (0.348) | (0.538) | (0.661) | (0.983) | (0.195) | (0.256) | (0.0298) | (0.0286) |
| Old city dummy | 1.241 | 1.764 | 0.733 | 1.463 | 0.920 | 0.920 | −0.00604 | −0.0685 |
| | (0.394) | (0.579) | (0.809) | (1.079) | (0.233) | (0.285) | (0.0299) | (0.0339) |
| Colonial port dummy | 0.462 | 0.979 | −0.873 | −0.152 | 0.672 | 0.671 | −0.132 | −0.171 |
| | (0.962) | (0.850) | (0.739) | (1.161) | (0.143) | (0.216) | (0.0435) | (0.0707) |
| log average precipitation | −0.937 | −0.913 | −0.182 | −0.149 | 0.245 | 0.245 | −0.0956 | −0.0921 |
| | (0.106) | (0.110) | (0.111) | (0.118) | (0.0407) | (0.0415) | (0.0146) | (0.0166) |
| log average temperature | 1.437 | 1.489 | 2.367 | 2.439 | 0.282 | 0.282 | −0.167 | −0.232 |
| | (0.276) | (0.283) | (0.305) | (0.319) | (0.104) | (0.106) | (0.0389) | (0.0479) |
| Year-by-coast FX | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 5,490,558 | 5,490,558 |
| $R^2$ | 0.507 | | 0.429 | | 0.662 | | 0.390 | |
| Number of municipalities | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 |
| First stage $F$-statistic | | 15.13 | | 15.13 | | 15.13 | | 40.13 |
| Over-ID test $p$-value | | 0.457 | | 0.307 | | 0.699 | | 0.144 |

*Notes:* See Section IIIC for discussion. log hotel sales, manufacturing and agricultural GDP are measured with the inverse hyperbolic sine transformation. *Three IVs* indicates the use of the three tourism attractiveness measures as instruments. Regressions in the final two columns are weighted using population weights and also include controls for gender, ethnicity and 3rd-order polynomials for age and years of education. Standard errors are clustered at the level of municipalities.

the estimated gains from tourism to potentially remaining concerns about the exclusion restriction as part of the counterfactual analysis in Section IVA.

**Role of Public Investments and Infrastructure:** As in many countries, Mexico's tourism sector has developed with the help of significant public investments in tourism infrastructure both at the federal and local levels of government since the 1960s. At the federal level, Mexico's FONATUR has invested in the creation of seven

stems from differences across coastal municipalities, that except for three instances report nonzero hotel revenues. Online Appendix Table A.12 reports results after replacing hotel revenues with number of tourists. Online Appendix Table A.13 uses additional information from the 100 percent census samples to confirm that the 10 percent samples do not give rise to sparseness concerns at the municipality level. Online Appendix Table A.14 first confirms that the identifying variation for the island and beach IVs is purely driven by coastal municipalities, and then reports close to identical point estimates after allowing all municipality controls to be interacted with the coastal region dummy. Online Appendix Table A.15 addresses the concern that the first-stage $F$-statistic drops from 17.56 to 15.3 when including the full set of controls in the joint IV specification in columns 10 and 12 in Table 2. To this end, we compare 2SLS estimates to limited information maximum likelihood (LIML) estimates. As the LIML estimator has been found to be more robust to weak instrument bias, the fact that the reported LIML point estimates are slightly higher provides reassurance against this concern.

planned tourism centers between the 1960s and 2010: Cancún, Los Cabos, Ixtapa, Huatulco, Loreto, and more recently Nayarit and Cozumel.[22] Federal investments in planned centers through FONATUR and its predecessors account for slightly more than 90 percent of the current stock of public investment in tourism in Mexico.[23] The first wave of these investments were targeted to raise foreign reserves for the Mexican central bank in the 1960s and 1970s, and the objective was to create tourism centers in coastal destinations with the most promising natural and cultural potential for tourism development.[24] In addition to federal investments through FONATUR, both state and municipality governments have made additional investments in the development and promotion of local tourism, accounting for the remainder of public spending targeted at the tourism sector.

These public investments have mainly taken two forms. The first are investments in local public capital and infrastructure that are specific to the tourism sector, such as building museums and monuments, tourist information centers, restoring historical buildings and structures, developing the marina, and spending on tourism promotion and advertising campaigns. The second are investments in transport infrastructure, such as roads and airports, that were mainly targeted at government-planned tourism centers through FONATUR starting from the 1960s.

Against this background, we can investigate the extent to which ex ante differences in tourism attractiveness, captured by our IVs, have been followed by an endogenous policy response of public investments targeted at the development of the tourism sector. These results serve to document the role of government policy in facilitating the development of tourism in Mexico. In turn, they help assess the exclusion restriction of the IV estimation above, and to inform the model that we develop in the next section.

To this end, we use the historical database on Mexican federal and local government investments, and construct a measure of the installed public capital stock of investments in tourism development across municipalities in the 1998 and 2008 cross sections. We also use geo-referenced information on government-planned tourism centers, airports, and the Mexican terrestrial transportation network (all roads and railways) that we obtain from INEGI's geo-statistics division. As reported in Table 6, we find that the stock of public investment in tourism is positively affected by our IVs for tourism attractiveness. In line with this, higher tourism attractiveness also leads to closer distances to planned tourism centers, better access to transport infrastructure, and reduced transport travel times on the full Mexican road and railway network to other municipalities in Mexico and border crossings to the United States.

These findings inform the empirical analysis and the model that we develop in the next section in two ways. First, we model tax-financed public investments as inputs to the development of the tourism sector. This allows us to take into account the role of the government, and to quantify the gains from tourism net of costly tax-financed public investments. Second, it could also be the case that public investments

[22] FONATUR was created in 1974 by merging two previous agencies INFRATUR and FOGATUR. After the end of our sample period in 2010, FONATUR more recently invested in two additional planned projects: Marinas Turísticas and Playa Espíritu.

[23] Online Appendix Section 2 provides a more detailed description.

[24] For some interesting background on this, the *New York Times* published an article on March 5, 1972, titled "Why the Computer Chose Cancun."

in tourism affect economic outcomes not just through their effect on increased local tourism activity, but also directly by improving access to infrastructure and reducing trade costs for the local manufacturing sector. To provide a first empirical check on such direct effects, we report in online Appendix Table A.16 the extent to which the IV point estimates of the local effects of tourism change after either excluding or controlling for distance to government-planned tourism centers, that were the target of transport investments and account for more than 90 percent of overall public spending on tourism development in the data. The fact that the point estimates are not noticeably reduced after excluding the bulk of public investments suggests that the local effects of higher ex ante tourism attractiveness operate mainly through increased local tourism activity, rather than additional direct effects due to the endogenous increase in public investments in tourism.[25] We also revisit this channel as part of the quantification in Section IVB, where we allow for tourism development to lead to an endogenous reduction in trade costs, that we quantify in the data following Table 6, and test the extent to which this additional channel affects the estimation of the gains from tourism and local agglomeration forces, as we discuss below.

**Tourism Input Demand:** A second question is to what extent the positive multiplier effect on manufacturing production may be driven by a subset of sectors that are used intensively as local inputs for tourism-related services. As reported in online Appendix Table A.17, we break up the 21 three-digit manufacturing sectors into above- and below-median intensity of touristic input use among traded industries. In particular, we construct two different measures. The first is based on the three-digit level total requirement coefficients from the 2007 Mexican input output tables. We use the total (direct and indirect) input requirement coefficients for the hotel sector across the 21 manufacturing sectors, and divide these sectors into above and below the median.[26] Alternatively, to better capture sectors that tourists demand directly, rather than solely relying on what the hotel sector uses as inputs in the Mexican IO tables, we also construct a second measure of tourism's input intensity: the Mexican tourism satellite account splits up total tourist tradable consumption into 5 three-digit sectors. These are (in decreasing order of importance): the food industry, artisanal products (part of other manufacturing), pharmaceuticals (part of chemical industry), clothing industry,

[25] Formally, the total derivative of the first stage is $\frac{d\log(HotelSales_{nt})}{dAttractiveness_{nt}} = \frac{\partial\log(HotelSales_{nt})}{\partial Attractiveness_{nt}} + \frac{\partial\log(HotelSales_{nt})}{\partial\log(PublicInvestment_{nt})} \times \frac{d\log(PublicInvestment_{nt})}{dAttractiveness_{nt}}$, while the total derivative of the second stage is $\frac{d\log(y_{nt})}{d\log(HotelSales_{nt})} = \frac{\partial\log(y_{nt})}{\partial\log(HotelSales_{nt})} + \frac{\partial\log(y_{nt})}{\partial\log(PublicInvestment_{nt})} \times \frac{d\log(PublicInvestment_{nt})}{d\log(HotelSales_{nt})}$. The fact that the IV point estimates $\left(\frac{d\log(y_{nt})}{d\log(HotelSales_{nt})}\right)$ remain unchanged after excluding the bulk of public spending in online Appendix Table A.16 suggests that while public investments respond as a function of higher ex ante tourism attractiveness, their effect on local outcomes operates mainly through the increase in tourism activity they were intended to bring about. In line with this, in earlier versions of this paper we also confirmed that the IV point estimates remain stable after including a comprehensive set of measures for access to infrastructure as controls on the right-hand side. The advantage of the approach above is that it provides a simple and transparent empirical check that does not run into concerns about adding several endogenous (bad) control variables.

[26] The two most intensively used input sectors are chemical products and petroleum/carbon-based products (both used in building hotels and resorts), and the two least used input sectors are leather products and the food industry.

Table 6—Role of Public Investment and Transport Infrastructure

| | log stock of public investment in tourism | | | log distance from planned tourism center | | | log km of paved roads | | |
|---|---|---|---|---|---|---|---|---|---|
| Dependent variables: | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Nearby island dummy | 2.050 | | | −0.491 | | | 0.00789 | | |
| | (0.672) | | | (0.145) | | | (0.0816) | | |
| Onshore fraction of white beach | | 31.50 | | | −5.757 | | | 2.678 | |
| | | (16.69) | | | (3.218) | | | (0.717) | |
| Pre-Hispanic ruins dummy | | | 0.972 | | | −0.0152 | | | 0.194 |
| | | | (0.236) | | | (0.0653) | | | (0.0570) |
| Year-by-coast FX | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Full set of controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 |
| $R^2$ | 0.654 | 0.653 | 0.652 | 0.422 | 0.417 | 0.413 | 0.619 | 0.619 | 0.620 |
| Number of municipalities | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 |

| | log distance to international airport | | | log transport time (simple average) | | | log transport time (population-weighted average) | | |
|---|---|---|---|---|---|---|---|---|---|
| Dependent variables: | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) |
| Nearby island dummy | −0.387 | | | −0.0591 | | | 0.00692 | | |
| | (0.157) | | | (0.0241) | | | (0.0407) | | |
| Onshore fraction of white beach | | −5.064 | | | −1.085 | | | −0.495 | |
| | | (3.030) | | | (0.266) | | | (0.234) | |
| Pre-Hispanic ruins dummy | | | −0.111 | | | −0.0406 | | | −0.0825 |
| | | | (0.0754) | | | (0.0108) | | | (0.0200) |
| Year-by-coast FX | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Full set of controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 | 4,889 |
| $R^2$ | 0.226 | 0.224 | 0.223 | 0.641 | 0.641 | 0.641 | 0.528 | 0.529 | 0.531 |
| Number of municipalities | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 | 2,455 |

| | log transport time (GDP-weighted average) | | |
|---|---|---|---|
| Dependent variables: | (19) | (20) | (21) |
| Nearby island dummy | 0.0193 | | |
| | (0.0464) | | |
| Onshore fraction of white beach | | −0.648 | |
| | | (0.351) | |
| Pre-Hispanic ruins dummy | | | −0.109 |
| | | | (0.0262) |
| Year-by-coast FX | ✓ | ✓ | ✓ |
| Full set of controls | ✓ | ✓ | ✓ |
| Observations | 4,889 | 4,889 | 4,889 |
| $R^2$ | 0.355 | 0.355 | 0.359 |
| Number of municipalities | 2,455 | 2,455 | 2,455 |

*Notes:* See Section IIIC for discussion. *Nearby island dummy* is an indicator whether an offshore island is within 5 km of the municipalities' coastline. *Onshore fraction of white beach* is the fraction of municipality area within 100 m of the coastline covered by white sand pixels that lie within the wavelength ranges of the 8 top-ranked Mexican beaches. *Pre-Hispanic ruins dummy* is an indicator of the presence of archaeological ruins. *Transport Time* refers to the mean (or weighted mean as indicated) of municipality travel times to other municipalities and border crossings on the full terrestrial Mexican transport network. Standard errors are clustered at the level of municipalities.

and printed media (part of printing industry). We use these five sectors as our second binary measure of traded sectors which may be used intensively by the tourism sector.

As reported in online Appendix Table A.17, we find that, as expected, sectors more intensively used in tourism are slightly more strongly affected by variation in local tourism activity. At the same time, the positive multiplier effects remain sizable and statistically significant in sectors with below-median tourism input intensity. These results suggest that part of the positive effect of tourism on local traded goods production may be driven in part by better market access for local input suppliers to tourism. To reflect this finding in our quantification, we allow for input-output linkages between tourism related services and all other sectors of the local economy in the theoretical framework that follows.

## III. Theoretical Framework

With these empirical results in hand, we now lay out a spatial equilibrium framework, whose main objectives are twofold. First, the estimation of the model allows us to shed light on the aggregate implications of tourism that are consistent with the local effects that we estimate in the previous section. Since we exploit within-country variation, our empirical estimates are by construction based on relative effects and cannot directly speak to aggregate effects of tourism. This limitation is particularly acute because tourism has had more than five decades to affect regional economic outcomes in the Mexican context: as we report above, local populations and employment strongly respond to differences in tourism activity, suggesting that the regional welfare differentials brought about by tourism activity have been smoothed over time.

Second, the model allows us to shed additional light on the underlying channels. The previous section suggests that tourism has strong positive effects on local economic activity, both directly and indirectly, i.e., through its effect on manufacturing production. To what extent are these multiplier effects a sign of possible productivity spillovers between the development of the local services sector through tourism and traded goods production? The answer is a priori unclear, as this result could be driven by neoclassical local demand effects alone: local population, input demand from the tourism sector, and public investment increase, improving local demand and trade market access of local manufacturers. Furthermore, to the extent that these multiplier effects do in fact reflect productivity spillovers, it is also a priori unclear whether such localized effects on manufacturing may be offset in the aggregate by a decrease in agglomeration forces among non-touristic regions of the country. These questions naturally feed back into the welfare evaluation of tourism in the aggregate: depending on the sign and magnitude of within- and cross-sector agglomeration forces, the aggregate gains from tourism can either be magnified or diminished compared to the conventional neoclassical gains from market integration in tourism.

We outline the theoretical framework in what follows, and Section IV describes the model calibration and presents the counterfactual analysis. Online Appendix Section 3 provides additional details about the structure of the model.

### A. *Model Setup*

The theoretical framework is a spatial equilibrium model in the spirit of Allen and Arkolakis (2014) and Ahlfeldt et al. (2015), with multiple sectors and input-output linkages as in Caliendo et al. (2018). It adapts the framework in three dimensions that capture important features of our empirical context. First, in addition to trade in manufacturing goods and labor mobility, it allows for trade in tourism-related services through consumers who can travel to destination regions and consume non-traded tourism services on their trips. Second, the development of the local tourism sector is made possible by government investments in tourism infrastructure. These investments are financed by a federal tax.[27] Third, in addition to the traditional within-sector source of agglomeration economies, the model features local cross-sector spillovers between the services sector and manufacturing.

In the model, regions within Mexico differ ex ante in three dimensions: their level of productivity for manufacturing goods, their level of attractiveness for tourism, and their level of local amenities for residents. Regions trade goods with each other and the rest of the world, and host international and domestic tourists that spend part of their income outside of their region of residence. Regions in the world are indexed by $n \in 1, \ldots, N$. Workers are mobile within Mexico. The share of workers in each Mexican region, $L_n/L_{\mathcal{M}}$ for $n \in \mathcal{M}$, is an endogenous outcome. For simplicity, we do not model intra-country heterogeneity for countries other than Mexico, whose population is exogenously given and equal to $L_n$ for $n \in \overline{\mathcal{M}}$. The model is static and aims at capturing the long-run steady state of the economy.[28]

**Household Preferences:** Each worker supplies one unit of labor inelastically. They earn labor income $w_n$, which is taxed at rate $\iota$ by the government to finance public investments. Workers derive utility from the consumption of a bundle of goods and services as well as from the local amenities of the region where they live, subject to idiosyncratic preference shocks. The utility of a worker living in region $n$ of her country is

$$U_n(\omega) = \varepsilon_n(\omega) C_n B_n L_n^{\epsilon}, \tag{2}$$

where $C_n$ is the consumption bundle of goods and services, $B_n$ is the exogenous amenity differences between regions, and term $L_n^{\epsilon}$ allows for that amenity to respond endogenously to how populated the region is. This aims to capture, in a reduced-form way, the notion that more populated regions can be either more congested, leading to a decrease in the utility of local residents (if $\epsilon \leq 0$), or more attractive, as the concentration of population gives rise endogenously to better local amenities (e.g., more sources of entertainment, variety in consumption, etc.). Finally, each worker $\omega$ has a set of idiosyncratic preferences $\varepsilon_n(\omega)$ for living in different regions $n$ of her country. They are drawn from a Fréchet distribution with mean 1 and dispersion parameter $\kappa$. Workers within Mexico choose to live in the region that maximizes their utility, so that worker $\omega$'s utility is $U(\omega) = \max_{n \in \mathcal{M}} \varepsilon_n(\omega) C_n B_n L_n^{\epsilon}$.

[27] Fajgelbaum et al. (2019) develop a spatial equilibrium that features taxation and public investment by local governments. Here taxation and investments are made by the national government.

[28] To provide corroborating evidence, online Appendix Table A.18 documents that our instruments do not lead to systematically different local effects in 2010 compared to 2000 economic outcomes.

Workers consume a bundle of local non-traded services ($C_s$), traded tourism-related services ($C_T$) and traded manufacturing goods ($C_M$), according to the following preferences:[29]

$$C_n = \left(\frac{1}{\alpha_{MT}}\left[C_{M,n}^{\frac{\rho-1}{\rho}} + C_{T,n}^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}\right)^{\alpha_{MT}} \left(\frac{1}{\alpha_S}C_{S,n}\right)^{\alpha_s}, \tag{3}$$

where the elasticity of substitution between tourism-related services and manufacturing goods is $\rho > 1$, and $\alpha_{MT} + \alpha_S = 1$. Workers spend a constant share of their income on local services.[30] We write $P_{M,n}$ the price of the composite manufacturing good, and $P_{T,n}$ the price of the bundle of tourism-related services for a consumer located in region $n$. The composite traded price index for the bundle of manufactured goods and tourism services is then $P_{MT,n} = \left(P_{M,n}^{1-\rho} + P_{T,n}^{1-\rho}\right)^{\frac{1}{1-\rho}}$, and the share of total spending in region $n$ on manufactured goods is $\alpha_{MT}\chi_n$, where $\chi_n \equiv P_{M,n}^{1-\rho}/P_{MT,n}^{1-\rho}$.

Each worker has idiosyncratic preferences for the various destinations she could visit as a tourist, and makes a discrete choice of a region among all possible destination regions, including abroad. We make the following timing assumption: workers first set up their budget and the share of income they spend on tourism based on the expected utility derived from tourism. Then, their idiosyncratic preference draws are revealed and they choose their destination.[31] The utility that a worker $\omega$ who lives in region $n$ derives from visiting region $i$ is

$$C_{T,n}(\omega) = \frac{A_i q_{T,i} a_i^T(\omega)}{t_{ni}}, \tag{4}$$

where $q_{T,i}$ is the quantity of tourism services she consumes in region $i$, $A_i$ is a tourism attractiveness shifter for each destination $i$, $a_i^T(\omega)$ is an idiosyncratic preference shock for region $i$ drawn from a Fréchet distribution with shape parameter $\beta$ and mean 1, and $t_{ni}$ is a utility cost that tourists from origin region $n$ incur when visiting region $i$. It captures travel costs from the region of residence to the region visited, as well as other potential barriers to tourism, such as cultural differences between regions or language barriers. Given the properties of the Fréchet distribution, region $n$-workers' expected utility derived from tourism is

$$C_{T,n} = \left[\sum_{k=1}^{N}\left(\frac{A_k q_{T,k}}{t_{nk}}\right)^{\beta}\right]^{1/\beta},$$

[29] More generally, the demand function can be parametrized as $\left(\frac{\left[\beta_M C_{M,n}^{\frac{\rho-1}{\rho}} + \beta_T C_{T,n}^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}}{\alpha_{MT}}\right)^{\alpha_T}\left(\frac{C_{S,n}}{\alpha_S}\right)^{\alpha_s}$, but the preference weights $\beta_M$ and $\beta_T$ that capture the relative strength of consumer tastes for each good are not separately identified from difference in productivity between these two sectors, so we normalize these weights to 1. The calibrated productivities in each sector should therefore be understood as capturing both a productivity effect as well as demand weights.

[30] This is consistent with the interpretation of this local spending as housing expenditure. For example, Davis and Ortalo-Magné (2011) show that housing expenditure constitutes a nearly constant fraction of household income.

[31] The timing assumption is convenient to solve the model. In particular, it leads to expressions isomorphic to assuming constant elasticity of substitution (CES) demand.

and the corresponding price index for tourism services for travelers from region $n$ is $P_{T,n} \equiv \left[\sum_{k=1}^{N} A_k \left(t_{nk} p_{T,k}\right)^{-\beta}\right]^{-1/\beta}$, where $p_{T,k}$ is the price of tourism in destination region $k$. In turn, the share of region $n$ workers who visit region $i$ (and the share of tourism spending by region $n$ workers that is spent in region $i$) is

$$\lambda_{ni} = \frac{A_i \left(t_{ni} p_{T,i}\right)^{-\beta}}{\sum_{k=1}^{n} A_k \left(t_{nk} p_{T,k}\right)^{-\beta}}.$$

We now turn to the supply side of the economy. There are three sectors, indexed by $j$: tourism services ($j = T$), local non-traded services ($j = S$), and manufacturing ($j = M$). We also index labor, used as an input to production, using $L$.

**Tourism Services:** The production of tourism services requires some investment in tourism capital (e.g., tourist information centers, museums, restorations, marketing costs to attract tourists). The government uses tax revenue to finance the provision of this local tourism capital, which enters as a productivity shifter in the production of tourism services.[32] Tourism services are then produced under perfect competition by combining local labor, local services, and a composite manufacturing input, according to the production function $q_{T,n} = Z_{T,n} \prod_{j \in L,M,S} \left(m_{j,n}^{T}\right)^{\nu_T^j}$, where $Z_{T,n}$ is the productivity of tourism services in region $n$, $m_{j,n}^{T}$ is the input use of input $j$ in the production of tourism in region $n$, and $\sum_{j \in L,M,S} \nu_T^j = 1$.[33] The local productivity of tourism services is improved by public investment according to

$$Z_{T,n} = Z_{T,n}^{o(1-\alpha_G)} G_n^{\alpha_G}, \tag{5}$$

where $Z_{T,n}^{o}$ captures exogenous differences between regions, and $G_n$ is government spending to build tourism capital in region $n$.[34] This formulation of public investment as a productivity shifter is similar to the one proposed by Fajgelbaum et al. (2019). We assume that this investment is non-rival and benefits all producers in the local tourism industry. Investment in local tourism infrastructure $G_n$ is financed by an income tax $\iota$ levied on all workers in Mexico.[35] The unit cost of production of tourism services provided in region $n$ is

$$c_{T,n} = \frac{\Psi_T \left(w_n\right)^{\nu_T^L} \prod_{j \in M,S} P_{j,n}^{\nu_T^j}}{Z_{T,n}^{o(1-\alpha_G)} G_n^{\alpha_G}}, \tag{6}$$

[32] Equivalently, public investment could be modeled as shifting local tourism amenities $A_n$. The two formulations are isomorphic, as demand and productivity shifters for tourism play symmetric roles and are not separately identified.

[33] We revisit the assumption of perfect competition in online Appendix Section 4.6, where we allow for positive rents in the tourism sector, part of which can be repatriated by multinational investors.

[34] See Footnote 40 and online Appendix Section 4.6 for alternative specifications of the tourism production function.

[35] The presence of local spillovers creates a rationale for government intervention through taxes and local investment. We take the extent of government investment as given in the data, and do not attempt to study its optimality. See Fajgelbaum and Gaubert (2018) for a study of optimal federal taxation in the context of a spatial equilibrium model with spillovers.

where $\Psi_T = \prod_{j \in L,M,S} \left(\nu_T^j\right)^{-\nu_T^j}$ is a constant. Given perfect competition, this is also the local price of tourism services, $p_{T,n}$, faced by tourists when they visit region $n$. In the calibration, we refer to $\widetilde{A_i} = A_i Z_{T,i}^{\beta}$ as the tourism attractiveness shifter in region $i$, which captures both a productivity and an amenity shifter. It follows that tourism trade shares can be written as

(7) $$\lambda_{ni} = \frac{\widetilde{A_i}\left(t_{ni} w_i^{\nu_T^L} P_{M,i}^{\nu_T^M} P_{S,i}^{\nu_T^S}\right)^{-\beta}}{\sum_{k=1}^{N} \widetilde{A_k}\left(t_{nk} w_k^{\nu_T^L} P_{M,k}^{\nu_T^M} P_{S,k}^{\nu_T^S}\right)^{-\beta}},$$

and the price index for tourism services is

(8) $$P_{T,n} \equiv \left[\sum_{k=1}^{N} \widetilde{A_k}\left(t_{nk} w_k^{\nu_T^L} P_{M,k}^{\nu_T^M} P_{S,k}^{\nu_T^S}\right)^{-\beta}\right]^{-\frac{1}{\beta}}.$$

**Manufacturing Production:** Intermediate varieties from a continuum $x \in [0,1]$ are produced in each region, combining inputs to production indexed by $j \in \{L,S,M\}$ for labor, services, and manufacturing.[36] A competitive local sector aggregates intermediate varieties and sells this composite to (i) local final consumers, (ii) local intermediate producers in manufacturing and tourism who use it as an input to their production, and (iii) the Mexican government who uses it to build a local tourism capital.

The production function for intermediate varieties is constant returns to scale $(\sum_{j \in L,M,S} \nu_M^j = 1)$, with $q_{M,n}(x) = M_n z_n(x) \prod_{j \in L,M,S} m_{j,n}^M(x)^{\nu_M^j}$, where $q_{M,n}(x)$ is the quantity of the intermediate variety produced, $m_{j,n}^M$ is the input use of input $j$ for manufacturing production, $M_n$ is the local productivity in manufacturing, common to all varieties in region $n$, and $z_n(x)$ is the variety $x$-specific efficiency in region $n$ drawn from a Fréchet distribution with shape parameter $\theta$ and mean 1: $F(z) = e^{-Z^{-\theta}}$. It will prove convenient to define the unit cost of the local input bundle for manufacturing in region $n$ as $c_{M,n} = \Psi_M (w_n)^{\nu_M^L} \prod_{j \in M,S} P_{j,n}^{\nu_M^j}$, where $\Psi_M$ is a constant[37] and $P_{j,n}$ is the unit cost of input $j$. Firms incur an iceberg trade cost $\tau_{ni}$ to ship the manufacturing good from region $i$ to region $n$. Firms behave competitively and therefore price at unit cost. A perfectly competitive local sector aggregates these varieties into a composite manufacturing good. They source across regions and countries and purchase intermediate varieties from the lowest cost supplier. The composite manufacturing good is a CES aggregate of individual varieties $x \in [0,1]$ with elasticity of substitution $\sigma_M$ and price index $P_{M,n}$,

$$Q_{M,n} = \left[\int q_{M,n}(x)^{\frac{\sigma_M - 1}{\sigma_M}} dx\right]^{\frac{\sigma_M}{\sigma_M - 1}}; \quad P_{M,n} = \left[\int p_{M,n}(x)^{1-\sigma_M} dx\right]^{\frac{1}{1-\sigma_M}},$$

[36] Since the use of tourism services as intermediate inputs is close to zero in the Mexican input-output tables, we do not also model tourism as an input to production in other sectors.

[37] Specifically, $\Psi_M = \prod_{j \in L,M,S} \left(\nu_M^j\right)^{-\nu_M^j}$.

where $p_{M,n}(x) = \min_{i \in 1,\ldots,N}\left\{\frac{c_{M,i}\tau_{ni}}{M_i z_i(x)}\right\}$ as local aggregators in region $n$ source from the lowest cost region. Given the properties of the Fréchet distribution that governs local efficiency levels, the share of manufacturing spending that region $n$ spends on goods produced in region $i$ is

$$\pi_{ni} = \frac{\left(\tau_{ni} c_{M,i}\right)^{-\theta} M_i^{\theta}}{\sum_{k=1}^{N}\left(\tau_{nk} c_{M,k}\right)^{-\theta} M_k^{\theta}}, \tag{9}$$

and the price index for the composite manufacturing good in region $n$ is

$$P_{M,n} = \left[K_1 \sum_{k=1}^{N}\left(\tau_{nk} c_{M,k}\right)^{-\theta} M_k^{\theta}\right]^{-\frac{1}{\theta}}, \tag{10}$$

where $K_1 = \left(\Gamma\left(\frac{\theta - \sigma_M + 1}{\theta}\right)\right)^{\frac{1}{1-\sigma_M}}$ is a constant.

*Agglomeration Forces*.—We allow for the presence of different sources of local production externalities. In particular, the productivity of a region for manufacturing goods $M_n$ can be endogenous to the level of local economic activity. This externality can stem from the level of economic activity in the manufacturing sector $\left(L_{M,n}\right)$ and/or the level of economic activity in the services sector $\left(L_{ST,n} = L_{T,n} + L_{S,n}\right)$. In both cases, local productivity increases with the size of economic activity with a constant sector-specific elasticity (denoted respectively $\gamma_M$ and $\gamma_S$), so that

$$M_n = M_n^o L_{M,n}^{\gamma_M} L_{ST,n}^{\gamma_S}, \tag{11}$$

where $M_n^o$ is the exogenous component of local productivity. This expression captures in a reduced-form way the channels through which local tourism expenditures can have positive or negative effects on traded goods production in the long run, beyond their neoclassical demand linkages. For example, it has been argued that tourism could act as a special case of the "Dutch disease," shifting activity into stagnant services sectors and away from manufacturing with higher potential for productivity growth. Expression (11) allows for tourism to have such adverse long-term consequences if, for example, $\gamma_M > 0$ but $\gamma_S = 0$. In that case, the development of tourism attracts workers away from manufacturing, a sector in which scale matters for productivity, causing a decrease in productivity. On the other hand, tourism could give rise to productivity spillovers that would not have materialized otherwise, if, for example, $\gamma_S > 0$ while $\gamma_M = 0$. There are a number of channels through which the development of tourism can a priori lead to positive spillovers on the manufacturing sector. For example, the development of tourism can improve the provision of local business services, such as finance, accounting, or consulting. Tourism revenues can also directly loosen the credit constraints of local firms. Alternatively, tourism could lead to a better-trained local workforce, spur more entrepreneurship by offering business opportunities, or facilitate domestic and international business networks through increased travel activity. All of these effects are summarized by the parameter $\gamma_S$.

**Local Non-Traded Services:** Finally, local services are produced and consumed by local residents. They are produced using local labor with constant returns to scale and productivity $R_n$, so that $P_{S,n} = w_n/R_n$.[38] Since $R_n$ is not identified independently from the level of local amenities $B_n$ in what follows, we choose to normalize $R_n = 1$ and interpret $B_n$ as indicating a combination of the level of local amenities and the productivity of local non-traded services.

## B. *Equilibrium*

Mexican workers choose in which region to live within Mexico. Given the properties of the Fréchet distribution and the workers' utility maximization problem in (2), the share of workers who choose to live in region $n \in \mathcal{M}$ can be expressed as

$$\text{(12)} \qquad \frac{L_n}{L_{\mathcal{M}}} = \frac{\left(B_n\left(\frac{w_n}{P_{MT,n}}\right)^{\alpha_{MT}}\right)^{\tilde{\kappa}}}{\sum_{k\in\mathcal{M}}\left(B_k\left(\frac{w_k}{P_{MT,k}}\right)^{\alpha_{MT}}\right)^{\tilde{\kappa}}}, \quad \text{for } n \in \mathcal{M},$$

where we define

$$\tilde{\kappa} \equiv \frac{\kappa}{1-\kappa\epsilon}.$$

Note that here, as for welfare below, the parameters $\kappa$ and $\epsilon$ enter only through their combined effect in $\widetilde{\kappa}$. The three market clearing conditions for the manufacturing goods market, the tourism services market, and the market for local services lead to the following system of $3 \times N$ equations. For all regions $i \in \left(1, \ldots, N\right)$,

$$\text{(13)} \qquad w_i L_{i,M} = \nu_M^L \sum_{n=1}^{N}\left(\alpha_{MT} w_n (1-\iota) L_n \chi_n + \sum_{j\in T,M}\frac{\nu_j^M}{\nu_j^L} w_n L_{n,j} + G_n\right)\pi_{ni},$$

$$\text{(14)} \qquad w_i L_{i,T} = \nu_T^L \sum_{n=1}^{N} \alpha_{MT} w_n (1-\iota) L_n (1-\chi_n) \lambda_{ni},$$

$$\text{(15)} \qquad w_i L_{i,S} = \alpha_S w_i (1-\iota) L_i + \sum_{j\in T,M}\frac{\nu_j^S}{\nu_j^L} w_i L_{i,j}.$$

Equation (13) is the labor market clearing in the manufacturing sector. It equates (on the left-hand side) the wage bill in manufacturing to a constant share of total manufacturing sales (on the right). The corresponding share $\nu_M^L$ is the Cobb-Douglas share of labor in gross output. Manufacturing sales in region $i$ are the sum across all regions of expenditures on manufacturing in that region, coming from (i) final consumption, (ii) intermediate input consumption, and (iii) government purchases for investment, multiplied by the fraction $\pi_{ni}$ of manufacturing expenditure spent on region $i$'s products. We describe these three terms in the parentheses in turn. The first is the expenditure of region $n$ on final manufacturing consumption. Recall that

[38] These services can be interpreted as housing. Formally, modeling housing as in, e.g., Redding (2016), leads to isomorphic expressions.

expenditures on traded goods and services are a constant fraction $\alpha_{MT}$ of income in that region net of taxes (captured by $w_n(1-\iota)L_n$). Then, a share $\chi_n$ of that total is spent on manufacturing, the rest being spent on tourism services. The second term is the intermediate input use of manufacturing by downstream sectors. For downstream sector $j$, it is equal to a constant share $\nu_j^M$ of gross output, itself a constant fraction $1/\nu_j^L$ of the wage bill $w_n L_{n,j}$ of that sector-region pair, given the Cobb-Douglas production functions. The third term is government spending in region $n$. Equations (14) and (15) follow the same logic for the labor market clearing in the tourism sector in region $i$, and the services sector in region $i$ respectively. Finally, the government budget balance condition is[39]

$$\sum_{\mathcal{M}} G_n = \sum_{\mathcal{M}} \iota L_n w_n. \tag{16}$$

Equations (9)–(16) define an equilibrium of the economy. There could be a priori multiple such equilibria. We come back to this point below.

### C. *Welfare Impact of Tourism Development*

The model lends itself naturally to welfare analysis. We use as a measure of welfare in a region the average utility level enjoyed by workers who live there. In any given spatial equilibrium, because of the free mobility of workers and the properties of the Fréchet distribution, this level of welfare is equalized across all Mexican regions. Given the workers' utility maximization problem in (2), this common welfare level can be expressed as

$$\begin{aligned} U_{\mathcal{M}} &= K_2\left[\sum_{k\in\mathcal{M}}\left(B_k(1-\iota)\left(\frac{w_k}{P_{MT,k}}\right)^{\alpha_{MT}}\right)^{\tilde{\kappa}}\right]^{\frac{1}{\tilde{\kappa}}} \\ &= K_3 B_n(1-\iota)\left(\frac{w_n}{P_{MT,n}}\right)^{\alpha_{MT}} L_n^{-\frac{1}{\tilde{\kappa}}}, \qquad \forall n \in \mathcal{M}, \end{aligned} \tag{17}$$

where the constant $K_2$ equals $\Gamma\left(\frac{\kappa-1}{\kappa}\right)L_{\mathcal{M}}^{\epsilon}$ and the constant $K_3$ equals $\Gamma\left(\frac{\kappa-1}{\kappa}\right)^{-1}L_{\mathcal{M}}^{\frac{1}{\kappa}}$. Welfare is a power mean, across all Mexican regions, of a measure of local utility that includes local real income, net of taxes, and local amenities.

To quantify the welfare gains brought about by tourism in Mexico, we run the following thought experiment. We compare the level of welfare in Mexico in the current equilibrium to what it would be in a counterfactual equilibrium were tourism would be absent, all else equal. By doing so, we propose a measure of what would be the welfare losses that Mexicans would incur without the tourism sector. For ease

[39] We assume for simplicity that aggregate trade is balanced in Mexico. In the data, Mexico runs a very small trade deficit. The model can be readily adapted to account for this aggregate deficit in the spirit of Dekle, Eaton, and Kortum (2007) and Caliendo and Parro (2015). We have experimented with this specification, allocating the aggregate deficit to regions in proportion to local GDP, and found that results remain stable when accounting for this deficit.

of exposition, we then report the inverse of this measure as the "gains from tourism," with a slight abuse of terminology.

**Counterfactual Equilibria:** To create this counterfactual equilibrium, we model a world with the exact same exogenous determinants as in the current-day baseline equilibrium, except that we assume that the Mexican government does not provide investments in the required tourism capital, so that tourism productivity is zero in all regions of Mexico. This shuts down both domestic and international tourism in Mexico. This approach provides a natural measure of the gains from tourism, ceteris paribus. In particular, it nets out from the gains from tourism the cost of deploying tourism infrastructure incurred by Mexican tax payers through the government. In the counterfactual equilibrium without tourism, there are no taxes levied on Mexican workers to finance tourism infrastructure. This force, ceteris paribus, tends to push real incomes up in the counterfactual equilibrium without tourism.[40] Finally, since mobile workers relocate and arbitrage away differences in welfare across regions, the difference in welfare between these two equilibria is identical across all Mexican regions, irrespective of their level of exposure to tourism.

In order to study the impact of international tourism alone, we then consider a second counterfactual equilibrium. We assume that there are prohibitive travel frictions to international tourism, but that there is still inter-regional tourism within the borders of Mexico, and we compute the welfare changes between the current and this counterfactual equilibrium. In this second counterfactual, we assume that without international tourism, tourism investments by the government and the corresponding tax $\iota$ are scaled down in proportion to the relative size of international tourism to total tourism in the baseline equilibrium.[41] In both counterfactuals, we assume that all other exogenous fundamentals of the economy stay unchanged between equilibria.

To solve for these counterfactual equilibria, we follow the methodology introduced by Dekle et al. (2007) and generalized to spatial equilibria in Caliendo et al. (2018) and Redding (2016), and express the equilibrium conditions of the model in changes relative to their baseline values. Online Appendix Section 3 describes the system of equations. This system allows us to solve for a counterfactual equilibrium of the economy corresponding to a change in tourism investment, as captured by a change in the income tax $\hat{\iota} = 0$, and/or by a change in travel frictions $\hat{t}_{ni}$, given the parameters of the model $\left(\nu_j^{j'}, \alpha_{MT}, \alpha_G, \beta, \theta, \rho, \widetilde{\kappa}\right)$ for $j, j' \in L, M, S, T$ and the

[40] Two comments are in order here. First, note that an alternative approach would be to evaluate the gains from trade in tourism relative to a counterfactual equilibrium in which all travel frictions are prohibitively high. The counterfactual change from today's observed level of tourism to tourism autarky would be identical to the approach we adopt here, except for not taking account of the cost of public investments. Second, the result that shutting down government investment in tourism shuts down tourism in Mexico relies on an assumption, often made in the macro-development literature (e.g., Aschauer 1989, Baxter and King 1993, Leduc and Wilson 2013), that public investment in infrastructure is a Cobb-Douglas complement to other types of infrastructure in the production of tourism. In online Appendix Section 4.6, we explore alternative cases in which government investment is instead a substitute for other types of infrastructure in the production of tourism, so that some level of tourism persists after shutting down government investments.

[41] That is,

$$\hat{\iota} = \hat{G}_n = \frac{\sum_{n \in \mathcal{M}} w_n L_n (1 - \chi_n) \left(\sum_{i \in \mathcal{M}} \lambda_{ni}\right)}{\sum_{n=1}^{N} w_n L_n (1 - \chi_n) \left(\sum_{i \in \mathcal{M}} \lambda_{ni}\right)}.$$

values of the endogenous variables $(\pi_{nj}, \lambda_{nj}, \chi_n, w_n, L_{M,n}, L_{T,n}, L_{S,n}, G_n)$ in the baseline equilibrium.

In the presence of within- and cross-sector spillovers and input-output linkages, the uniqueness of the equilibrium is not guaranteed.[42] To evaluate the welfare gains from tourism, we solve for the counterfactual equilibrium that is the closest to the baseline equilibrium we observe in the data. That is, we use the values of the variables from the current equilibrium as a starting point for the counterfactual equilibrium. The numerical procedure that looks for the counterfactual equilibrium then updates the candidate value of endogenous variables based on a weighted average of this initial guess and the new values that come out of solving the model. The procedure is iterated until new values and initial values converge.

### D. *Role of Local Spillovers*

We close the description of the model with a discussion of how local and aggregate productivity endogenously changes between equilibria that differ in their degree of tourism development. To that end, we can rewrite local manufacturing productivity defined in (11) as

$$M_n = M_n^o s_{M,n}^{\gamma_M}\left(1 - s_{M,n}\right)^{\gamma_S} L_n^{\gamma_S+\gamma_M},$$

where $s_{M,n}$ denotes the share of workers of region $n$ working in manufacturing. Manufacturing productivity responds to (i) the change in local scale of economic activity, captured by the term $L_n^{\gamma_S+\gamma_M}$ (the agglomeration effect), and (ii) the change in the composition of economic activity, captured by the term $s_{M,n}^{\gamma_M}\left(1 - s_{M,n}\right)^{\gamma_S}$ (the sectoral reallocation effect). We examine these two channels in turn.

**Agglomeration Effect:** Assume that there is a positive shock to the tourism sector. In regions with high touristic attractiveness, the development of tourism tends to raise real wages and attract more workers. Through the classic agglomeration effect, this increase in population density boosts local manufacturing productivity. In the aggregate, however, increases in employment in touristic regions are counterbalanced by decreases in employment in other areas. Since productivity responds with constant elasticity to employment changes, productivity gains in some regions are thus offset by productivity losses in others. This is similar to Kline and Moretti (2014): the classical agglomeration channel leads to muted effects in the aggregate because the total population is fixed.

**Sectoral Reallocation Effect:** Our framework gives rise to an additional sectoral reallocation effect as tourism develops. Through $s_{M,n}^{\gamma_M}\left(1 - s_{M,n}\right)^{\gamma_S}$ above, agglomeration spillovers operate more strongly when both local services and manufacturing

[42] The model does not fit the assumptions of gravity models of trade in Allen, Arkolakis, and Li (2014), as the tourism and the manufacturing sectors are allowed to differ in trade elasticities. Alternatively, the proof of uniqueness of a multi-sector multi-country trade model developed in Allen, Arkolakis, and Li (n.d.) does not directly apply here, because our model has two additional layers: (i) mobility of workers within Mexico, and (ii) local productivity that is endogenous to the level of local economic activity.

sectors are sufficiently developed in an area, so that the manufacturing sector can benefit from both within- and cross-sector spillovers. In particular, the value of the spillover parameters $\gamma_S$ and $\gamma_M$ determine what this optimal balance is. For example, when $\gamma_S = \gamma_M$, the optimal sectoral mix to maximize agglomeration forces is an equal balance of manufacturing and local services. In contrast, when $\gamma_S = 0$, local agglomeration externalities are highest under full local specialization in traded goods production.

A positive shock to local tourism attracts workers away from manufacturing. For nonzero values of $\gamma_S$ and $\gamma_M$, the effect on local productivity through the reallocation effect is a priori ambiguous. In regions with high preexisting shares of manufacturing, the development of tourism is more likely to reinforce the classical agglomeration force, as the local economy moves closer to an optimal sectoral balance. In contrast, in regions with low preexisting shares of manufacturing employment, the reallocation effect is more likely to work in the opposite direction of the classical agglomeration force, as we move further from the optimal balance. Again, the values of $\gamma_S$ and $\gamma_M$ govern what this balance is.

In the aggregate, the effect of tourism development on productivity will thus depend on the parameter values of $\gamma_S$ and $\gamma_M$, but also on the initial distribution of activity across sectors $s_{M,n}$ in each region, and how this geography is related to initial differences in local tourism attractiveness. Overall, in a framework featuring both within- and cross-sector agglomeration forces, sectoral shocks across regions can in principle give rise to positive as well as negative productivity gains, both locally and in the aggregate.

## IV. Calibration and Quantification

### A. *Calibration*

Adapting Redding (2016) to our setup (and in particular Proposition 6) leads to the following data requirements for the model calibration: given parameters $\left(\nu_j^{j'}, \alpha_{MT}, \alpha_G, \beta, \theta, \rho, \widetilde{\kappa}, \gamma_M, \gamma_S\right)$, bilateral trade costs $\left(\tau_{ni}, t_{ni}\right)$ and regional data on wages, employment, sectoral employment shares, and public investment in tourism $(w_n, L_n, L_{M,n}, L_{T,n}, G_n)$, there exist unique values of residential amenities $(B_n)$, manufacturing productivities $(M_n^0)$, and tourism attractiveness shifters $(A_n)$ that are consistent with the data up to a normalization that corresponds to a choice of units in which to measure productivity and amenities.

The calibration of the model proceeds sequentially in three main steps. In the first step, we calibrate the model to today's reference equilibrium corresponding to the observed level of economic activity, trade and tourism. This allows us to recover a vector of, possibly endogenous, model-based manufacturing productivities, $M_n$, and a set of local tourism shifters $A_n$. This step requires data on $(w_n, L_n, L_{M,n}, L_{T,n}, G_n)$ and parameters $\left(\nu_j^{j'}, \alpha_{MT}, \alpha_G, \beta, \theta, \rho\right)$ together with a parameterization of bilateral trade costs, but does not require knowledge of the spatial labor supply elasticity $(\widetilde{\kappa})$ or agglomeration parameters $\left(\gamma_M, \gamma_S\right)$. In the second and third steps of the calibration, we use the calibrated model in combination the our instrumental variable strategy from Section II to estimate these parameters in turn. We describe the procedure and data below, and online Appendix Section 4 provides additional details.

The model is calibrated to the mean of inflation-adjusted outcomes for 2000 and 2010 as the baseline period.[43] In order to limit the computational requirement, we aggregate the data coming from each of the 2,455 Mexican municipalities described in the motivating evidence into a set of 300 regions. Specifically, we keep the 150 coastal municipalities unchanged, but aggregate the interior municipalities to 150 economic centers located at the centroids of the largest 150 interior municipalities. This aggregation is largely inconsequential for our welfare quantification, as we discuss in online Appendix Section 4.5 (Tables A.30 and A.31).[44] For simplicity, we aggregate all countries but Mexico into a "Rest of the World" (RoW) aggregate (see online Appendix Section 4.1).

**Regional Data and Measurement Error:** We use nominal wage and local employment data from the Mexican population censuses as our measures of $w_n$ and $L_n$.[45] To measure the size of the tourism, manufacturing, and non-traded services sectors in each region, we combine information from the Censos Económicos at the local level with aggregate data. The aggregate data we use are the shares of total GDP represented by the tourism, manufacturing, and services sectors from the Mexican national accounts, as well as input-output shares $\left(\nu_s^{s'}\right)$ that we calibrate using the 2003 Mexican input-output table (see online Appendix Section 4.2). With these data in hand, we first compute the Cobb-Douglas share of traded services $\alpha_{MT}$ and non-traded services $\alpha_S$ in consumption that ensures that in the aggregate the value-added share of traded and non-traded sectors match the data. This computation involves taking into account the input-output structure of the model (see online Appendix Section 4.1). We then calibrate the local shares of all sectors by region. To measure the relative regional shares of tourism and manufacturing value added, we use manufacturing GDP which is directly observable in all regions, and we use local hotel sales as a basis to calibrate local tourism GDP. We scale these hotel sales with a constant factor of proportion across all regions so that, in the aggregate, the relative size of tourism to manufacturing matches the ratio of tourism to manufacturing GDP in Mexico's national accounts data above.[46] Having calibrated the relative size of tourism in the traded sector in each region, we then compute the share of non-traded services workers in each region, accounting again for the fact that local non-traded services are used both for final consumption, as well as for the production of tourism and manufacturing. This procedure allows us to calibrate $\left(L_{S,n}, L_{T,n}, L_{M,n}\right)$ in all Mexican regions in a way that is consistent with the structure of the model. Finally, to allow for measurement error in the data we input to the model, we bootstrap our whole quantification procedure after treating the regional data that we feed into the calibration (wages, population, hotel sales, and

[43] As discussed in Section II, the population census data are for 2000 and 2010, while the economic census data are for 1998 and 2008.

[44] The key empirical moments we use to inform the calibration are based on variation among coastal municipalities (similar to the regression analysis above) that are unaffected by this aggregation.

[45] To aggregate interior regions, we take the sum of employment and the employment-weighted mean of wages.

[46] For the small number of regions for which this procedure predicts an employment in the tourism sector that is higher than the total employment in services reported in this region, we cap tourism employment at the level reported for the services sector as a whole.

manufacturing GDP) as point estimates with a signal-to-noise ratio of 80–20, rather than data points (see online Appendix Section 4.4).[47]

**Public Investment in Tourism:** To estimate the public investment in local tourism infrastructure $G_n$, we use data on the municipality stock of public investment in tourism development in Mexico that we convert into equivalent steady-state annual flows, consistent with our static model. We calibrate the share $\alpha_G$ from equation (5) using the ratio of government investment over total tourism GDP, which leads to $\alpha_G = 0.036$. This is close to related elasticities estimated in, e.g., Fajgelbaum et al. (2019). To calibrate the common tax level that allows to finance this public investment, we compute $\iota = 0.5\%$ as the share of Mexico's GDP represented by this total annualized investment $\left(\iota = \sum_{\mathcal{M}} G_n / GDP\right)$. Online Appendix Sections 2 and 4 provide additional details about the data and calibration.

**Trade Costs for Goods and Tourism:** Data on trade and tourism flows are available for international flows. We take aggregate trade flows for manufacturing and tourism between Mexico and RoW from the World Bank's WITS database for cross-country trade in goods and services. We calibrate border frictions for trade in goods and tourism such that the model matches exactly the aggregate trade data in manufactured goods and tourism between Mexico and the rest of the world.[48] Unfortunately, similar data are not available for intra-country flows within Mexico. We therefore parameterize trade costs within Mexico as following a function of regional bilateral distances, as in Redding (2016),

$$\tau_{nj}^{-\theta} = d_{nj}^{-D_M} \quad \text{and} \quad t_{nj}^{-\beta} = d_{nj}^{-D_T}, \quad \text{for } (n,j) \in \mathcal{M} \times \mathcal{M},$$

where $d_{nj}$ is the distance between the centroid of the two regions $n$ and $j$.[49] We calibrate the distance decay elasticity for trade in goods following the literature $(D_M = 1)$. For tourism trade flows, we use the data on bilateral tourism exports described in Section I and online Appendix Section 2 to estimate a gravity equation using Poisson pseudo-maximum-likelihood (PPML) following Silva and Tenreyro (2006) with log distance in addition to origin-by-year fixed effects, destination-by-year fixed effects, and dummies for common border, language, colonial ties, and travel visa requirements on the right-hand side.[50] As depicted in online Appendix Figure A.1, we find a distance elasticity for tourism trade $D_T = 0.96$ (standard error of 0.043 clustered at the level of origin-destination pairs). To provide additional evidence whether the lack of data on within-country tourism flows is likely to affect counterfactuals, we have also used information on the top five Mexican origin states for tourism flows to three destination states reported in an

[47] This procedure allows for a relatively large degree of measurement error in the national and regional accounts. We effectively draw regional outcomes from a normal distribution with mean equal to the observed regional values and a 95 percent confidence interval of $+/-$ 40 percent of that value.

[48] Specifically, frictions between region $n$ in Mexico and RoW are $d_{nj}^{-D_M} \tau_{Border}$ for manufacturing, and $d_{nj}^{-D_T} t_{Border}$ for tourism. The parameters $\tau_{Border}$ and $t_{Border}$ are calibrated such that values of $\lambda_{in}$ and $\pi_{in}$ summed over all Mexican regions match exactly the data for international flows.

[49] The within-region distance is normalized at the minimum of between-region distances.

[50] Data on bilateral travel visa requirements (dummy equal to 1 if no waiver for tourist visas applies) were provided for the year 2004 by Oxford's International Migration Institute (IMI).

internal report by SECTUR (2011). As reported in online Appendix Table A.20, we find that the calibrated model does a good job at capturing the top origin regions, providing some support that the assumption of gravity in domestic tourism flows is a reasonable approximation.

**Additional Parameters:** For the value of the trade elasticity for flows of goods, we use the estimate $\theta = 6.1$ from Adao, Costinot, and Donaldson (2017). This estimate is also in line with other existing estimates reported in the literature (Head and Mayer 2014). To estimate the parameter $\beta$ that governs the elasticity of substitution $(1+\beta)$ between destinations, we use the panel data on country-level bilateral tourism exports as detailed in online Appendix Section 4.2. To be conservative in our quantification of the gains from tourism, we pick the upper bound of the estimate of the tourism trade elasticity supported by the data $(1+\beta = 2.5)$. Finally, the value of the upper-nest elasticity of substitution between manufacturing and tourism has to be smaller than the lower-nest value. We set it at the same level $\left(\rho = 2.5\right)$, again to be conservative.

*First Step: Calibration of Regional Fundamentals.*—Using information on $(w_n, L_{M,n}, L_{S,n}, L_{T,n}, G_n)$ with parameters $\left(\nu_j^{j'}, \alpha_{MT}, \alpha_G, \beta, \theta, \rho\right)$, we calibrate the baseline equilibrium according to equations (9), (10), (7), (8), (13), (14), and (15). Following Redding (2016), we invert the calibrated model to recover the unique tourism and manufacturing shifters $\widetilde{A_n}$ and $M_n$ (up to scale) that are consistent with the data. Using the above calibrated $\alpha_G$ and data on $G_n$, we can further decompose $\widetilde{A_n}\ (= A_n G_n^{\beta\alpha_G})$ into a fundamental component $A_n$ and a part driven by government investment.[51] As mentioned above, in the presence of spillovers there is a potential for multiple equilibria in the model. Conditional on the data we observe, though, the mapping to unobserved productivities and tourism shifters is unique.[52]

*Second Step: Spatial Labor Supply Elasticity.*—The estimating equation for the long-run spatial labor supply elasticity is directly derived from equation (12) of the model,

$$\log L_n = K_o + \widetilde{\kappa} \log\left(\left(\frac{w_n}{P_{MT,n}}\right)^{\alpha_{MT}}\right) + \xi_n \quad \text{for } n \in \mathcal{M}. \tag{18}$$

We estimate equation (18) instrumenting for $\log\left(\left(w_n/P_{MT,n}\right)^{\alpha_{MT}}\right)$ with our three tourism attractiveness instruments that we discuss in Section II. This addresses the concern that the OLS estimate is likely downward-biased because it confounds variation in labor demand and supply in the estimation of the supply elasticity. Moreover, measurement error in real wages would also lead to a downward bias. As reported

[51] We normalize $Z_{T,n}^o$ to 1 as it is not separately identified from $A_n$. We also verify the extent to which the model-based measures of local tourism attractiveness are correlated with our tourism IVs and the calibrated regional hotel sales for both $\widetilde{A_n}$ and $A_n$. For all three IVs and hotel sales we find a statistically significant correlation as reported in online Appendix Table A.19.

[52] That is, the possibility of multiple equilibria arises when conducting counterfactual analysis, not at the calibration stage.

in online Appendix Table A.21, we find an IV point estimate of 6.35 that is indeed larger than in OLS (1.91). Both estimates are statistically significant at the 1 percent level. The IV estimate is larger than estimates of the short-run spatial labor supply elasticity that are commonly estimated in the literature to be around 2, but signals that even from a long-run perspective, there are significant frictions to mobility: the elasticity is far from infinite even though tourism has had decades to materialize into the current spatial equilibrium.[53]

Finally, as discussed in Section II, we use the empirical strategy above to construct the regional amenity measures used as the outcome variables in the model-based robustness regressions in online Appendix Table A.4. In particular, we construct three different vectors of regional amenities. Each of them is computed as the residual variation in local population that is left unexplained by variation in real wages (i.e., the residual in specification (18)). We construct this variable three different times, using specification (18), in order to exclude each of the three instruments separately when estimating $\widetilde{\kappa}$. This ensures that we do not build in a mechanical orthogonality condition between local amenities and our instruments when testing whether our instruments are correlated with the model-based measures of the local amenities of residents.

*Third Step: Agglomeration Forces*.—To fully characterize the effect of tourism on long-run economic outcomes, we require estimates of the within- and cross-sector spillovers on manufacturing production $(\gamma_M, \gamma_S)$. To estimate these, we combine model-based indirect inference with the exclusion restrictions of the IV strategy that we develop in Section II. In particular, we derive several moment conditions that must hold under the exclusion restrictions in a counterfactual spatial equilibrium in the absence of tourism activity. We then simulate the model and calibrate the combination of the within- and cross-sector agglomeration elasticities such that these moments hold as close as possible through the lens of the calibrated model.

The exclusion restrictions of our empirical strategy above imply that each of the three measures of tourism attractiveness are orthogonal to (i) the exogenous manufacturing productivity of places $M_n^o$, and (ii) the counterfactual distribution of population in Mexico in the absence of tourism activity.[54] Using these restrictions, we define the six following moment conditions:

$$E\left[z_n^{(j)} \log M_n^o\right] = 0, \quad \text{for } j \in \{1,2,3\}, \tag{19}$$

and

$$E\left[z_n^{(j)} \log L_n^o\right] = 0, \quad \text{for } j \in \{1,2,3\}, \tag{20}$$

where $\{L_n^o\}_{n \in \mathcal{M}}$ denotes the (counterfactual) distribution of population in Mexico absent tourism, $M_n^o$ is the exogenous component of local productivity, and $z_n^{(j)}$ for $j = 1, \ldots, 3$ denote the beach, island and ruins instrumental variables. We simulate

[53] See, e.g., Fajgelbaum et al. (2019) for a discussion of the estimates of the labor supply elasticity in the literature.

[54] Conditional on orthogonality with respect to $M_n^o$ and $L_n^o$ in the no-tourism counterfactual equilibrium, no additional information would be provided by adding further orthogonality conditions (e.g., wages, GDP). As in Section II, orthogonality is conditional on the controls used in the empirical analysis that we continue to account for.

a counterfactual equilibrium without tourism for a range of candidate parameters $(\gamma_M, \gamma_S)$ and compute the correlations corresponding to (19) and (20) in the simulated model. We then identify the parameters for which these correlations are as close as possible to zero.[55]

Importantly, this procedure is based on an otherwise fully calibrated model that matches the current-day equilibrium with tourism, but is computed here for a counterfactual equilibrium without tourism. When estimating the agglomeration parameters, this counterfactual accounts and controls for all other general equilibrium forces through which tourism affects regional outcomes, such as input-output linkages to other sectors and migration. The procedure thus identifies the strength of cross- and within-sector agglomeration forces required to fit the observed correlation between regional outcomes and the instruments in today's equilibrium reported in Section II, while imposing zero correlations in the no-tourism counterfactual equilibrium.

The exclusion restrictions together with the structure of the model help us identify both the cross-sector spillover parameter, which requires variation in $L_{ST,n}$, and the within-sector spillover parameter that requires variation in $L_{M,n}$. Each of the three IVs impact both $L_{ST,n}$ and $L_{M,n}$. They impact $L_{ST,n}$ directly through tourism. Given the structure of the model, they also impact $L_{M,n}$ through spillovers and GE effects that make manufacturing employment a function of local tourism shifters. Furthermore, the two sets of moments we define in (19) and (20) provide distinct information to pin down the parameters. In the model, local population is a nonlinear function not only of local productivity $M_n^o$, which corresponds to the first set of moments, but also, through GE linkages and migration, of all of the fundamentals of the calibrated economy. Figure 2 summarizes these forces at work. We show graphically that the six moment conditions jointly identify the two parameters of interest by plotting the loss function that we minimize in the procedure across a range of candidate combinations for $(\gamma_M, \gamma_S)$. We find a bowl shape with a single parameter combination that minimizes the loss function across the six moment conditions. To provide further intuition on this result, we also document what the observed local effects of tourism in today's equilibrium would have been under alternative values of $\gamma_M$ and $\gamma_S$, as we report in Section IVB.

As depicted in Figure 2, we find that the best-fitting combination of parameters to match our moment conditions is $\hat{\gamma}_M = 0.064$ (with a standard error of 0.035) and $\hat{\gamma}_S = 0.087$ (standard error: 0.034).[56] The value of the within-sector spillover is on the higher end of measures of agglomeration externalities reported in Rosenthal and Strange (2004), but well within the range of estimates reviewed in for example Melo, Graham, and Noland (2009), and somewhat lower than found in more recent studies (e.g., Adao, Arkolakis, and Esposito 2017; Peters 2017). Our estimated cross-sector agglomeration force has no existing references in the literature to compare this to that we are aware of. As part of the quantification

[55] Specifically, we measure these correlations by regressing the simulated $\log M_n^o$ and $\log L_n^o$ on each of the three IVs, conditional on the full set of controls as in Section II. We then minimize a loss function that is the sum of these regression coefficients, weighted by the inverse of their standard errors. Online Appendix Section 4.3 provides additional details.

[56] To obtain standard errors, we bootstrap the procedure accounting for sampling error in both regional data and parameter estimates as described in online Appendix Section 4.4.

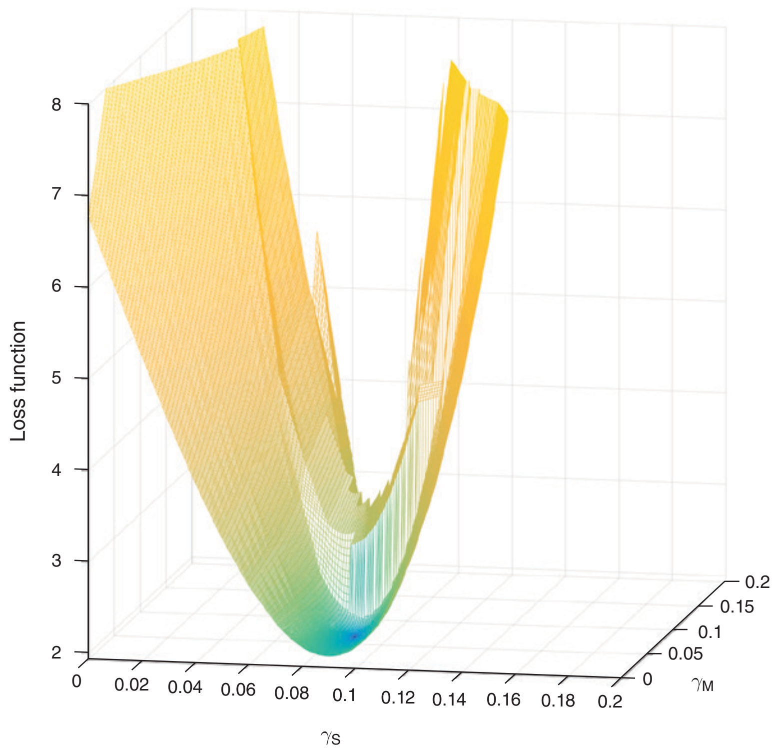


Figure 2. Indirect Inference for Best-Fitting Combination of Agglomeration Forces

*Note:* See Section IVA for discussion.

below, we also investigate counterfactual results across a range of alternative parameter combinations.

*Link between Local Effects and Quantification.*—As discussed in Section II, we can at this stage also examine the implications of potential violations of the exclusion restriction in the context of the model-based quantification of the gains from tourism. Upward- or downward-biased estimates of tourism's local effects on economic outcomes in today's observed equilibrium in Section II (e.g., due to correlations with amenities for residents or other omitted variables) would lead to two potential biases in the model's estimation. First, the estimate of $\widetilde{\kappa}$ from regression (18) would be biased in the same direction as the local effects (upward or downward). Second, it would also lead to a bias of our estimate of $\gamma_S$ in the same direction, as the moment conditions in (20) would be violated. In case of upward-biased local effects, the stronger-than-actual counterfactual population change among touristic places would falsely load onto $\gamma_S$, and vice versa in case of a downward bias. Using these insights, we can explore the sensitivity of our counterfactual analysis to alternative parameter combinations of $\widetilde{\kappa}$ and $\gamma_S$, relative to our preferred baseline estimates. As discussed below, we also explore a number of additional robustness exercises as part of the quantification.

Table 7—The Gains from Tourism

| | Estimated | No spillovers |
|---|---|---|
| Parameters | $\gamma_S = 0.087$<br>$\gamma_M = 0.064$ | $\gamma_S = 0$<br>$\gamma_M = 0$ |
| Gains from all tourism | 4.64%<br>(3.01, 9.03)<br>[3.67, 8.35] | 4.25%<br>(3.20, 6.85)<br>[3.35, 6.15] |
| Gains from international tourism | 1.82%<br>(0.80, 5.092)<br>[1.40, 4.74] | 2.38%<br>(1.91, 3.32)<br>[2.02, 3.18] |

*Notes:* See Section VB and online Appendix 4.4 for discussion. 95 percent confidence intervals below point estimates in round brackets, and 90 percent confidence intervals in square brackets.

## B. *Quantification*

**Gains from Tourism:** Table 7 presents our baseline estimates of the welfare gains from tourism, following the methodology described in Section IIIC.[57] The per capita welfare gains brought about by tourism amount to 4.64 percent (95 percent confidence interval 3.01–9.03). The development of international tourism contributes about 40 percent of these gains (1.82 percent), with the remainder stemming from the gains of inter-regional tourism within Mexico. As discussed in Section III, these gains are net of the government investments made over time to develop tourism in Mexico, as those are accounted for in our model. In particular, there are a savings associated with moving to a no-tourism equilibrium: the counterfactual equilibrium without tourism has no public spending on tourism, and no income tax taken on workers, contrary to the current equilibrium with trade in tourism.[58]

**Role of Spillovers:** Table 7 decomposes these welfare results into the neoclassical gains from tourism development, and those due to agglomeration economies. Interestingly, while the spillovers lead to large regional reallocations of production in Mexico (rationalizing the large observed local effects), their aggregate effect on Mexican welfare is more muted. In particular, in the absence of spillovers, the welfare gains from tourism development would have been 10 percent lower, at 4.25 percent.

To guide intuition as to what feature of the data is driving our results, we study in Table 8 a series of counterfactuals that correspond to alternative agglomeration forces. For each of these scenarios, Table 8 illustrates what would have been the outcome of the regression analysis of the local effects of tourism, and the corresponding aggregate welfare gains, if the data had been generated by the alternative parameterization of agglomeration forces, holding everything else constant. In particular, the

[57] The confidence intervals account for measurement error in the regional data we feed into the calibration in Section IVA and sampling error in the parameter estimates that enter the first step of the model calibration, as described in online Appendix Section 4.4.

[58] As discussed in Section III, in the counterfactual without international tourism, government investments are scaled back in proportion to the calibrated share of foreign tourists across regions in the model.

Table 8—The Role of Agglomeration Forces for Local and Aggregate Effects

| Dependent variable: | Counterfactual change in log total GDP | | | |
|---|---|---|---|---|
| | $\gamma_S = 0$<br>$\gamma_M = 0$ | $\gamma_S = 0$<br>$\gamma_M = 0.15$ | $\gamma_S = 0.15$<br>$\gamma_M = 0$ | $\gamma_S = 0.087$<br>$\gamma_M = 0.064$ |
| Parameters: | (1) | (2) | (3) | (4) |
| *Panel A. IV estimates* | | | | |
| log tourism GDP | 0.232 | 0.0478 | 0.657 | 0.409 |
| | (0.0549) | (0.0123) | (0.144) | (0.0900) |
| Coast FX | ✓ | ✓ | ✓ | ✓ |
| Full set of controls | ✓ | ✓ | ✓ | ✓ |
| Observations | 300 | 300 | 300 | 300 |
| Number of clusters | 32 | 32 | 32 | 32 |
| *Panel B. Reduced-form regressions* | | | | |
| Nearby island dummy | 0.321 | 0.064 | 0.918 | 0.561 |
| | (0.0832) | (0.0159) | (0.238) | (0.146) |
| Onshore fraction of white beach | 5.542 | 1.204 | 15.37 | 10.02 |
| | (1.456) | (0.278) | (4.160) | (2.552) |
| Pre-Hispanic ruins dummy | 0.0136 | 0.00546 | 0.0332 | 0.0213 |
| | (0.125) | (0.0239) | (0.357) | (0.219) |
| Coast FX | ✓ | ✓ | ✓ | ✓ |
| Full set of controls | ✓ | ✓ | ✓ | ✓ |
| Observations | 300 | 300 | 300 | 300 |
| Number of clusters | 32 | 32 | 32 | 32 |
| Gains from tourism (%) | 4.25 | 6.85 | 0.47 | 4.64 |

*Notes:* See Section VB for discussion. Point estimates in panel A are from an IV regression using the island, beach, and ruins instruments. Panel B presents the corresponding reduced-form estimates. Standard errors are clustered at the level of Mexican states.

table reports the estimated gains from tourism alongside the point estimates of the following regressions:

$$\widetilde{\Delta \log GDP_n^j} = \alpha_{coast}^j + \beta_1^j \log GDPTourism_n + \beta^{j'} X_n + \epsilon_n^j, \tag{21}$$

where the left-hand side measures model-based long-run regional changes in total GDP when moving from a no-tourism counterfactual equilibrium to today's spatial equilibrium. Each different parameterization of the agglomeration economies $(\gamma_M, \gamma_S)$, that we index by $j$ here, yields a different cross section of regional changes in local GDP on the left-hand side. On the right-hand side, we replicate the regression specification in (1), and instrument for local tourism GDP in today's equilibrium (which is equal to the counterfactual change in local tourism GDP in each of the $j$ counterfactuals) with the three IVs as previously in Section II.[59] As before, we report (21) both in reduced form (outcome on IVs) and as second-stage IV estimates.

[59] In these model-based regressions, the IV approach addresses the same types of concerns as discussed in Section II. The vector of tourism attractiveness shifters $(A_n)$ could be correlated with other local advantages, such as the $M_n$ and $B_n$, and in addition tourists incur a travel cost so that variation in tourism is also correlated with local market access. To address these confounding factors in (21), we use the three IVs under the same identifying assumptions as before.

Column 1 of Table 8 explores the case without any spillovers. In this case, tourism has an effect on local GDP that is about 60 percent the size of the effect we observe in the regression analysis (0.23 versus 0.4). The effect of tourism on local manufacturing is actually negative in this scenario. In absence of agglomeration forces, the development of tourism increases local factor prices, which in turn adversely affects manufacturing. It also brings about increased local market access (through additional consumer and input demand by tourism), but this alone is insufficient to overturn this adverse effect on traded goods production. In column 2, we shut down the cross-sector agglomeration force ($\gamma_S = 0$), but allow for relatively strong agglomeration economies within manufacturing ($\gamma_M = 0.15$). In this case, the development of tourism barely leads to an increase in local GDP relative to other regions. The adverse local effect of tourism on manufacturing described above is now reinforced by the presence of within-sector agglomeration externalities in manufacturing. The overall welfare gains from tourism are reduced to 0.47 percent. In this case, tourism acts as a special case of the Dutch disease. Resources are reallocated away from manufacturing goods production which, due to economies of scale within manufacturing, has negative implications for manufacturing productivity. Column 3 reports the polar opposite case where only relatively strong cross-sector spillovers are at play ($\gamma_S = 0.15$). The development of tourism has a strong positive effect on local manufacturing productivity which leads to a net positive effect on manufacturing GDP and total local GDP, significantly overshooting the effect in the reduced-form analysis and our preferred parameterization in column 4. In the aggregate, this leads to additional welfare benefits of the development of tourism due to a growth in manufacturing productivity that would not have otherwise occurred. Column 4 reports the results for the best fitting parameter values. The effect of tourism on local GDP is close to identical to what we observe in the regression analysis. About 60 percent of the effect of tourism on GDP (0.23) is driven by purely neoclassical channels, reported in column 1. The remainder is driven by agglomeration and co-agglomeration effects.

Finally, as shown in Table 7, an interesting contrast to these findings emerges when we focus on the gains from international-only tourism. Here, we find that the welfare gains brought about by international tourism are slightly dampened compared to what they would have been in the absence of spillovers. This asymmetry in the role of the agglomeration forces between the gains from tourism as a whole and the gains from international tourism relates to our discussion in Section IIID. In the case of international tourism, the regions most impacted have on average a lower share of manufacturing than the average regions impacted by domestic tourism across Mexican regions. Because of this, the reallocation of resources away from the manufacturing sector and into the services sector brought about by tourism, moves the economy further away from the optimal mix of sectors, from a spillover standpoint. That is, spillover losses induced by a lower scale in manufacturing dominate, because these regions start from an already low production point for manufacturing. Overall, these regions have more to lose by loosing manufacturing scale than by gaining scale in services. As a result, the estimated gains from international tourism are slightly lower than the gains that would have occurred in the absence of agglomeration economies (1.82 versus 2.38 percent).

*Extensions and Robustness*.—In the final part of the analysis, we investigate the sensitivity of our findings to a number of alternative modeling assumptions and parameter values. In the following, we focus on three sets of additional results, while online Appendix Section 4.6 presents additional results on the estimated gains when taking into account imperfect competition in the tourism sector and repatriation of the corresponding profits abroad. The online Appendix also explores what the local welfare effects of tourism would have been in the absence of labor mobility.

**Alternative Parameter Values:** We first explore the sensitivity of our estimated gains from tourism to different assumptions about the key parameters determining the size of the estimated gains from tourism. In particular, online Appendix Table A.23 reports the estimated gains from tourism across a range of parameter combinations for the trade elasticity of tourism $(\beta)$, the spatial labor supply elasticity $(\widetilde{\kappa})$, and the cross-sector co-agglomeration force $\gamma_S$. All other parameters are held constant at their values of our baseline calibration discussed above. We render a more detailed discussion of this sensitivity analysis to online Appendix Section 4.6, and focus here on the potential concern that residential amenities may be correlated with the IVs. As discussed above, this violation of the exclusion restriction would lead to upward-biased estimates of both $\widetilde{\kappa}$ and $\gamma_S$. Online Appendix Table A.23 documents two important insights on this question. First, these biases have opposite effects on the welfare gains from tourism: while larger values of the spatial labor supply elasticity result in lower estimated gains from tourism, the opposite is the case for tourism's cross-sector spillover. Second, the analysis sheds light on the sensitivity of our point estimates: for the range of values of $\widetilde{\kappa} \in (2.35, 6.35)$ and $\gamma_S \in (0, 0.087)$, the welfare gains from tourism are estimated to be in the range of 2.23 to 6.85 percent.[60]

**Non-Homotheticity:** With non-homothetic preferences for tourism-related services, part of the observed increase in Mexican tourism since the 1950s could be due to higher incomes. Although this would not invalidate the counterfactual we quantify above, it would matter for the interpretation of the results. To get a sense of the importance of such non-homotheticities, we use microdata from the Mexican income and expenditure surveys for the year 2004 and estimate the tourism Engel curve conditional on municipality-by-period fixed effects, as depicted in online Appendix Figure A.2. Using the estimate of this slope, and the fact that Mexican real GDP per capita grew by 135 percent over the period 1960–2010 (source: World Development Indicators), we find that non-homotheticity in Mexican consumption of tourism contribute about 0.3 percentage points of the long-run change in Mexican tourism GDP. We then recompute the welfare gains from tourism starting from a current-day equilibrium that assumes away this part of the demand for tourism services. We find that under this metric, non-homotheticities do not play a major role in shaping the welfare gains from tourism in our baseline counterfactual. As presented

[60] For completeness, we also report a second online Appendix Table A.24 where we keep $\gamma_S$ at the estimated 0.087 and report the gains from tourism across a range of values of $\widetilde{\kappa} \in (2.35, 6.35)$ and $\gamma_M \in (0, 0.064)$. The estimated gains are in the range of 4.30 and 8.58.

in online Appendix Table A.25, we find an estimate of the gains from tourism of 4.55 percent, which is very close to our baseline estimate (4.64).

**Transportation Infrastructure:** The analysis in Section II suggests that, while the local effects of tourism are quite robust to conditioning on public spending, part of the positive effect could be driven by better access to transport infrastructure. In the context of our quantitative analysis, this gives rise to the concern that part of the impact of tourism on manufacturing comes from an endogenous reduction in transport costs rather than productivity spillovers. In turn, this could lead to overstated welfare gains since the estimation of the cross-sector externality $(\gamma_S)$ could be upward biased due to this omitted increase in local market access. We explore the sensitivity of our results to this concern in three different ways. First, we repeat the whole quantitative analysis, but now assume that the development of tourism leads to the construction of federal highways between the top 20 percent of touristic municipalities along the coastline and their nearest state capital. Using GIS, we model this as a 50 percent reduction in bilateral trade costs between any pair of municipalities that are crossed by straight-line connections between the centroids of state capitals and tourism centers.[61] Second, we instead assume that the development of tourism brings about a 50 percent reduction in the trade costs of these tourism centers with respect to of all of their bilateral trading partners (all domestic regions and RoW). Third, we apply the estimated effect of tourism on bilateral transport costs on the Mexican transport network from Section II (Table 6). In particular, we obtain the second-stage IV estimate of that elasticity and use the highest of the three point estimates (0.036 in online Appendix Table A.26). We then make the assumption that each region's bilateral trade costs fell in proportion to their observed current-day levels of tourism, for regions above the twentieth percentile of tourism activity. We assume that trade costs do not change for regions below. In all three counterfactual exercises, touristic regions thus experience an endogenous increase in their transport costs as we move from today's spatial equilibrium to the counterfactual equilibrium in the absence of tourism. As reported in online Table A.27, we find estimates of $\gamma_S$ and $\gamma_M$ that are very close to our baseline estimates, ranging from 0.08–0.086 for $\gamma_S$ and 0.08–0.086 for $\gamma_M$. As expected, the spillovers from tourism $\gamma_S$ are somewhat weaker than in our baseline specification, but the magnitude of these changes is small across all three counterfactuals. In line with this, we find very similar gains from tourism that range between 4.61–5.23 compared to our baseline estimate of 4.64. Overall, these results provide some further reassurance that our findings are unlikely to be biased upward due to omitted increases in local market access.

## V. Conclusion

We study the economic consequences of the development of tourism, a fast-growing services sector in developing countries. To do this convincingly and comprehensively, we combine a rich collection of Mexican microdata with a spatial equilibrium model of trade in goods and tourism services and a new empirical strategy. The analysis

[61] Based differences in speed limits between Mexican federal highways and rural two-lane roads (110 versus 90 km/h), the 50 percent reduction would be an upper bound.

presents several findings. We find that tourism causes large and significant long-run local economic gains. Given that tourism has had more than five decades to shape relative regional economic outcomes in Mexico in a setting with labor mobility, the raw empirical moment speaking most directly to this effect is the fact that a 10 percent increase in local tourism revenues leads to a 2.5 percent increase in relative local employment and a 2 percent increase in the local population.

We find that these local effects are in part driven by sizable positive multiplier effects on manufacturing production. Taking account of other general equilibrium forces, such as input-output linkages and the gain in market access brought about by tourism, we find that these multiplier effects provide evidence of positive spillovers from the development of the local services sector on traded goods production. In particular, we estimate significant cross-sector spillovers in addition to within-sector localization economies within manufacturing. While these two sources of agglomeration economies reinforce one another locally, leading to the large observed reallocations of manufacturing and total GDP toward tourism centers in the data, we find that they in part offset one another for the aggregate implications of tourism. That is, while tourism leads to sizable gains in agglomeration economies at the local level, these gains are muted at the national level. Spillover effects contribute to about 10 percent of the total gains from tourism and the aggregate welfare gains are mainly driven by a classical market integration effect.

The analysis serves to inform currently ongoing policy debates in two main ways. First, we provide credible empirical evidence on the long-term effects of tourism activity on economic outcomes. Given that most of the current tourism policies are targeted at investing in the local attractiveness for tourism (the $\widetilde{A}_n$ in our framework), our results on both the local and aggregate implications of tourism integration are directly related to these policies. Second, this research provides a useful methodology combining empirical evidence with a spatial equilibrium model to study the propagation of localized and sector-specific economic shocks to aggregate outcomes in other empirical contexts of interest.

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