The Impact of Infrastructure on Services Trade: Evidence from the Oresund Bridge

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Abstract

How sensitive is services trade to distance, and how does improved connectivity shape services trade, labor markets, and their distributional consequences? We answer this question by exploiting the opening of the Øresund Bridge that lowered commuting and business travel costs between Sweden and Denmark while leaving freight costs largely unchanged. Gravity estimates of the distance elasticity of services trade are biased when infrastructure that facilitates business travel also integrates labor markets, confounding trade and commuting responses. We develop a structural spatial model with commuting, migration, and services trade to separately identify these channels. The distance elasticity of services trade ranges from -1.06 to -0.45, depending on scope for remote delivery. Commuting is substantially more distance-sensitive, implying uneven gains from lower commuting costs and more diffuse benefits from lower services trade costs. While Swedish firms can more easily serve Denmark, they also lose workers who commute across the border. Workers accessing higher-wage markets gain, while those facing increased competition lose.

Keywords: Services trade, commuting, distance elasticity, infrastructure
JEL Codes: F14, F15, R23, R12, O18, L80

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1 Introduction

Despite the rapid expansion of global trade in services, our understanding of the spatial frictions that shape services trade remains limited. Unlike goods, services are non-storable and often require face-to-face interactions, making them potentially more sensitive to communication barriers and geographic distance. On the other hand, some services can be delivered fully remotely. While there is extensive evidence on how goods trade responds to distance, causal estimates of how infrastructure affects services trade—and how responsive services trade is to distance—remain scarce. To what extent does improved geographical connectivity affect trade in services, and what are the aggregate and distributional consequences of such integration for firms and workers?

Addressing this question is challenging. First, measuring services trade is difficult: when a good crosses a border it gets recorded at customs, but when a consultant drives to meet a client, that transaction is rarely captured in standard trade statistics. Second, identifying the effect of infrastructure on services trade is complicated by the fact that the same connectivity improvements that facilitate business travel also lower commuting costs and integrate labor markets. By shifting wages and reallocating workers across borders, these forces can confound trade and commuting responses, implying that standard gravity estimates of services trade with respect to distance may be biased when labor market adjustments are not accounted for.

We study this question using a large-scale natural experiment—the opening of the Øresund Bridge in 2000, which reduced commuting and business travel costs between Sweden and Denmark while leaving freight costs largely unchanged. We leverage detailed data on the universe of firm-level services trade from the Swedish Central Bank (1997–2002) and Statistics Sweden (2003–2017), complemented with firm-level goods trade data from Statistics Sweden. The main source of services trade data is the International Transactions Reporting System (ITRS), under which banks reported transactions between residents and non-residents to the Swedish Central Bank following BPM5 guidelines (the IMF's Balance of Payments Manual, 5th Edition). Each payment generated a notice that classified the underlying service transaction.

To capture labor market adjustments, we use individual-level worker and commuter data from Statistics Sweden. We complement these data with aggregate Danish data from Statistics Denmark.

The Oresund Bridge presents a clean setting to identify the causal impact of reduced travel times on services trade. Prior to the bridge, commuting and business travel between southern Sweden and Copenhagen relied on ferries, making travel time-consuming and unpredictable. The bridge created a fast, reliable connection, reducing travel times by up to 67% for locations like Malmö and integrating two asymmetric labor markets: Swedish workers could access higher-paying jobs in Denmark, while Danish firms gained access to a larger labor pool. Crucially, the bridge allowed for a clean separation of commuting and business travel from freight transport, as tolls and logistical frictions left goods trade costs largely unaffected.[1]

We document several new facts. Using detailed administrative firm-level data on services trade from Sweden, we show that firms located within 50 km of the bridge experienced large and persistent increases in services trade with Denmark—exports nearly tripled and imports more than tripled five years after the bridge opened. These effects are concentrated at the intensive margin, not driven by firm entry or changes in affiliate presence. We also find that the bridge increased commuting from Sweden to Denmark by nearly five-fold, with no comparable change in the reverse direction. This shift caused wages to rise in southern Sweden and decline in adjacent Danish municipalities, consistent with cross-border labor market integration. Swedish municipalities near the bridge also saw increases in housing prices (+15%) and working-age population, primarily due to commuters. The rise in commuting stimulated both services imports and exports in Sweden, though the export gains were smaller, dampened by the loss of domestic workers to higher-paying Danish firms. By contrast, we find no significant change in goods trade, underscoring the distinct nature of services and the role of face-to-face interactions.

[1]Two factors limit the impact on goods trade. First, bridge tolls for commercial vehicles were relatively high. Second, delivery times were largely unaffected because loading and unloading typically occur during fixed office hours, making faster transit irrelevant unless shipments arrive before the daily cutoff. Same-day loading and unloading enabled by the bridge remains uncommon for most trade.

While the reduced-form evidence establishes key facts, it leaves important questions unanswered. It cannot disentangle how much of the increase in services trade reflects lower business travel costs versus commuting-induced changes in labor supply, nor can it isolate the net effect on Swedish firms, which both gain market access and lose workers to Denmark. To address this, we build a quantitative spatial equilibrium model in the spirit of Monte et al. (2018a), extended to incorporate tradable services alongside goods, with service trade costs that are distance-sensitive and vary by sector depending on the scope for remote delivery. Workers choose both where to live and where to work, subject to migration and commuting costs.

We calibrate the model using firm-level trade flows, individual-level labor data, and detailed travel times. We estimate sector-specific distance elasticities of services trade—varying with the scope for remote delivery (e.g., IT vs. business services)—which combine the elasticity of trade to trade costs and the elasticity of substitution across service varieties. Identification exploits both cross-sectional variation (municipalities closer to Denmark trade more even pre-bridge) and differential changes in effective distance induced by the bridge, with larger shocks near Malmö. We estimate these parameters jointly using nonlinear least squares on bilateral export and import ratios. The implied distance elasticity ranges from -0.45 (IT) to -1.06 (business services), consistent with the greater importance of face-to-face interactions in the latter. For commuting, we adopt a complementary two-step approach. First, we estimate the composite elasticity—the product of the sensitivity of commuting costs to distance and commuting flows to wages—using changes in municipality-level commuting shares around the bridge opening (PPML). Second, we separately identify the wage elasticity of commuting using an instrumental variable strategy following Ahlfeldt et al. (2015), instrumenting wage changes with pre-construction driving time to the bridge. The estimated commuting elasticity is substantially larger — roughly three to seven times — than the service trade elasticities, reflecting the fact that commuting involves repeated daily travel. This difference is central: reductions in commuting costs generate highly localized welfare gains near the bridge, whereas reductions in service trade costs produce more spatially diffuse benefits.

To isolate the effects of commuting cost changes from service trade cost changes,

we do two counterfactuals where we shut down each force sequentially. We find that the welfare gains in Swedish municipalities near the bridge are driven overwhelmingly by the commuting channel. Holding service trade costs unchanged barely moves the welfare curve, while shutting down commuting eliminates most of the gain. This result reflects the fact that Swedish service exports to Denmark represent only about 0.5% of total Swedish service output in 1997 — so even a large proportional increase in bilateral trade has modest aggregate welfare consequences relative to the labor income gains from commuting to higher-wage Danish employers.

We then ask how these effects change in a more service-integrated economy. We simulate a counterfactual in which pre-bridge barriers to cross-border services trade are eliminated, raising Sweden's service exports to Denmark from 0.5% to 8.42% of output. In this setting, welfare gains from lower trade costs are substantially larger and more spatially diffuse, accruing across municipalities rather than concentrating near the bridge. More broadly, the results highlight that trade liberalization and labor mobility need not be complementary. While lower trade costs expand service exports, commuting draws workers away from local production, offsetting output gains on the Swedish side.

Finally, removing the bridge yields sizable general equilibrium effects. Real income in southern Sweden rises by up to 2.22% in municipalities closest to the bridge, while it falls modestly in Denmark (e.g., -0.84% in Copenhagen), reflecting increased labor market competition. Gains are highly uneven across space and sectors: service-intensive regions and mobile Swedish workers benefit most, as commuting allows them to earn higher wages while residing in lower-cost areas. Welfare gains decline with distance from the bridge. On the production side, Danish service firms expand (by 2–4% in nearby areas), while Swedish service firms contract (by up to 2.25%), reflecting the reallocation of labor toward Denmark. The resulting inflow of Swedish commuters raises Denmark's effective labor supply and production, while reducing local labor supply in Sweden. The bridge cost 2.66 billion (2000 USD). Aggregating ex ante welfare gains yields annual benefits of 0.46 billion in Sweden and a loss of 0.18 billion in Denmark, implying a payback period of approximately 9.5 years.

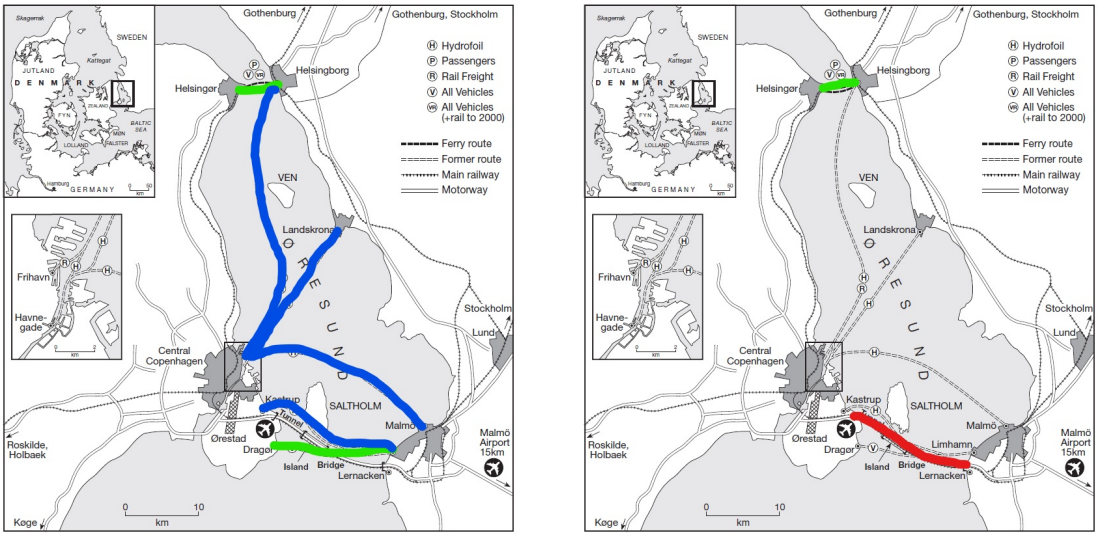
Our paper contributes to several strands of literature. The first is the empirical literature on the gravity of services trade and the estimation of distance elasticities. Existing work relies on aggregate bilateral flows, subnational data, or indirect inference from output and absorption to recover services trade costs (Walsh, 2008; Gervais and Jensen, 2019; Anderson et al., 2014; Nordås and Rouzet, 2017; Kimura and Lee, 2006; Lennon, 2009). We use firm-level administrative balance of payments data and a natural experiment—an infrastructure investment that reduces commuting and business travel costs—to estimate distance elasticities of services trade. We show that standard gravity estimates are biased when such infrastructure simultaneously integrates labor markets, confounding trade and commuting responses. We further estimate elasticities across service sectors defined by their scope for remote delivery, uncovering substantial heterogeneity. Second, we speak to the growing work on face-to-face interactions in trade (Bernard et al., 2019; Keller and Yeaple, 2013; Startz, 2016; Söderlund, 2023). While these papers establish that face-to-face frictions matter for goods trade and production networks, we show they matter even more for services, where on-site presence and in-person interaction are often essential. Third, we contribute to the literature on the effects of infrastructure on trade (Donaldson, 2018; Redding and Turner, 2015; Allen and Arkolakis, 2022; Coşar and Fajgelbaum, 2016; Faber, 2014) and quantitative spatial trade models with labor mobility (Monte et al., 2018b; Redding and Rossi-Hansberg, 2017). In this literature, services are typically either excluded from the analysis or treated as locally non-tradable. We build on this by incorporating tradable services, commuting, and migration into a unified framework with micro-founded worker location decisions. Given services' dominance of modern economies, we show that it is quantitatively important for understanding how infrastructure shapes welfare. Finally, we build on existing work using the Oresund Bridge (Persson et al., 2022; Akerman, 2009; Bütikofer et al., 2024) by focusing on trade in services—an outcome not examined in prior studies.

By combining reduced-form and structural evidence, this paper provides estimates of the distance elasticity of services trade and shows how infrastructure improvements that facilitate commuting—rather than goods transport—can reshape trade in services, labor market integration, and regional welfare.

2 Background

Before the Oresund Bridge opened, travel between Sweden and Denmark relied on six ferry routes, only two of which carried cars. Cross-border travel was therefore slow and inconvenient. In 1991, the two governments agreed to build a permanent link across the Oresund Strait to improve transport and deepen regional integration. Construction began in 1995, and the bridge-tunnel link opened on July 1, 2000. It quickly replaced most ferry traffic; only one of the original six ferry routes remains in operation. Figure A.1 illustrates the transport network before and after the bridge.

Figure 1: Cross-Border Connections Before and After the Bridge



Before Opening of Bridge

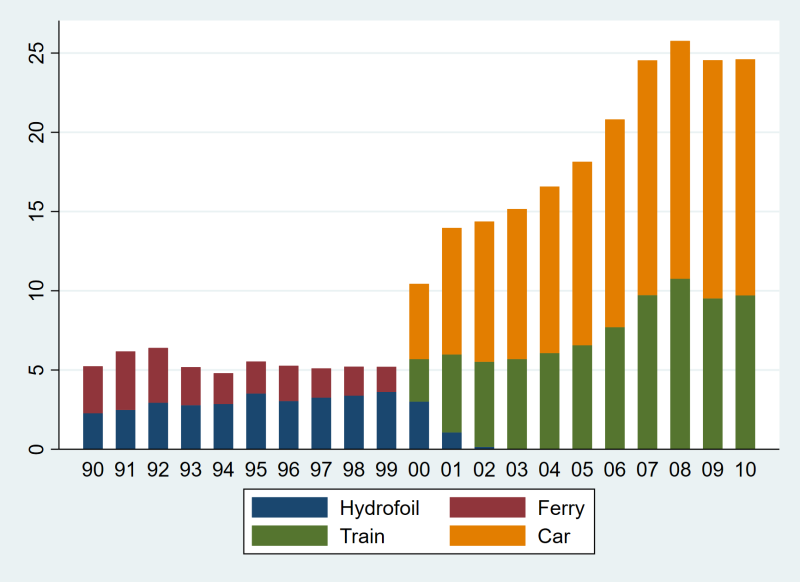
After Opening of Bridge

Note: Green links denote ferry routes that carried cars, blue links denote passenger-only ferries, and the red link denotes the Oresund Bridge.

The bridge sharply reduced crossing times. Before its construction, the trip could take up to an hour by ferry; by car or train, the crossing now takes roughly 10 to 15 minutes. This decline in travel time increased cross-border trips and made daily commuting feasible on a much larger scale. Figure 2 shows the increase in traffic across the strait after the bridge opened.

The commuting response was asymmetric. Lower housing costs in Sweden and

Figure 2: Trips Across the Oresund by Mode of Transport



Note: Hydrofoils are high-speed passenger ferries. "Ferry" refers to ferries that also transport cars.

higher wages in Denmark led many cross-border commuters to live in Sweden, especially around Malmö, and work in Denmark, mainly in Copenhagen. This pattern increased housing demand in southern Sweden and expanded Danish firms' access to labor.

For our analysis, the bridge provides a sharp reduction in cross-border travel time that changed both commuting incentives and the effective costs of trading services within the region.

3 Data

This section describes the datasets used to study how the Oresund Bridge affected services trade, goods trade, commuting, and residential location.

3.1 Trade Data

Our main outcome is services trade. We use firm-level balance-of-payments data from the Swedish Central Bank covering monthly service exports and imports by partner country and 43 service categories from the fourth quarter of 1997 through 2002. These data are central to the paper: they span the bridge opening, cover the full set of reporting firms above the threshold,[2] and allow us to observe service trade at the firm level.

The data capture cross-border transactions that generate monetary payments. They therefore exclude services supplied through foreign commercial presence (Mode 3). By contrast, they capture remote cross-border provision (Mode 1) and consumption abroad (Mode 2), and they capture the subset of Mode 4 transactions in which Swedish firms bill foreign clients directly for short-term on-site service provision. The main source is the International Transactions Reporting System (ITRS), under which banks reported transactions between residents and non-residents to the Riksbank following BPM5 guidelines (the IMF's Balance of Payments Manual, 5th Edition). Each payment generated a notice that classified the underlying service transaction.[3]

In addition, credit card companies provided the Riksbank with aggregated data on total Swedish card spending in foreign countries. This was a crucial supplement to bank reporting, as it captured high-frequency, low-value Mode 2 transactions like restaurant meals and local transport. Although declining in relative importance compared to cards, physical cash remained a key component. The Riksbank tracked Swedish banknotes that were exchanged by travelers at foreign banks and exchange offices and subsequently repurchased by Swedish banks.[4]

Because the bank reporting (ITRS) often lacked detail on the purpose of travel, surveys were used to refine the data. During 1997–2002, the Riksbank used house-

[2]The reporting threshold was 75,000 SEK in 1997, 100,000 SEK in 2000, and 150,000 SEK in 2002.

[3]Transactions below the reporting threshold remain in the balance of payments as non-itemized aggregates, but they cannot be assigned to firms, service categories, or partner countries.

[4]To verify the data, the Riksbank used mirror statistics from other central banks to assess how much Swedish currency was exchanged in specific tourist destinations.

hold and traveler surveys, often in collaboration with TEM and SCB, to distinguish between business travel and private tourism and to improve the geographical distribution of spending.[5]

To benchmark the service-trade response against goods markets, we also use annual firm-level goods trade data from Statistics Sweden with partner-country information and 8-digit HS product codes.

3.2 Commuting and Travel Times

We use individual-level Sweden-to-Denmark commuter data from Statistics Sweden based on tax records for all individuals residing in Sweden and earning labor income in Denmark. These records identify the year, the Danish municipality of work, income earned in Denmark, and, through additional registers, the Swedish municipality of residence. We complement these microdata with aggregate annual series from Statistics Denmark and the Oresund Database on total cross-border trips by mode of transport from 1990 to 2010 and on commuting flows in both directions.

To measure the change in market access created by the bridge, we compute travel times from every Swedish municipality to Copenhagen before and after the opening. Travel times are based on car journeys from Google Maps, with manual adjustments to account for ferry crossings before the bridge and in the few cases where a remaining ferry route remains the fastest connection afterward.

3.3 Firm and Worker Characteristics

We match firm-level trade records to geocoded workplace data from Statistics Sweden to locate firms within Sweden. The workplace data include firm identifiers, workplace identifiers, employment, and municipality. For multi-establishment firms, we allocate exports and imports across municipalities in proportion to each workplace's share of firm employment.

[5]If one payment covered multiple services, the reporter typically coded only the main purpose. As a result, some narrowly defined services were absorbed into broader categories such as travel or tourism.

We also use Statistics Sweden's LISA database, which provides matched employer-employee information including income, workplace municipality, residence municipality, and education. These data allow us to link trade exposure to worker outcomes and to the commuter records.

3.4 Other Data

To study local housing-market effects, we use transaction-level data from Statistics Sweden on all sales of single-family houses in Sweden. The records include transaction date, price, living area, land area, construction year, and house type.

We further use annual municipal data from Statistics Denmark on wages, population, house prices, and aggregate goods and services trade.

4 Reduced Form Evidence

This section studies how the Oresund Bridge affected commuting, service and goods trade, wages, worker location, and house prices. We combine descriptive evidence with reduced-form regressions. Data availability differs across outcomes, as summarized in Table 1. We summarize the evidence in six facts.

Fact 1: The Oresund Bridge significantly reduced travel time and increased commuting to Denmark in Swedish regions close to the bridge

To examine cross-border mobility, we study changes in travel time and commuting. We compute the change in driving time from Swedish municipalities to Copenhagen using Google Maps and historical ferry information.[6] Sweden has 290 municipalities, which we group by distance to the bridge: below 50 kilometers, 50 to 150 kilometers, and above 150 kilometers. As shown in Figure 3, all municipalities within a 50 km

[6]See Section A.1.1 in the Appendix for details on how the change in driving time is computed.

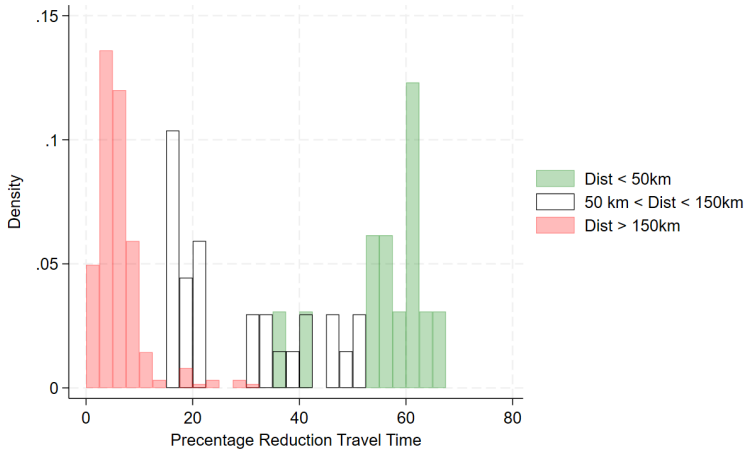
Table 1: Summary of Main Data Sources

Dataset	Coverage and unit	Main variables
Swedish Central Bank services trade data	1997Q4–2002; unit: firm × month × partner country × service category	Service exports and imports in 43 service categories
Statistics Sweden goods trade data	1997–2010; unit: firm × year × partner country × product code	Goods exports and imports, 8-digit HS products
Statistics Sweden commuter records	1997–2010; unit: individual × year	Danish work municipality, income in Denmark, Swedish residence municipality
Oresund Database and Statistics Denmark travel data	1990–2010; unit: annual aggregate series by mode and direction	Trips by transport mode, bilateral commuting flows
Google Maps travel times	Around bridge opening (pre/post 2000); unit: municipality	Travel time to Copenhagen
Statistics Sweden workplace and LISA data	1997–2010; unit: workplace-level registers and matched worker-year records	Workplace location, employment, income, education, home and work municipality
Statistics Sweden house transactions and Danish municipal aggregates	1995–2010; unit: Swedish transaction-level records and Danish municipality-year aggregates	House prices, housing characteristics, wages, population, aggregate trade

Note: This table provides a compact overview of the datasets used in the paper, including their coverage, unit of observation, and key variables. The services trade data are the paper's most distinctive source because they provide firm-level, monthly, country-specific, and service-category-specific information around the bridge opening. As with balance-of-payments data more generally, they capture cross-border transactions linked to monetary payments and exclude services supplied through foreign commercial presence.

radius experienced commuting time reductions of at least 30%, with the majority seeing declines exceeding 50%. Municipalities within the 50-150 km range experienced declines in commuting times between 15-30%, while the majority of municipalities that are more than 150 km away experienced negligible declines.

Figure 3: Distribution of Percentage Reduction in Driving Time to Copenhagen from Swedish Municipalities

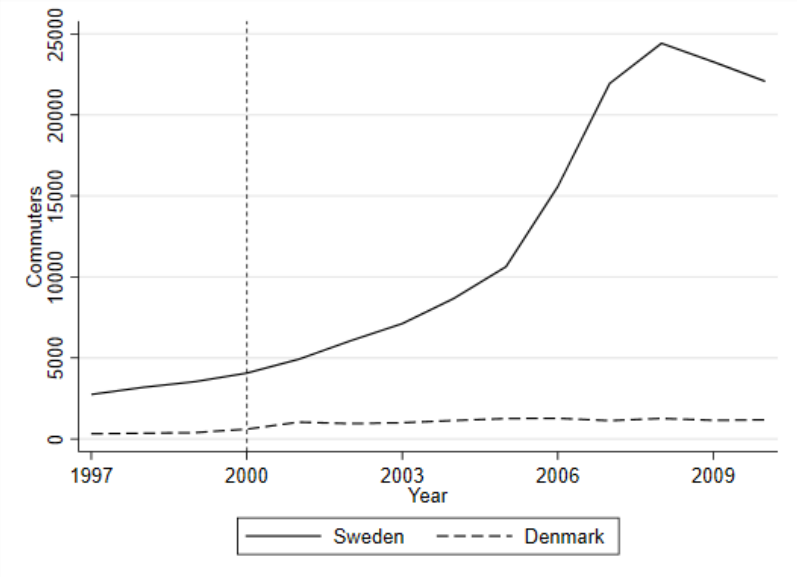


Notes: There are 13 Swedish municipalities located within 50 kilometers of the Oresund Bridge, 27 in a band between 50 and 150 kilometers, and 250 located beyond 150 kilometers.

Swedish (Danish) commuters are workers who live in Sweden (Denmark) and earn income taxed in Denmark (Sweden).[7] Financial incentives to commute from Sweden to Denmark are strong because wages are higher in Denmark. A 2006 report documents gross salaries in Copenhagen about 35 to 40% above Malmö; after taxes, fees, and transport costs, the gap is about 15 to 20% (Øresundsbro Konsortiet, 2006). This wage gap creates strong asymmetry: commuting rises sharply from Sweden to Denmark but not in the other direction (Figure 4).

[7]We define services trade as any service that generates a payment between a Swedish firm and a Danish firm. Hence, if a Swedish commuter works for a Danish firm, this does not yield any payments between a Swedish and a Danish firm and is thus not considered as services trade. However, if the commuter is a consultant in an individual company based in Sweden that bills the Danish firm for his or her work, this counts as services exports from Sweden to Denmark. The Swedish consultant would not necessarily need to commute to export services to Denmark and could, for instance, provide IT services remotely.

Figure 4: Number of Commuters by Country



Notes: Swedish commuters are defined by people who start their trip from Sweden and commute to Denmark and vice versa.

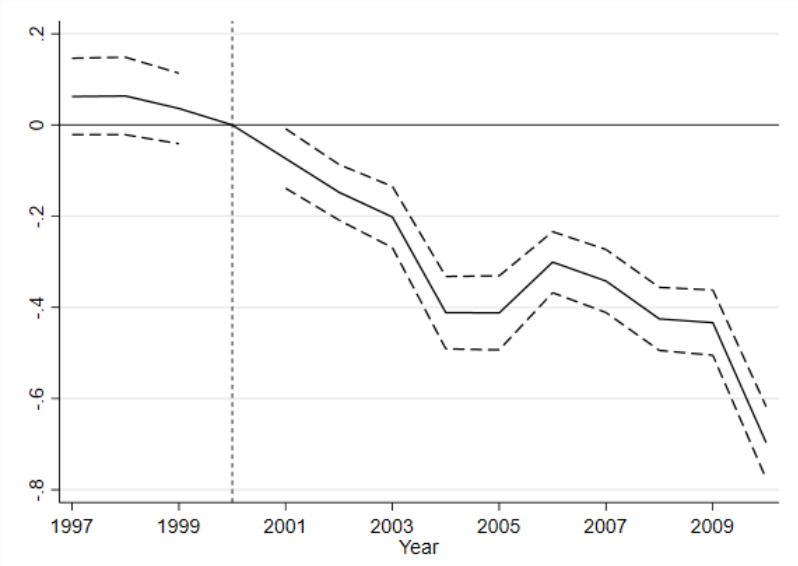
The bridge primarily affected the ability of workers living very close to the bridge to commute to Denmark, and hence it altered the distance elasticity of commuting. To examine the change in the distance elasticity of commuting in response to the opening of the bridge, we estimate the following dynamic difference-in-difference specification using PPML:

$$\mathbb{E}[Com_{mt} \mid X] = \exp\Big(\alpha + \sum_{t=1997}^{1999} \beta_t \ln Dist_m \times \mu_t + \sum_{t=2001}^{2010} \beta_t \ln Dist_m \times \mu_t + \delta_m + \gamma_t\Big) \tag{1}$$

where Com_{mt} is the number of workers in municipality m who live in Sweden but earn income in Denmark in year t. $Dist_m$ is the distance from municipality m to the Oresund Bridge. Hence, β_t captures the impact of distance on commuting. Since we expect a greater distance from the bridge to reduce the commuting response to the opening of the Oresund Bridge, we expect β_t to be negative. Figure 5 plots the

difference-in-differences estimates, which are negative and statistically significant. Results are also robust to including municipality population as a control. Hence, the results are not driven by the fact that the workforce is growing closer to the bridge. It also makes sense that it takes time for the impact on commuting to materialize, as people have to switch from a Swedish to a Danish employer.

Figure 5: Impact of Distance to Bridge on Commuting in Sweden

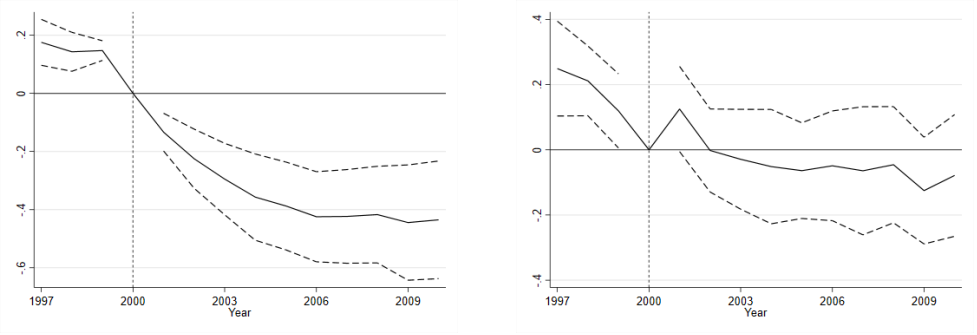


Notes: This figure captures the impact of distance to the Oresund Bridge on commuting from Sweden to Denmark. This data is based on micro-level commuting data aggregated to the municipal level.

We run the same regression on a subset of municipalities in the Oresund region.[8] Figure 6 shows that commuting increased more in Swedish municipalities close to the bridge, with no comparable pattern in Denmark.

[8]The Øresund Region (also written Oresund Region) is a cross-border metropolitan area spanning eastern Denmark and southern Sweden, centered around the Øresund Strait that separates the two countries. On the Danish side it includes Copenhagen, Frederiksberg, Helsingør, Roskilde. On the Swedish side, it includes Malmö, Lund, Helsingborg, Landskrona, and Trelleborg.

Figure 6: Impact of Distance to Bridge on Commuting in the Oresund Region



Sweden Denmark

Notes: This figure captures the impact of distance to the Oresund Bridge on commuting from Sweden to Denmark. The data is based on aggregate municipal data from both Sweden and Denmark.

Fact 2: Services trade increased for firms close to the bridge with a larger magnitude for imports

We expect services trade between Sweden and Denmark to increase after 2000, because the bridge lowered the cost of face-to-face interactions by enabling business travel. It also made it easier to provide services that require on-site presence, such as childcare, nursing, and plumbing, because they rely on commuting. We do not observe trips made specifically to sell services, but Section A.1 in the Appendix documents a sharp rise in crossings after 2000 and shows that about one fifth of crossings are non-commuting business trips in 2015.[9] Although the business-trip share may have changed over time, these patterns are consistent with a substantial increase in business travel across the strait.

We analyze the effect of the bridge on services trade by comparing firms close and far away from the bridge using PPML:

[9]We define a non-commuting business trip from Denmark to Sweden as a trip where the person does not earn income from a Danish firm. We also observe that most travelers live in Sweden, primarily because many more commuters live in Sweden.

$$\mathbb{E}[service_{it} \mid X] = \exp\Big(\alpha + \sum_{t=-4}^{-1} \beta_t \, Close_i \times \mu_t + \sum_{t=1}^{5} \beta_t \, Close_i \times \mu_t + \delta_i + \gamma_t\Big) \tag{2}$$

Here $service_{it}$ denotes exports to Denmark or imports from Denmark by firm i in semester t, and $Close_i$ takes the value 1 if firm i is located within 50 kilometers of the bridge and 0 otherwise. In the figures below, we also split treated firms into four distance bands: firms located in Malmö, firms outside Malmö but within 50 kilometers of the bridge, firms located between 50 and 100 kilometers from the bridge, and firms located between 100 and 150 kilometers from the bridge. Firms located farther than 150 kilometers from the bridge constitute the control group. We use this specification because the effect need not diminish linearly with distance from the bridge. For example, a 10% reduction in travel time to Denmark would have a negligible effect on services that require extensive face-to-face interaction for a city in Sweden that is located three hours away.

Because monthly flows are noisy, we aggregate them to semiannual frequency (two periods per year) to improve precision. The sample runs from 1998 to 2002, with period 0 defined as the second half of 2000 when the bridge opened. We exclude transport services and construction, which were directly affected by the bridge construction, and royalties, which mainly capture transactions in immaterial rights.

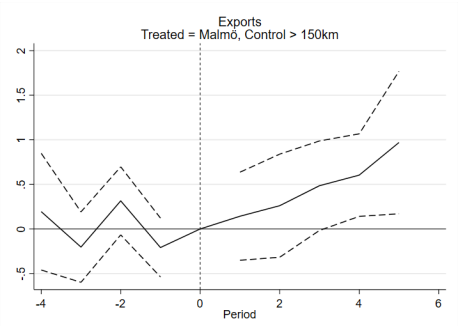
Equation 2 relies on parallel trends: absent the bridge, firms close to and far from the bridge would have followed similar service-trade trends with Denmark, as shown below in Figures 7 and 8. Section A.2 in the Appendix additionally shows that treatment and control firms are very similar in service-trade composition and firm size.

Figures 7 and 8 show positive effects only for firms within 50 kilometers of the bridge. Five years after opening, point estimates are around 1 for exports and 1.2 for imports. Under PPML, these correspond to multiplicative effects of about $\exp(1) \approx 2.7$ for exports and $\exp(1.2) \approx 3.3$ for imports, or percentage effects of about 172%

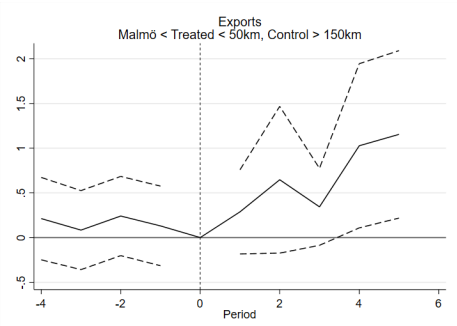
and 232%.

Figure 7: Impact of the Oresund Bridge on Services Exports

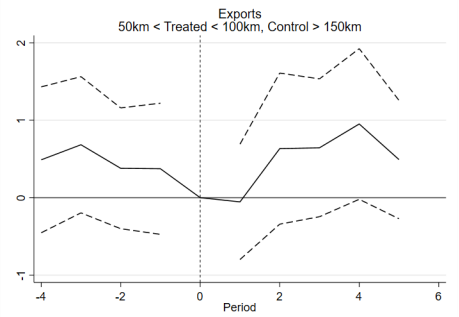
Malmö



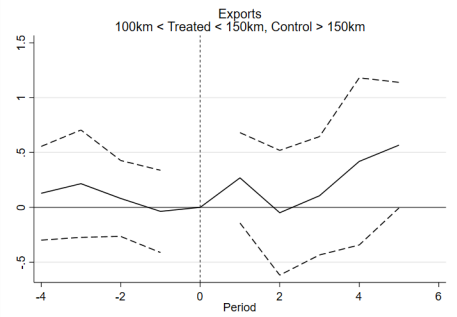
Malmö < Distance < 50km



50km < Distance < 100km



100km < Distance < 150km



Notes: The control group consists of firms that are located 150 kilometers or farther from the Oresund Bridge.

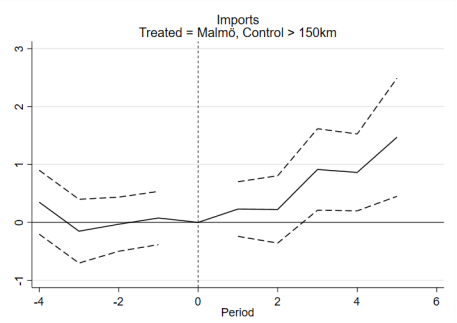
Sections A.2.2 and A.2.3 in the Appendix provide additional checks. The main message is that the estimated effect is not driven by entry into service trade, expansion in the number of workplaces close to the bridge, or shifts in delivery mode through foreign affiliates. We also estimate an alternative specification with continuous distance to the bridge (Section A.2.4), which confirms the baseline results.

Fact 3: Goods trade was generally not affected by the bridge

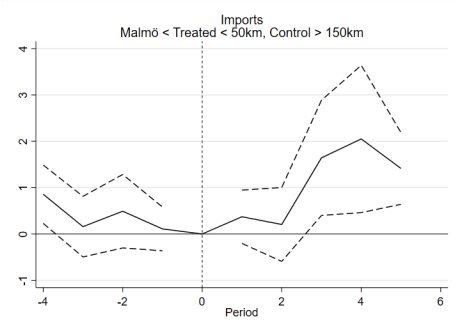
While the bridge had a strong effect on services trade for firms close to the bridge, we find no comparable effect on goods trade. We have confirmed this with several major

Figure 8: Impact of the Oresund Bridge on Services Imports

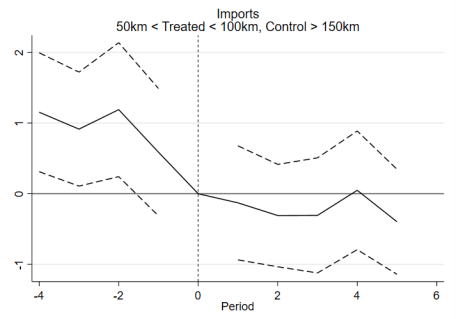
Malmö



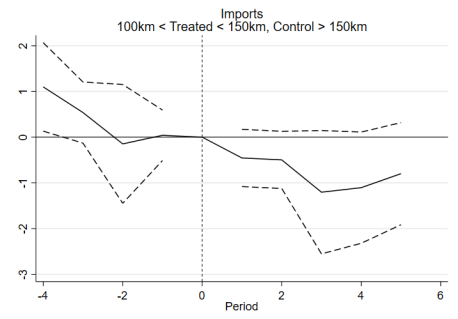
Malmö < Distance < 50km



50km < Distance < 100km



100km < Distance < 150km



Notes: The control group consists of firms that are located 150 kilometers or farther from the Oresund Bridge.

shipping companies operating in the Oresund region. There are many reasons for this. First, shipping rates remained largely unchanged because tolls for commercial vehicles were relatively expensive.

Second, due to the way shipping companies operate in the region, the bridge did not have a substantial impact on delivery speed. This is because loading and unloading mostly occur during normal office hours. A truck typically has to arrive before 4 pm for the load to be unloaded that day; otherwise, the load is unloaded the following morning. This means that loading and unloading typically occur on different days, so a faster travel route does not matter much unless firms can still unload the same day. The bridge did enable same-day loading and unloading for shipments between Sweden and Denmark. However, this remains fairly rare for the bulk of trade.

Another factor that limits same-day loading and unloading is that trucking companies typically want to maximize load utilization for both economic and environmental reasons. Firms are generally reluctant to cross the bridge empty to pick up a load because of the expensive tolls. Moreover, trucking companies need to report their fuel use, and while there are no direct financial consequences for driving half-empty trucks, many shipping companies present themselves as taking environmental concerns seriously. Taken together, these factors imply that the bridge had only a marginal impact on goods trade between Sweden and Denmark.

Section A.3 reports the goods-trade results in detail, including replications of two previous studies. Section A.3.3 shows that for bi-exporters, services exports increase while goods trade does not.

Fact 4: The bridge caused wages to converge between Sweden and Denmark in regions close to the bridge

The opening of the Oresund Bridge expanded access to Danish jobs for Swedish workers. Because Danish wages are higher, the bridge created a positive labor-demand shock for workers living on the Swedish side within commuting distance. On the Danish side, the inflow of Swedish commuters implies a local labor-supply

shock. We therefore expect wages to rise in Swedish municipalities close to the bridge and to fall in nearby Danish municipalities. To study this, we estimate:

$$\ln(wage_{inet}) = \alpha + \sum_{t=1995}^{1999} \beta_t \, Close_{m(i,t)} \times \mu_t + \sum_{t=2001}^{2010} \beta_t \, Close_{m(i,t)} \times \mu_t + \delta_i + \gamma_{nt} + \xi_{et} + \varepsilon_{inet} \tag{3}$$

where $wage_{inet}$ is the annual salary of individual i working in industry n with education level e at time t. Industry is defined at the one-digit level. Education is defined as the highest level of educational attainment, evaluated on a seven-point scale.[10] $Close_{m(i,t)}$ takes the value 1 if worker i's workplace municipality $m(i,t)$ is within 50 kilometers of the bridge in year t. γ_{nt} captures industry-time fixed effects and ξ_{et} captures education-time fixed effects. β_t captures the effect of the bridge on wages for people working in municipalities close to the bridge. Results show that the bridge had a significant impact on wages a few years after it opened. The timing of the effect coincides with the period when the number of commuters started to rise more sharply.

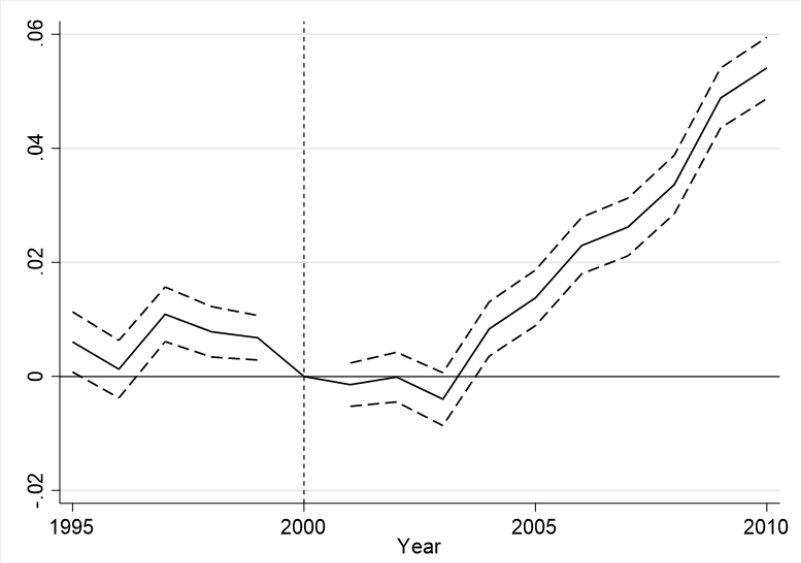
In the case of Denmark, we only have access to average wages at the municipal level. Consequently, we formulate a slightly different estimating equation. To allow for the fact that rich and poor municipalities are likely to be on different trajectories, we split Danish municipalities into three equally sized groups based on average wages in 1999. We then interact this variable with the time dummies.

$$\ln(avg\ wage_{mdt}) = \alpha + \sum_{t=1995}^{1999} \beta_t \, Close_m \times \mu_t + \sum_{t=2001}^{2010} \beta_t \, Close_m \times \mu_t + \delta_m + \gamma_{dt} + \varepsilon_{mdt} \tag{4}$$

Here $avg\ wage_{mdt}$ is average wages in Danish municipality m in year t. $Close_m$ equals 1 if municipality m is within 50 kilometers of the bridge, and γ_{dt} captures wage-group time fixed effects. We find a negative wage effect in Danish municipalities close to

[10]The education scale is broadly defined as follows: preschool, elementary <9 years, elementary 9–10 years, high school, some college <2 years, associate/bachelor's degree, and doctorate/PhD. Note that high school is not compulsory in Sweden.

Figure 9: Impact of the Bridge on Swedish Wages



Notes: This figure captures the impact of the bridge on wages of Swedish workers. The regression compares treated individuals that live within 50 kilometer of the bridge to control individuals that live beyond that distance from the bridge.

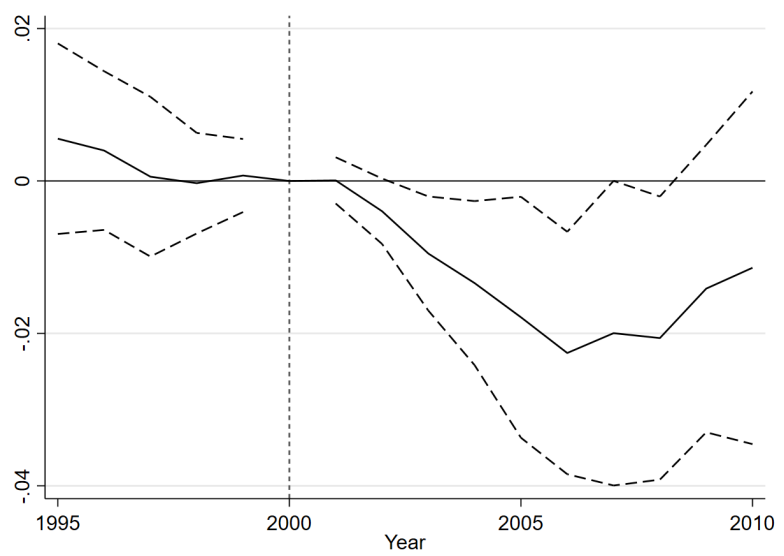
the bridge.

Fact 5: The bridge had a positive impact on the Swedish worker population size in regions close to the bridge, (primarily driven by commuters), but no similar impact in Denmark

Because the bridge increased employment opportunities for Swedish workers close to the crossing, we also expect changes in local worker population. We study both total workers (including commuters earning income in Denmark) and workers earning income only in Sweden. We estimate:

$$\ln(workers_{mdt}) = \alpha + \sum_{t=1995}^{1999} \beta_t \, Close_m \times \mu_t + \sum_{t=2001}^{2010} \beta_t \, Close_m \times \mu_t + \delta_m + \gamma_{dt} + \varepsilon_{mdt} \quad (5)$$

Figure 10: Impact of the Bridge on Danish Wages



Notes: This figure captures the impact of the bridge on wages of Danish workers. The regression is based on average wages at the municipal level and compares municipalities that are located less than 50 kilometers from the bridge to municipalities located further than 50 kilometers from the bridge.

where $workers_{mdt}$ is the size of the working population in municipality m, density group d, year t. Municipalities are grouped into three equally sized density groups based on 1999 population density. γ_{dt} captures density-group time fixed effects, and $Close_m$ equals 1 for municipalities within 50 kilometers of the bridge. The estimates show a positive effect on total worker population close to the bridge, but a much smaller and insignificant effect when commuters are excluded.

Figure 11: Impact of the Bridge on Worker Population Size in Sweden



Total Worker Population | Population Working in Sweden

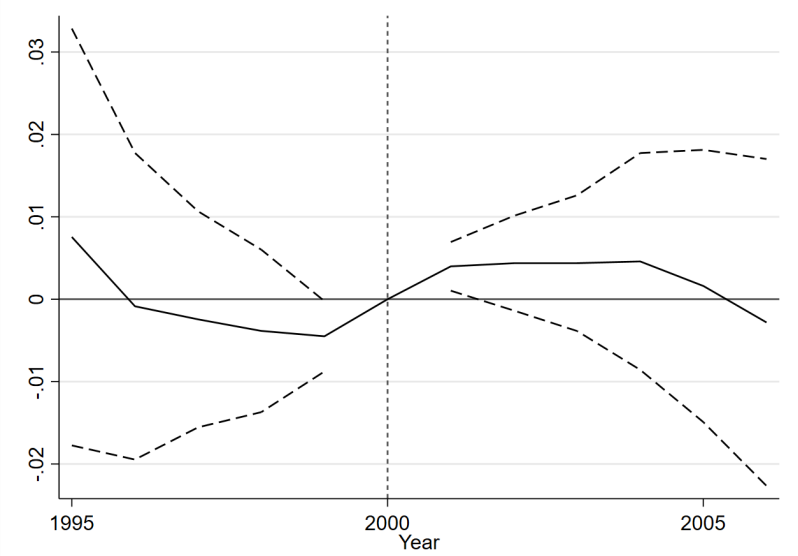
Notes: This figure captures the impact of the bridge on the size of the working municipal population. The regression compares municipalities that are located less than 50 kilometers from the bridge to municipalities located further than 50 kilometers from the bridge. Total workers also include workers that live in a certain municipality but work in Denmark and therefore lacks a taxable income in Sweden.

We also run the same regression using aggregate Danish data. As independent variable, we use the number of employed workers in each municipality. Here we find no impact on the size of the working population close to the bridge.

Fact 6: The bridge had a positive impact on house prices in Sweden close to the bridge while no impact in Denmark

Higher employment opportunities close to the bridge in Sweden may also affect housing demand and prices. We use the universe of single-family house sales in Sweden from 1995 to 2010 and estimate the following dynamic difference-in-differences specification on repeated cross sections:

Figure 12: Impact of the Bridge on Worker Population Size in Denmark

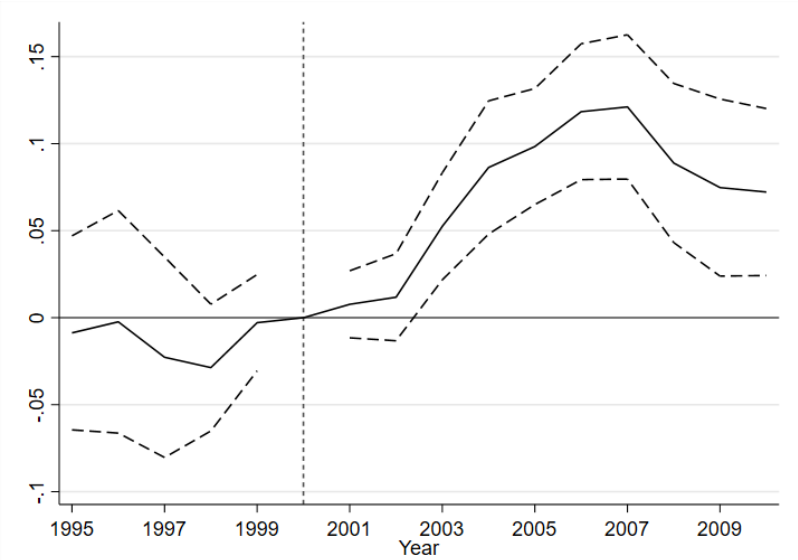


Notes: This figure captures the impact of the bridge on the size of the working municipal population in Denmark. The regression compares municipalities that are located less than 50 kilometers from the bridge to municipalities located further than 50 kilometers from the bridge.

$$\ln(price_{imdt}) = \alpha + \sum_{t=1995}^{1999} \beta_t \, Close_m \times \mu_t + \sum_{t=2001}^{2010} \beta_t \, Close_m \times \mu_t + \delta_m + \gamma_{dt} + \xi_i + \varepsilon_{imdt} \quad (6)$$

$price_{imdt}$ is the transaction price for house sale i in municipality m, density group d, and year t. Density groups are defined as in Equation 5, allowing different trends across less and more densely populated municipalities. $Close_m$ equals 1 for municipalities within 50 kilometers of the bridge. ξ_i includes house and time controls (living area, auxiliary indoor area, lot size, construction year, house type, and transaction month). Figure 13 shows a positive effect on house prices in Swedish municipalities close to the bridge.

Figure 13: Impact of the Bridge on House Prices in Sweden



Notes: This figure captures the impact of the bridge on house prices in Sweden. The data is based on transaction level closing prices of single unit houses. The regression compares house price sales in municipalities that are located less than 50 kilometers from the bridge to municipalities located further than 50 kilometers from the bridge.

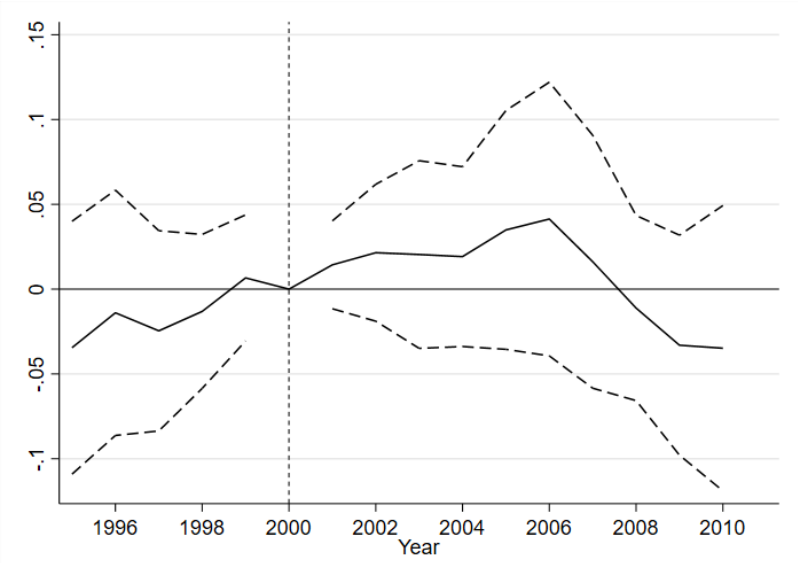
We run a similar analysis for Denmark using municipal average quarterly house prices aggregated to annual frequency. We allow for heterogeneous trends by inter-

acting year dummies with quintile groups based on 1999 house prices, population density, average wages, and unemployment. The regression is:

$$\ln(price_{mt}) = \alpha + \sum_{t=1995}^{1999} \beta_t \, Close_m \times \mu_t + \sum_{t=2001}^{2010} \beta_t \, Close_m \times \mu_t + \delta_m + \gamma_{mt} + \xi_{mt} + \theta_{mt} + \omega_{mt} + \varepsilon_{mt} \tag{7}$$

where $Close_m$ takes the value 1 if the municipality is located less than 50 kilometers from the bridge, and γ_{mt}, ξ_{mt}, θ_{mt}, and ω_{mt} represent group-specific time trends based on average house prices, average wages, population density, and unemployment in 1999. Figure 14 shows that the Oresund Bridge had no impact on house prices in municipalities located close to the bridge in Denmark.

Figure 14: Impact of the Bridge on House Prices in Denmark



Notes: This figure captures the impact of the bridge on house prices in Denmark. The data is based on averages of house price sales across municipalities. The regression compares house price sales in municipalities that are located less than 50 kilometers from the bridge to municipalities located further than 50 kilometers from the bridge.

The reduced-form evidence shows that the bridge increased commuting from Swe-

den to Denmark, raised services trade with Denmark, and affected wages, population, and house prices near the bridge. But the reduced form cannot by itself tell us how much of the increase in services trade reflects labor movement driven by lower commuting costs versus service trade driven by lower business-travel costs. Nor can it quantify the net effect on Swedish firms, which gained market access but also lost some workers to higher-paying Danish firms, or the overall welfare and cost-benefit implications of the bridge. To answer these questions, we build a structural spatial model.

5 Model

Our framework consists of three regions: Sweden, Denmark, and the Rest of the World (ROW), treated as an integrated economy. We model Sweden and Denmark at the municipal level. Let $\mathcal{N}$ denote the set of municipalities in Sweden and Denmark, indexed by l, n, d, and let W denote the ROW. Thus, $\overline{\mathcal{N}} = \mathcal{N} \cup \{ROW\}$ encompasses all locations in Sweden, Denmark, and the ROW.

Each municipality has a fixed endowment of native workers $\overline{L}_l$. Workers born in Sweden or Denmark can choose where to live within $\mathcal{N}$, subject to migration costs, and where to work within Sweden and Denmark, subject to commuting costs. As a result, each municipality can have different numbers of residents R_l and workers L_l. In contrast, ROW workers neither migrate nor commute, so $\overline{L}_W = L_W = R_W$.

Workers consume manufacturing goods, service goods, and housing at their place of residence. We divide services into four categories: Business services, Information Technology (IT), Transportation services, and Other services. We distinguish among these sectors because they likely face different trade costs.[11] For instance, business services may require more in-person contact than IT services.

[11]These service groupings also align well with the raw data grouping from Statistics Sweden; goods not crossing Swedish border, processing and repair services, construction services, freight transport services, passenger transport and travel services, other transport services, transport support services, insurance claims and premiums, financial intermediation services, data, information and telecom services, intellectual property, research and development services, cultural, educational and health services, other business services, transfers.

Each location is endowed with a housing supply H_l. We index industries by $k = 1, 2, ..., 5$, where $k = 1$ is manufacturing and $k = 2, ..., 5$ are the four service sectors. Each location produces one variety in each industry under perfect competition.

To keep the model tractable, we abstract from occupational choice conditional on workplace. Wages therefore equalize across industries within a location, with w_l denoting the wage in location $l \in \mathcal{N} \cup \{W\}$. The model also allows for trade in goods and services across municipalities and across borders.

5.1 Preferences and Endowments

5.1.1 Preferences and Endowments of Workers Born in Sweden and Denmark

In Sweden and Denmark, workers are geographically mobile and heterogeneous in their preferences over locations. Each worker born in municipality l chooses where to live and work.[12] A worker ω from l, where $l \in \mathcal{N}$, derives utility from residing in municipality n and working in municipality d. Utility depends on consumption of manufacturing and service goods ($Q^k_{n\omega}$), housing ($H_{n\omega}$), idiosyncratic residential and workplace amenities ($b^R_{n\omega}, b^L_{d\omega}$), migration costs ($\kappa^R_{ln}$), and commuting costs ($\kappa^L_{nd}$):

$$U_{lnd\omega} = \frac{b^R_{n\omega} b^L_{d\omega}}{\kappa^R_{ln} \kappa^L_{nd}} \Pi_k \left(\frac{Q^k_{n\omega}}{\beta^k} \right)^{\beta^k} \left(\frac{H_{n\omega}}{\beta^H} \right)^{\beta^H} \qquad \text{for } l, n, d \in \mathcal{N},$$

with $\sum_k \beta^k + \beta^H = 1$.

The idiosyncratic amenities shock $b^R_{n\omega}$ captures individual-specific reasons for living in different locations. Following McFadden (1974) and Eaton and Kortum (2002), we model $b^R_{n\omega}$ as drawn from a Fréchet distribution:

$$G^R_n(b) = e^{-B^R_n b^{-\epsilon^R}}, \qquad b > 0, \epsilon^R > 1,$$

[12] Although Sweden and Denmark are both EU members, enabling cross-border migration, our model calibration reveals minimal actual migration flows between the two countries.

where B_n^R determines average residential amenities in location n and ϵ^R controls their dispersion. Thus, workers facing the same wages and prices may still choose different residences. Similarly, the workplace amenities shock $b_{d\omega}^L$ is also Fréchet-distributed:

$$G_d^L(b) = e^{-B_d^L b^{-\epsilon^L}}, \qquad b > 0, \epsilon^L > 1,$$

with B_d^L and ϵ^L governing average workplace amenities and their dispersion.

Composite goods $Q_{n\omega}^k$, for $k = 1, 2, ..., 5$, aggregate varieties from all municipalities and the ROW through a CES function:

$$Q_{n\omega}^k = \left(\sum_{i \in \mathcal{N} \cup W} (Q_{in\omega}^k)^{\frac{\sigma^k - 1}{\sigma^k}} \right)^{\frac{\sigma^k}{\sigma^k - 1}},$$

where σ^k is the elasticity of substitution. Utility maximization yields equilibrium consumption:

$$Q_{in}^k = \frac{(P_{in}^k)^{-\sigma^k}}{(P_n^k)^{1-\sigma^k}} X_n^k \quad \text{for } k = M, S,$$

where X_n^k is total expenditure on industry k in municipality n, P_n^k is the local price index, and P_{in}^k is the delivered price from i to n.

Workers allocate a fraction β^H of income to housing. Total expenditure X_n combines labor income, land rents, and the trade balance TB_n:

$$X_n = \overline{w}_n R_n + r_n^H H_n + TB_n,$$

where $\overline{w}_n$ is the average wage in n, R_n is the number of residents, and $TB_n \gtrless 0$ denotes a trade deficit or surplus. Land prices are pinned down by market clearing:

$$r_n^H H_n = \beta^H X_n = \beta^H (\overline{w}_n R_n + r_n^H H_n + TB_n). \tag{8}$$

We assume that housing rents accrue to local landlords. This lets housing prices affect location choices without introducing rent-income redistribution.

5.1.2 Preferences and Endowments of Workers Born in the ROW

For workers in the ROW, we abstract from both migration and commuting. These workers derive utility from consuming manufacturing and service composites (Q_W^k) and housing H_W, together with the amenity value B_W^R of the ROW.

The utility function takes the Cobb-Douglas form:

$$U_W = B_W^R \Pi_k \left(\frac{Q_W^k}{\beta^k}\right)^{\beta^k} \left(\frac{H_W}{\beta^H}\right)^{\beta^H}.$$

Since we do not model migration or commuting for ROW workers, there is no need for idiosyncratic residential or workplace shocks. Both wages and labor supply are fixed: $w_W = \overline{w}_W$ and $R_W = L_W = \overline{L}_W$.

5.2 Production: Manufacturing and Service Sector

Our production framework follows the new economic geography literature. Firms in both manufacturing and services use labor and intermediate inputs in a roundabout production process.[13]

In each municipality n, firms in sector k produce output according to the production function:

$$Q_n^k = A_n^k \Gamma^k L_n^{\alpha_L^k} \prod_{k'} [I^{kk'} n]^{\alpha^k k'}$$

where $k, k' = 1, 2, ..., 5$. Here A_n^k captures location-specific productivity, α_L^k is the labor share, and $\alpha^{kk'}$ is the share of intermediate inputs from sector k'. The constant Γ^k, defined as $\Gamma_k = \left(\frac{1}{\alpha_L^k}\right)^{\alpha_L^k} \Pi_{k'} \left(\frac{1}{\alpha_{k'}^k}\right)^{\alpha_{k'}^k}$, scales inputs so that $\alpha_L^k + \sum_{k'} \alpha_{k'}^k = 1$ implies constant returns to scale.

Consistent with Eaton and Kortum (2002), Alvarez and Lucas Jr (2007), Di Giovanni and Levchenko (2013), and Arkolakis et al. (2012), we assume the same sub-

[13] While we initially considered Marshallian externalities in the service sector, calibration yielded statistically insignificant estimates, leading us to exclude them from our baseline specification.

stitution elasticities in both production and consumption.[14] The resulting unit cost at location n is:

$$c_n^k = \frac{w_n^{\alpha_L^k} \prod_{k'} (P_n^{k'})^{\alpha^{kk'}}}{A_n^k}$$

Goods are traded subject to iceberg trade costs τ_{nd}^k for $n, d \in \overline{\mathcal{N}}$, which incorporate both transportation costs and cross-border tariffs. Under the assumption of zero fixed export costs, firms employ mill pricing, setting delivered prices as:

$$P_{nd}^k = \tau_{nd}^k c_n^k$$

5.3 Migration and Commuting

This section characterizes worker mobility across municipalities in Sweden and Denmark, denoted by $n, d, l, i \in \mathcal{N}$. Given the preferences in Section 5.1, the indirect utility of a worker ω born in municipality l, residing in municipality n, and employed in municipality d is:

$$V_{lnd\omega} = \frac{b_{n\omega}^R b_{d\omega}^L w_d}{\kappa_{ln}^R \kappa_{nd}^L \Pi_k (P_n^k)^{\beta^k} (r_n^H)^{\beta^H}}$$

Workers choose residence and workplace sequentially. We solve the problem by backward induction.

5.3.1 Commuting

The indirect utility conditional on residence location varies monotonically with idiosyncratic amenities ($b_{d\omega}^L$), which follow a Fréchet distribution. The probability that

[14] Assuming identical substitution elasticities across final and intermediate uses simplifies the model structure by allowing each location to have a single price index per industry. This unified price index applies to both consumers and producers. From an empirical perspective, this assumption is also consistent with the data limitations we face: the available trade data do not distinguish between imports used for final consumption and those used as intermediate inputs. As a result, we estimate a single substitution elasticity for each industry, capturing the aggregate responsiveness of import demand to relative price changes.

a worker residing in municipality n commutes to municipality d is:

$$\lambda_{d|n}^{L} = \frac{B_d^L \left(w_d/\kappa_{nd}^L\right)^{-\epsilon^L}}{\sum_{i\in\mathcal{N}} B_i^L \left(w_i/\kappa_{ni}^L\right)^{-\epsilon^L}} \equiv \frac{\Phi_{d|n}^L}{\Phi_n^L} \tag{9}$$

where $\Phi_{d|n}^L = B_d^L \left(w_d/\kappa_{nd}^L\right)^{-\epsilon^L}$ and $\Phi_n^L = \sum_{i\in\mathcal{N}} B_i^L \left(w_i/\kappa_{ni}^L\right)^{-\epsilon^L}$.

Workplace choice depends on wages (w_d), commuting costs (κ_{nd}^L), and workplace amenities (B_d^L). Ceteris paribus, workers living in municipality n are more likely to work in municipality d when wages and amenities are higher and commuting costs are lower.

The labor market clearing condition equates employment in municipality d with the aggregate commuting inflows:

$$L_d = \sum_{n\in\mathcal{N}} \lambda_{d|n}^L R_n \tag{10}$$

Expected worker income for residents of municipality n is:

$$\overline{w}_n = \sum_{d\in\mathcal{N}} \lambda_{d|n}^L w_d$$

Thus, expected income ($\overline{w}_n$) is higher in locations with better access to high-wage jobs.

The expected utility for a worker born in municipality l residing in municipality n is:

$$V_{ln\omega} = \mathbb{E}V_{ln\omega} = \Gamma\left(\frac{\epsilon^L - 1}{\epsilon^L}\right)\left[\sum_{d\in\mathcal{N}} B_d^L \left(\frac{w_d}{\kappa_{nd}^L}\right)^{\epsilon^L}\right]^{\frac{1}{\epsilon^L}} \frac{b_{n\omega}^R}{\kappa_{ln}^R \Pi_k (P_n^k)^{\beta^k} (r_n^H)^{\beta^H}}$$

Defining $\widetilde{w}_n = \Gamma\left(\frac{\epsilon^L-1}{\epsilon^L}\right)\left[\sum_{d\in\mathcal{N}} B_d^L \left(\frac{w_d}{\kappa_{nd}^L}\right)^{\epsilon^L}\right]^{\frac{1}{\epsilon^L}}$, we obtain:

$$V_{ln\omega} = \frac{b_{n\omega}^R \widetilde{w}_n}{\kappa_{ln}^R \Pi_k (P_n^k)^{\beta^k} (r_n^H)^{\beta^H}}$$

5.3.2 Migration

The indirect utility $V_{ln\omega}$ varies monotonically with the residential amenity shock $b^R_{n\omega}$, which is Fréchet-distributed. Consequently, $V_{ln\omega}$ is also Fréchet-distributed: $G_{n|l}(V) = e^{-\Phi^R_{n|l} V^{-\epsilon^R}}$, where:

$$\Phi^R_{n|l} = B^R_n \left(\frac{\widetilde{w}_n}{\kappa^R_{ln} \Pi_k (P^k_n)^{\beta^k} (r^H_n)^{\beta^H}} \right)^{\epsilon^R}$$

The probability that a worker born in municipality l chooses to reside in municipality n is:

$$\lambda^R_{n|l} = \frac{B^R_n [\kappa^R_{ln} \Pi_k (P^k_n)^{\beta^k} (r^H_n)^{\beta^H}]^{-\epsilon^R} \widetilde{w}_n^{\epsilon^R}}{\sum_{i \in \mathcal{N}} B^R_i [\kappa^R_{li} \Pi_k (P^k_i)^{\beta^k} (r^H_i)^{\beta^H}]^{-\epsilon^R} \widetilde{w}_i^{\epsilon^R}} \equiv \frac{\Phi^R_{n|l}}{\Phi^R_l} \tag{11}$$

where $\Phi^R_{n|l} = B^R_n [\kappa^R_{ln} \Pi_k (P^k_n)^{\beta^k} (r^H_n)^{\beta^H}]^{-\epsilon^R} \widetilde{w}_n^{\epsilon^R}$ and $\Phi^R_l = \sum_{i \in \mathcal{N}} B^R_i [\kappa^R_{li} \Pi_k (P^k_i)^{\beta^k} (r^H_i)^{\beta^H}]^{-\epsilon^R} \widetilde{w}_i^{\epsilon^R}$. The shock $b^R_{n\omega}$ generates heterogeneous residential choices among workers facing the same prices, migration costs, and location characteristics. Ceteris paribus, workers born in municipality l are more likely to live in municipality n when consumption prices and housing costs are lower, expected wages and amenities are higher, and migration costs are lower. The residential population in municipality n is determined by:

$$R_n = \sum_l \lambda^R_{n|l} \overline{L}_l \tag{12}$$

The expected utility of a worker born in municipality l is:

$$V_{l\omega} = \Gamma \left(\frac{\epsilon^R - 1}{\epsilon^R} \right) \sum_{n \in \mathcal{N}} \left[B^R_n \left(\frac{\widetilde{w}_n}{\kappa^R_{ln} \Pi_k (P^k_n)^{\beta^k} (r^H_n)^{\beta^H}} \right)^{\epsilon^R} \right]^{\frac{1}{\epsilon^R}} \tag{13}$$

5.4 Goods and Service Trade and Aggregation

Firms in municipality n and industry k sell to all municipalities in $\mathcal{N}$ and to the ROW. Their output is used both for final consumption and as an intermediate input. Sales from municipality n to municipality d in industry k are:

$$Y_{nd}^k = \frac{\left(\tau_{nd}^k c_n^k\right)^{1-\sigma^k}}{(P_d^k)^{1-\sigma^k}} MS_d^k$$

where MS_d^k denotes market size, that is, total expenditure on sector k in municipality d:

$$MS_d^k = \beta_k X_d + \sum_{k'} \alpha_{k'}^k Y_d^{k'}$$

Total sales from location n are:

$$Y_n^k = \sum_{d \in \overline{\mathcal{N}}} Y_{nd}^k = \sum_{d \in \overline{\mathcal{N}}} \frac{\left(\tau_{nd}^k c_n^k\right)^{1-\sigma^k}}{(P_d^k)^{1-\sigma^k}} MS_d^k$$

The price index of industry k in municipality n is derived from the equilibrium pricing rule as:

$$(P_n^k)^{1-\sigma^k} = \sum_{d \in \mathcal{N} \cup \mathcal{W}} (P_{dn}^k)^{1-\sigma^k} \tag{14}$$

The model yields a gravity equation for bilateral trade. Using the CES expenditure function and equilibrium pricing rule, the share of location n's expenditure on goods from location d is:

$$\pi_{dn}^k = \frac{(c_d^k \tau_{dn}^k)^{1-\sigma^k}}{\sum_{i \in \overline{\mathcal{N}}} (c_i^k \tau_{in}^k)^{1-\sigma^k}} \quad \text{for } d, n \in \mathcal{N} \cup W \tag{15}$$

Under revenue-expenditure equality and zero profits, workplace income equals total expenditure on locally produced goods:

$$Y_n^k = (c_n^k)^{1-\sigma^k} \sum_{d \in \overline{\mathcal{N}}} (\tau_{nd}^k)^{1-\sigma^k} \frac{MS_d^k}{(P_d^k)^{1-\sigma^k}} = \sum_{i \in \overline{\mathcal{N}}} \pi_{ni}^k MS_i^k \qquad \text{for } n \in \mathcal{N} \cup W \tag{16}$$

Define $RMA_n^k = \sum_{d \in \mathcal{N} \cup W} (\tau_{nd}^k)^{1-\sigma^k} \frac{MS_d^k}{(P_d^k)^{1-\sigma^k}}$ as market accessibility. Market access rises when trade costs are lower and nearby markets are larger.

5.5 General Equilibrium

The general equilibrium is characterized by vectors w_n, $\overline{w}_n$, $\widetilde{w}_n$, r_n^H, L_n, R_n, $P_n^k k = 1, ..., K$, and $M_n^k k = 1, ..., K$ satisfying:

1. Optimal migration and commuting decisions per Equations (9), (10), (11) and (12) in Section 5.3.

2. Labor market clearing conditions:

$$\sum_k L_n^k = L_n \quad \text{for } n \in \overline{\mathcal{N}} \tag{17}$$

$$w_n L_n^k = \alpha_L^k Y_n^k \tag{18}$$

   with output by sector and location defined in Equation 16 in Section 5.4.

3. Goods and service trade shares defined by Equation 15.

4. Price indices by sector and location defined by Equation 14.

5. Land market clearing per Equation (8).

6 Data and Calibration

This section outlines our model calibration methodology using empirical data, emphasizing parameters critical for evaluating the economic implications of the bridge

connecting Sweden and Denmark, which we analyze thoroughly in Section 7. The DEK procedure significantly reduces calibration requirements, though several key parameters remain essential.

For the manufacturing sector ($k = 1$), we assume the elasticity of substitution between varieties at $\sigma^k = 4$, consistent with empirical findings from Broda and Weinstein (2006), who derived this value from comprehensive price and expenditure datasets. Regarding the service sector's substitution elasticity of varieties, we leverage the bridge's observed impact on service trade for parameter estimation.

We utilize OECD input-output tables[15] for Sweden, Denmark, and the rest of the world (ROW) to calibrate production shares within the manufacturing and service sectors across all regions, as well as consumption shares by country. These tables provide aggregate industry output by country and interregional trade flows. We calculate trade imbalances (surpluses or deficits) as the difference between imports and exports, maintaining these values constant throughout our counterfactual analysis. We distribute these trade surpluses or deficits to municipalities proportionally to their total output.

For municipal-level data, we draw from Statistics Sweden and Denmark to determine production shares across manufacturing and service sectors. We allocate country-industry level output (sourced from OECD input-output tables) to individual municipalities based on their respective output shares, yielding industry-specific municipal output values (Y_d^k). Additionally, we obtain average wages by municipality (w_d) from Statistics Sweden and Denmark. We further compute commuter shares (λ_{nl}^L) and migration shares (λ_{nl}^R) using data from Statistics Sweden. Using labor demand equations (17) and (18), alongside labor supply equations 10 and (12), we calibrate municipal labor supply (L_d), resident population (L_d^R), and total labor stock originating from each municipality ($\overline{L}_d$).

We provide comprehensive details regarding these parameter calibrations in Online Appendix B, which also presents statistical summaries of calibrated parameters including production and consumption shares by country, as well as output, labor supply, resident population, and industry-specific output by municipality.

[15]Source: `https://www.oecd.org/en/data/datasets/input-output-tables.html`

6.1 Trade Cost

Ideally, with data on the bilateral trade share π_{nl}^k $(k = 1, ..., K)$ across municipalities and borders, there would be no need to calibrate trade costs in the DEK procedure. However, in the absence of direct data on bilateral trade shares π_{nl}^k $(k = M, S)$ within countries, we will calibrate the trade costs for the manufacturing and service sectors both within municipalities and across borders. In summary, the trade cost will be modeled as a function of distance for all trade flows, along with cross-border costs for imports and exports. We will estimate the trade cost using available export share data by sector and municipalities. The rest of this section details our assumptions regarding trade costs for goods and services, including within municipalities of a country, between Swedish/Danish municipalities and the rest of the world (ROW), and across Sweden and Denmark.

6.1.1 Parametrization of Trade Cost

Within-Country Trade For intra-country trade between municipalities, the trade cost is modeled as a function of distance. Following Monte et al. (2018b), the trade cost function is specified as:

$$\log \tau_{nl}^k = D^k + \psi^k \log dist_{nl} \quad \text{for } k = 1, ..., K$$

where n and l denote two locations within the same country (Sweden or Denmark), and $dist_{nl}$ represents the distance between these two locations. The term D^k is a sector-specific constant that captures base trade costs (excluding distance), while ψ^k denotes the distance elasticity parameter for sector k, reflecting how trade costs change with distance.

Cross-Border Trade Between Swedish and Danish Municipalities For trade between Swedish and Danish municipalities, we adopt a slightly different approach to account for the multi-stage transportation process for manufacturing and service sectors.

Specifically, in the **manufacturing** sector, we assume that goods are shipped via sea transport.[16] The trade cost function thus incorporates multiple transportation stages: from the municipality to the seaport, from the seaport in one country to the seaport in the other country, and finally, from the seaport to the destination municipality. The cost is given by:

$$\begin{aligned} \log \tau_{nl}^{1} &= D^{1} + \psi^{1} \log(dist_{n,port}) \\ &\quad + \psi^{1} \log(dist_{port,l}) + \log \tau_{C,C'}^{1} \end{aligned}$$

where $dist_{n,port}$ represents the distance between municipality n and the major port in the origin country, and $dist_{port,l}$ is the distance from the major port in the destination country to the destination municipality l. The term $\tau_{C,C'}^{1}$ represents the cross-border cost between Sweden and Denmark, including shipping costs from port to port and cross-border fees. Note that under this assumption, the bridge did not affect the cost of goods trade, which is consistent with our empirical results in Section 4.[17]

For the **service** sector ($k = 2, ..., K$), where trade is primarily via road transport, the trade cost function depends mainly on the driving distance between municipalities:

$$\log \tau_{nl}^{k} = D^{k} + \psi^{k} \log dist_{nl} + \log \tau_{C,C'}^{k}$$

where $dist_{nl}$ denotes the driving distance between municipalities n and l. D^{k} is the sector-specific constant for the service sector, and ψ^{k} is the distance elasticity pa-

[16] Most goods are shipped by sea, but some shipping to Denmark or Germany also happens by truck. However, we found that the shipment of goods does not respond to the building of the bridge and the transportation cost does not change before or after the bridge. So the assumption of goods transportation through sea ports is without loss of generality.

[17] After interviewing several shipping companies in southern Sweden, we found two main reasons why goods trade was not significantly affected by the bridge. First, the tolls for crossing are substantial. Second, loading and unloading typically occur during office hours. As a result, truckers prefer to consolidate all shipments on the Swedish side before crossing into Denmark, rather than making multiple trips. This often means they cannot reach their Danish destinations in time to unload the same day. Consequently, the shorter travel time offered by the bridge did not translate into faster deliveries, and the tolls prevented any reduction in overall transport costs.

rameter for services. $\tau^k_{C,C'}$ represents the cross-border cost for services trade between Sweden and Denmark when n and l are located in different countries, capturing factors such as cultural differences and legal system discrepancies. It is important to note that, due to data limitations, we are unable to distinguish between remote and in-person service trade. Consequently, the estimated distance elasticity should be interpreted as reflecting the average trade cost associated with distance across all modes of service delivery.

Trade from Swedish/Danish Municipalities to the ROW For municipalities exporting **manufacturing** goods to the ROW, the trade cost includes the distance from the municipality to the seaport, as well as the cross-border costs. The export cost function is expressed as:

$$\log \tau^1_{n,ROW} = D^1 + \psi^1 \log(dist_{n,port}) + \log \tau^1_{C,ROW}$$

where $dist_{n,port}$ is the distance from municipality n to the major port in Sweden or Denmark, and $\tau^1_{C,ROW}$ represents cross-border costs such as shipping costs, insurance, and other trade barriers.

For the **service** sector, we assume a similar specification but the traveling distance that matters is the distance from municipality n to the nearest major airport in Sweden or Denmark, i.e., $dist_{n,airport}$. That is,

$$\begin{aligned} \log \tau^k_{n,ROW} &= D^k + \psi^k \log(dist_{n,airport}) + \log \tau^k_{C,ROW} \\ &\quad \text{for } k = 2, ..., 5 \end{aligned}$$

The term $\tau^k_{C,ROW}$ represents the cross-border cost for exports, including tariffs, shipping freights, and cross-border fees for sector k.

Similarly, for municipalities importing manufacturing/service goods from the ROW, the cost incorporates the distance from the nearest seaport/airport to the

municipality, along with the cross-border costs:

$$\log \tau^1_{ROW,n} = D^1 + \psi^1 \log(dist_{port,n}) + \log \tau^1_{ROW,C} \quad \text{for } k = 1$$
$$\log \tau^k_{ROW,n} = D^k + \psi^k \log(dist_{airport,n}) + \log \tau^k_{ROW,C} \quad \text{for } k = 2, ..., 5$$

where, $dist_{port,n}$ is the distance from the nearest major port to municipality n in Sweden or Denmark, and $dist_{airport,n}$ $(k = 2, ..., 5)$ represents the distance from the nearest major airport to municipality n in Sweden or Denmark. $\tau^k_{ROW,C}$ represents the cross-border cost for imports, accounting for factors such as tariffs, shipping costs, and cross-border fees for sector k.

6.1.2 Estimation of Distance Elasticity in the Service Sector ($k = 2, ..., 5$)

To estimate the distance elasticity and substitution elasticity σ^k in the service sector, we utilize both export and import ratios of services between each Swedish municipality and Denmark/the Rest of the World (ROW), which are readily available in the data.

We first derive the following estimation equation of export ratio for service trade. For $d \in$ SWE, the relative exports to Denmark and the ROW are given by:

$$\begin{aligned}
\frac{Y^k_{d,DNK}}{Y^k_{d,ROW}} &= \frac{(c^k_d)^{1-\sigma^k} \sum_{l \in \text{DNK}} \tau^{1-\sigma^k}_{dl} \frac{MS^k_l}{(P^k_l)^{1-\sigma^k}}}{(c^k_d)^{1-\sigma^k} \tau^{1-\sigma^k}_{d,ROW} \frac{MS^k_{ROW}}{(P^k_{ROW})^{1-\sigma^k}}} \\
&= \frac{\sum_{l \in \text{DNK}} \tau^{1-\sigma^k}_{dl} \frac{MS^k_l}{(P^k_l)^{1-\sigma^k}}}{(\tau^k_{d,airport})^{1-\sigma^k} (\tau^k_{\text{DNK,ROW}})^{1-\sigma^S} \frac{MS^k_{ROW}}{(P^k_{ROW})^{1-\sigma^k}}}
\end{aligned}$$

Taking the log of the relative export ratio $\frac{Y^k_{d,DNK}}{Y^k_{d,ROW}}$, and incorporating a time dimension with a subscript t, we get:

$$\log \frac{Y^k_{d,DNK,t}}{Y^k_{d,ROW,t}} = \log \sum_{l \in \text{DNK}} \tau^{1-\sigma^k}_{dl} \frac{MS^k_l}{(P^k_l)^{1-\sigma^k}} + (1 - \sigma^k) \log \tau^k_{d,airport} + \mu^{E,k}_t \quad (19)$$

where, the industry-year fixed effect $\mu_t^{E,k}$ accounts for aggregate shocks common to all Swedish municipalities, i.e., $(\tau^k_{DNK,ROW})^{1-\sigma^S}\frac{MS^k_{ROW}}{(P^k_{ROW})^{1-\gamma^k}}$.

$P^S_{l,t}$ can be solved using the following equations from the model:

$$
\begin{aligned}
RMA^k_d &= \sum_{l\in\overline{\mathcal{N}}}(\tau^k_{dl})^{1-\sigma^k}\frac{MS^k_l}{(P^k_l)^{1-\sigma^k}} \\
(P^k_l)^{1-\sigma^k} &= \sum_d \left(c^k_l\right)^{1-\sigma^k}(\tau^k_{dl})^{1-\sigma^k} \\
Y^k_d &= (c^k_d)^{1-\sigma^k} RMA^k_d
\end{aligned}
$$

where, τ^k_{dl} is defined in Section 6.1.1. It incorporates cross-border trade barriers, denoted by $\tau^k_{C,C',t}$ for $C, C' \in \text{SWE}, \text{DNK}, \text{ROW}$, whenever origin d and destination l belong to different countries. These trade cost parameters, $\tau^k_{C,C',t}$, are calibrated to ensure that each country's aggregate export share in industry k—measured as $\frac{Y^k_{C,C}}{Y^k_C}$—matches the corresponding trade shares reported in the OECD Input-Output Tables.

Similarly, we derive a second set of estimation equation of import ratio for service trade from DNK and ROW to each Swedish municipality d. After rearranging the equation, we get:

$$
\log\frac{Y^k_{DNK,d,t}}{Y^k_{ROW,d,t}} = \log\sum_{l\in\text{DNK}}(c^k_l)^{1-\sigma^k}\tau^{1-\sigma^k}_{ld} + (1-\sigma^k)\log\tau^k_{airport,d} + \mu^{I,k}_t \qquad (20)
$$

The cross-sectional variation in the export ratio to Denmark relative to the rest of the world (ROW) across Swedish municipalities provides a means to identify the distance elasticity of service trade costs. The underlying intuition is that municipalities located closer to Denmark enjoy relatively better access to the Danish market than those situated further away. Consequently, service exports to Denmark are expected to constitute a larger share of total exports in municipalities proximate to the Danish border.

The construction of a bridge that reduces trade costs between Swedish and Danish municipalities amplifies this dynamic by encouraging consumers and firms to sub-

stitute services previously sourced from the ROW with those from Denmark. This substitution effect, driven by the decline in bilateral trade costs, is expected to be stronger for municipalities located nearer to the bridge. The spatial heterogeneity in the response to this cost reduction facilitates identification of the substitution elasticity, σ^k.

Since both the distance elasticity (ψ^k) and the substitution elasticity (σ^k) affect the computation of $RMA^k_{d,t}$, Equations (19) and (20) are nonlinear in these parameters. We therefore estimate ψ^k and σ^k using nonlinear least squares, selecting the parameters (ψ^k, σ^k, μ^k_t) to minimize the discrepancy between the model's predicted trade shares and the observed data.

$$\psi^k, \sigma^k, \mu_t^{E,k}, \mu_t^{I,k} \in$$
$$\arg\min \sum_{d,t} \left(\log \frac{Y^k_{d,DNK,t}}{Y^k_{d,ROW,t}} - \log \sum_{l \in \text{DNK}} \tau_{dl}^{1-\sigma^k} \frac{MS^k_l}{(P^k_l)^{1-\sigma^k}} - (1-\sigma^k) \log \tau^k_{d,airport} - \mu_t^{E,k} \right)^2$$
$$+ \sum_{d,t} \left(\log \frac{Y^k_{DNK,d,t}}{Y^k_{ROW,d,t}} - \log \sum_{l \in \text{DNK}} (c^k_l)^{1-\sigma^k} \tau_{ld,t}^{1-\sigma^k} - (1-\sigma^k) \log \tau^k_{airport,d} + \mu_t^{I,k} \right)^2$$

To estimate ψ^k and σ^k in $k = 2, ..., 5$ in the service sectors, we take advantage of the service export shares of Sweden municipalities in the years 1997 and 2002 given the data availability. The estimation details for manufacturing trade costs are relegated to Appendix B.1.

6.1.3 Estimation Results

Table 2 reports the estimated distance elasticities ψ^k for all industries, as well as the substitution elasticities σ^k for service industries. Column (1) shows that the overall estimated distance elasticity is 0.0241 with a standard deviation of 0.0053. Within the service sector, the estimated values of ψ^S vary substantially, ranging from 0.0706 to 0.4764. These estimates align with the expectation that service trade costs are generally more sensitive to geographic distance than those in manufacturing. Notably, the distance elasticity is highest in the Business sector and lowest in IT. This pattern is intuitive: comparing to the goods trade, trade costs are more distance-sensitive in service industries such as Business services, where face-to-face interactions are often critical. By combining σ^k and ϕ^k together,

the goods trade elasticity with regard to distance is 0.0974, which is much lower than that in service industries. Among the service industries, the trade elasticities are less sensitive in IT, where remote delivery is more feasible. The service trade elasticity with regard to distance ranges from -1.057 (Business industry) to -0.4518 (IT industry). That is, with a 10% of increase in the transportation cost, the volume of service trade will see a decrease ranging from 10.57% to 4.52%. Though the literature on the service trade elasticity with regard to distance is scarce, our estimates align well with the estimates we found in the literature. For example, Kimura and Lee (2006) and Lennon (2009) use the international service trade flow data to estimate the gravity equation in service trade. They found that the elasticity is close to -1.

The estimated substitution elasticities σ^k across service industries range from 2.2226 to 7.2979, which is broadly in line with the range of estimates for manufacturing sectors reported in previous studies.

Table 2: Distance Elasticity in Trade Costs (ψ^k)

	(1) Manufacturing	(2) Business	(3) IT	(4) Others	(5) Transportation
ψ_k	0.0241	0.4764	0.0706	0.1207	0.1274
sd	(0.0053)	(0.0010)	(0.0314)	(1.253e-5)	(0.0183)
σ^k	4	2.2226	6.4001	7.2979	6.9349
sd		0.0004	0.0382	0.9772	0.0047
Distance Elas. ($\psi_k\sigma^k$)	0.0974	1.057	0.4518	0.8808	0.8835
Year FE	Yes	Yes	Yes	Yes	Yes
Obs	1696	246	58	146	134

Notes: Column (1) presents the estimate in manufacturing industry, using the Swedish municipality level manufacturing trade data in 1997, 2002 and 2006. Columns (2) - (5) present the estimates of industries in service sector, using the Swedish municipality level service trade data in 1997 and 2002.
Standard deviations are reported in parentheses. Statistical significance is denoted by asterisks: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

By calibrating the model to match each country's export shares across years, we recover calibrated cross-border trade costs for both the manufacturing and service sectors over time, i.e., $\tau^k_{C,C}$, which accounts for across border trade barriers such as sea freight, insurance, regulation barriers, etc. Table 3 presents the calibrated values. Overall, cross-border trade costs between Sweden (SWE) and Denmark (DNK) are lower than those between either country and the rest of the world (ROW). In the manufacturing sector, trade costs remain

relatively stable throughout the period from 1997 to 2006. In the service sector, the cross-border cost is much higher in the business sector, which is consistent with the fact that cross-border business activities often require frequent travel and in-person interaction.

The calibrated trade costs also align with the expectation that service-sector barriers have generally declined over time. For instance, in the IT sector, the trade cost between Sweden and ROW falls from 3.09 in 1997 to 2.93 in 2002, and further to 2.72 in 2006. In the Business sector, the cost of cross-border trade between SWE and DNK decreases substantially, from 16.48 in 1997 to 11.06 in 2006. This downward trend likely reflects technological advancements that have improved the effectiveness of remote communication and reduced the need for physical presence.

6.2 Commuting and Migration Cost

To estimate the distance elasticity of commuting costs, we parameterize the cost function as follows:

$$\kappa_{nd}^{L} = \widetilde{\kappa}_{nd}^{L} \cdot dist_{nd}^{\nu^L},$$

where $dist_{nd}$ denotes the distance between municipalities n and d, $\widetilde{\kappa}_{nd}^{L}$ is a location-pair-specific term that may vary over time, and ν^L captures the elasticity of commuting costs with respect to distance. Although we do not need to calibrate $\widetilde{\kappa}_{nd}^{L}$ or the locational amenity term B_d^L thanks to the DEK procedure, our focus here is on estimating the elasticities ν^L and ϵ^L in Equation (9), where ν^L characterizes the commuting cost with respect to the distance, and ϵ^L governs the dispersion of individuals' taste over different workplaces.

We estimate these elasticities using the following log-linearized equation for $\log \lambda_{d|n,t}^{L}$, i.e. Equation (9), where $n, d \in \mathcal{N}$:

$$\begin{aligned} \log \lambda_{d|n,t}^{L} &= \log B_{d,t}^{L} + \epsilon^L \log w_{d,t} - \epsilon^L \log \widetilde{\kappa}_{nd,t}^{L} - \nu^L \epsilon^L \log dist_{nd,t} \\ &\quad - \log \left(\sum_{i \in \mathcal{N}} B_{i,t}^{L} \left(\frac{w_{i,t}}{\kappa_{ni,t}^{L}} \right)^{\epsilon^L} \right). \end{aligned} \tag{21}$$

We implement a two-step estimation procedure. In Step 1, we estimate the composite parameter $\nu^L \cdot \epsilon^L$ by exploiting variation in commuting shares and distances across

Table 3: Trade Costs Across Borders ($\tau^k_{C,C'}$)

					Manufacturing				
		1997			2002			2006	
	SWE	DNK	ROW	SWE	DNK	ROW	SWE	DNK	ROW
SWE	1.00	2.26	3.91	1.00	2.28	3.95	1.00	2.09	3.91
DNK	2.68	1.00	4.55	2.59	1.00	4.50	2.62	1.00	4.62
ROW	1.59	1.54	1.00	1.57	1.53	1.00	1.51	1.45	1.00
					Business				
		1997			2002			2006	
	SWE	DNK	ROW	SWE	DNK	ROW	SWE	DNK	ROW
SWE	1.00	16.48	111.23	1.00	10.74	89.21	1.00	11.06	73.19
DNK	26.85	1.00	351.02	24.80	1.00	270.82	25.50	1.00	243.24
ROW	3.74	7.60	1.00	3.69	4.75	1.00	4.30	5.75	1.00
					IT				
		1997			2002			2006	
	SWE	DNK	ROW	SWE	DNK	ROW	SWE	DNK	ROW
SWE	1.00	1.99	3.09	1.00	1.76	2.93	1.00	1.72	2.72
DNK	2.34	1.00	3.77	1.97	1.00	3.05	1.89	1.00	3.00
ROW	1.62	1.76	1.00	1.71	1.63	1.00	1.63	1.71	1.00
					Others				
		1997			2002			2006	
	SWE	DNK	ROW	SWE	DNK	ROW	SWE	DNK	ROW
SWE	1.00	1.83	2.26	1.00	1.84	2.29	1.00	1.78	2.19
DNK	1.74	1.00	2.33	1.72	1.00	2.31	1.71	1.00	2.24
ROW	1.81	1.95	1.00	1.77	1.91	1.00	1.79	1.90	1.00
					Transportation				
		1997			2002			2006	
	SWE	DNK	ROW	SWE	DNK	ROW	SWE	DNK	ROW
SWE	1.00	1.29	1.96	1.00	1.23	2.04	1.00	1.18	1.99
DNK	1.45	1.00	1.66	1.40	1.00	1.57	1.32	1.00	1.42
ROW	1.50	1.20	1.00	1.43	1.17	1.00	1.44	1.09	1.00

Notes: The within country trade cost $\tau^k_{C,C}$ is set equal to 1. We calibrate the cross country trade cost $\tau^k_{C,C'}$ such that the export shares $\frac{Y^k_{C,C'}}{Y^k_C}$ from the model match exactly to the ones in OECD input-output table.

municipalities. Specifically, we estimate the following regression:

$$\log \lambda^L_{d|n,t} \quad = \quad -\nu^L \epsilon^L \log dist_{nd,t} + \mu_{d,t} + \mu_{n,t} + \varepsilon_{d|n,t}, \quad \text{for } n, d \in \mathcal{N}, \tag{22}$$

where $\mu_{d,t}$ captures destination fixed effects, including workplace amenities, $\log B^L_{d,t}$, and wages, $\log w_{d,t}$, and $\mu_{n,t}$ captures origin fixed effects such as accessibility at origin n, i.e., $-\log\left(\sum_{i\in\mathcal{N}} B^L_{i,t}(w_{i,t}/\kappa^L_{ni,t})^{\epsilon^L}\right)$.

We use commuting data for the years 1997, 2002, and 2006, obtained from the Statistics of Sweden, which provides detailed records on commuting flows across municipalities in Sweden, and the commuting flows from Swedish municipalities to Danish municipalities. However, comparable data for commuters residing in Denmark are unavailable. For tractability, we assume that individuals living in Denmark do not commute either domestically or to Sweden. We argue that this simplification has minimal impact on our results. First, wage changes in Danish municipalities around the time of the bridge's construction are small (as shown in Section 4), limiting incentives for Danish residents to alter commuting behavior. Second, since wages are significantly higher in Denmark reported in Section 4, most cross-border commuting flows occur from Sweden to Denmark, making it reasonable to exclude commuting from Denmark to Sweden in our analysis. Based on the available data, we construct the commuting shares $\lambda^L_{d|n,t}$, representing the share of workers living in n and commuting to d.

The residual term $\varepsilon_{d|n,t}$ absorbs $\log \widetilde{\kappa}^L_{nd,t}$, which is the location-pair-specific attractiveness. With the assumption that $\log \widetilde{\kappa}^L_{nd,t}$ is exogenous to $\log dist_{nd,t}$ following Monte et al. 2018b, OLS provides a consistent estimate of $\nu^L \cdot \epsilon^L$. The estimation results are reported in Table 4. Column (1) presents OLS estimates from Equation (22), showing a significantly negative elasticity with respect to distance. Given the large number of zeros in the commuting data, we use Poisson pseudo-maximum likelihood (PPML) estimation to address potential zero-inflation bias. The result, shown in Column (2), yields a statistically significant estimate of $\nu^L \cdot \epsilon^L = 2.983$.

As a robustness check, we include origin-destination fixed effects to control for time-invariant bilateral factors embedded in $\log \widetilde{\kappa}^L_{nd,t}$. In this specification, identification relies on changes in cross-border commuting patterns between Sweden and Denmark following the reduction in commuting times caused by the Öresund Bridge. The implicit assumption is that the variation in the location-pair-specific attractiveness $\log \widetilde{\kappa}^L_{nd,t}$ is independent of

the reduction in commuting times. The estimates reported in Columns (3) and (4) remain consistent with our baseline findings.

Table 4: Estimation of $\nu^L \epsilon^L$

	(1)	(2)	(3)	(4)
	Year = 1997; 2002; 2006			
	FE	PPML	FE	PPML
$\log Dist_{nd,t}$	-1.464	-2.954	-2.041	-2.345
	(0.00908)***	(0.0121)***	(0.151)***	(0.180)***
Origin-Year FE	YES	YES	YES	YES
Destin-Year FE	YES	YES	YES	YES
Origin-Destin FE	NO	NO	YES	YES
N	105323	323136	87282	152885

Note: This table presents the estimation of Equation (22) using commuting share data of all municipalities in Sweden.
Standard deviations are reported in parentheses. Statistical significance is denoted by asterisks: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Given the estimate $\nu^L \cdot \epsilon^L = 2.983$, we rearrange Equation (21) to obtain the following linear specification:

$$\log \lambda^L_{d|n,t} + \nu^L \epsilon^L \log dist_{nd,t} \quad = \quad \epsilon^L \log w_{d,t} + \mu_{n,t} + \varepsilon_{d|n,t},$$

where $\mu_{n,t}$ captures origin-time fixed effects related to accessibility to jobs across municipalities, specifically $-\log\left(\sum_{i\in\mathcal{N}} B^L_{i,t}\left(w_{i,t}/\kappa^L_{ni,t}\right)^{\epsilon^L}\right)$. The error term $\varepsilon_{d|n,t}$ includes $\epsilon^L \log \widetilde{\kappa}^L_{nd,t}$ and $\log B^L_{d,t}$. Both components of the error term are potentially correlated with wages. Since both components may be correlated with $\log w_{d,t}$, the wage term is potentially endogenous. For example, if a municipality has high amenities ($B^L_{d,t}$), workers want to live/work there, which drives up both wages and commuting flows.

To address this endogeneity, we estimate the model in first differences and use an instrumental variable (IV) for $\Delta \log w_{d,t}$. The estimating equation is:

$$\Delta \log \lambda^L_{d|n,t} + \nu^L \epsilon^L \Delta \log dist_{nd,t} = \epsilon^L \Delta \log w_{d,t} + \Delta\mu_{n,t} + \Delta\varepsilon_{d|n,t}, \quad \text{for } n, d \in \mathcal{N}. \tag{23}$$

Following the strategy employed by Ahlfeldt et al. (2015), we instrument for $\Delta \log w_{d,t}$ using the pre-construction driving time to the bridge. The rationale is that, given higher

wages in Denmark and the improved feasibility of cross-border commuting after the Öresund Bridge opened, workers residing closer to the bridge were more inclined to seek employment in Danish municipalities. In response, firms in nearby Swedish municipalities needed to raise wages to retain their workforce. Consequently, proximity to the bridge is expected to be associated with a larger increase in local wages.

We estimate Equation (23) separately for two time periods: 2002 vs. 1997, and 2006 vs. 1997.[18] Panel 1 of Table 5 presents the estimation results. Columns (1) and (3) report OLS estimates of Equation (23) using the commuting share differences between 2002-1997 and 2006-1997, where the elasticity ϵ^L is found to be positive and statistically significant, consistent with the notion that higher wages attract more commuters. However, these estimates may be biased due to endogeneity.

Columns (2) and (4) report the IV estimates. In Column (2), which uses the change in commuting shares between 2002 and 1997, the first-stage regression shows a significant negative coefficient on $\log \text{DrivingTime2Bridge}_n$, indicating that municipalities closer to the bridge experienced larger wage increases. The corresponding IV estimate of ϵ^L is 5.574 and statistically significant. Column (4), which uses the change between 2006 and 1997, yields a larger estimate of ϵ^L, equal to 7.164. We regard Column (4) as our preferred specification, because the longer adjustment window gives workers more time to respond to the new commuting opportunities created by the bridge. As a result, the effect of the bridge on commuting behavior is likely to be more fully reflected by 2006. We therefore set $\epsilon^L = 7.164$ in the subsequent quantitative analysis. Given the estimate $\nu^L \cdot \epsilon^L = 2.954$, and our preferred value of $\epsilon^L = 7.164$, the implied elasticity of commuting costs with respect to distance (i.e. ν^L) is approximately 0.41. This estimate suggests that commuting costs rise steeply with distance, reflecting strong spatial frictions in daily mobility.

When compared to the estimated distance elasticities of service trade costs, ψ^k, reported in Table 2, the commuting elasticity is substantially larger than the trade elasticities for the IT, Other Services, and Transportation sectors. This pattern is consistent with the nature and frequency of cross-location interactions. Commuting involves daily travel, making workers highly sensitive to even small increases in travel distance. By contrast, most

[18] In addition, we exclude the Norrland region—a sparsely populated area in northern Sweden with a predominantly agricultural economy—from the sample. Since Norrland is geographically remote and had negligible cross-border commuting both before and after the bridge, its exclusion improves the precision of our estimates.

service trade—particularly in IT and Transportation—can often be conducted remotely or asynchronously, and therefore incurs relatively lower distance-related frictions. In contrast, Business Services typically require frequent in-person meetings, on-site collaboration, and face-to-face communication, making them more sensitive to distance in ways that resemble commuting behavior.

These distinctions underscore the importance of accounting for the type and intensity of spatial interactions when modeling integration costs. In Section 7.2, we further examine the differential effects of reducing commuting and service trade costs on Sweden's economy.

Table 5: Estimation of ϵ^L

	(1)	(2)	(3)	(4)
	$\Delta t = 2002 - 1997$		$\Delta t = 2006 - 1997$	
	OLS	IV Second Stage	OLS	IV Second Stage
dlnWage	1.477	5.574	1.386	7.164
	(0.166)***	(2.176)*	(0.169)***	(2.105)***
		IV First Stage		IV First Stage
$\log DrivingTime2Bridge$		-0.00778		-0.00110
		(0.000141)***		(0.000186)***
Origin FE	YES	YES	YES	YES
N	20571	20571	20344	20344
Cragg-Donald Wald F statistic (Weak identification test)		143.2		140.7

Note: This table presents the estimation of Equation (23) using commuting share data in Sweden. We exclude the Norrland Area as the Norrland Area is very faraway from the bridge and few people commute to Denmark before or after the bridge was built.
Standard deviations are reported in parentheses. Statistical significance is denoted by asterisks: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

To estimate the distance elasticity of migration costs, we parameterize the migration cost function analogously to the specification used for commuting costs:

$$\kappa_{ln}^R = \widetilde{\kappa}_{ln}^R \cdot dist_{ln}^{\nu^R}$$

where $dist_{ln}$ denotes the distance between birthplace l and destination n. The term $\widetilde{\kappa}_{ln}^R$ is a location-pair-specific component that may vary over time, while ν^R captures the elasticity of migration costs with respect to distance. Thanks to the DEK procedure, we do not need to separately calibrate $\widetilde{\kappa}_{ln}^R$ or the locational amenity term B_n^R. Instead, we focus on

estimating the key structural parameters ν^R and ϵ^R, which govern spatial frictions and preference heterogeneity, respectively.

We adopt an estimation strategy analogous to that used for commuting cost parameters. Details of the estimation procedure are provided in Appendix E. Our preferred estimates are $\nu^R\epsilon^R = 3.461$ and $\epsilon^R = 4.135$. These parameter values are used in the quantitative analysis that follows.

We assess the model's fit in Appendix C. The results show that the model-predicted workforce and population across municipalities closely match the observed data. Moreover, the model mimics the empirical evidence in Section 4 very well.

7 Counterfactual

7.1 Welfare and Output Effects of the Bridge

This section evaluates how the construction of the bridge influences overall welfare and sectoral output in Sweden and Denmark. Welfare is measured as the ex-ante expected utility of an individual born in municipality l, taking into account the option to migrate or commute to any other municipality:

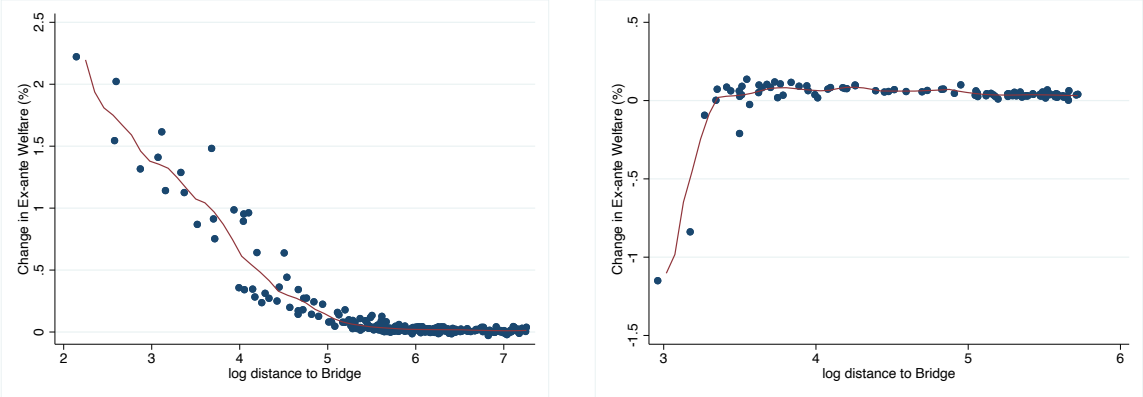
$$\widehat{V}_l = \sum_{n \in \mathcal{N}} \left[\lambda^R_{n|l} \left(\frac{\widehat{\widetilde{w}}_n}{\widehat{\kappa}^R_{ln} (\hat{P}^M_n)^{\beta^M} (\hat{P}^S_n)^{\beta^S} (\hat{r}^H_n)^{\beta^H}} \right) \right]^{\frac{1}{\epsilon^R}}$$

Figure 15 displays changes in welfare as a function of each municipality's log-distance to the bridge. Panel 15a shows results for Swedish municipalities, while Panel 15b does the same for Danish municipalities. In both figures, the horizontal axis represents the log of the distance to the bridge, and the vertical axis shows the change in welfare for each municipality. Each point on the graph corresponds to a municipality.

As expected, in Sweden, welfare gains are concentrated in municipalities located close to the bridge. These areas benefit from improved access to the Danish labor market, where wages are higher. The ability to commute across the bridge allows workers to enjoy increased earnings while remaining in lower-cost areas of Sweden. As a result, the bridge generates spatially uneven welfare improvements that fade with distance. The municipality closest to the bridge gains 2.22% in total welfare, while the farthest municipality gains only 0.038%.

These welfare gradients highlight the importance of geographic proximity in mediating the economic returns from improved infrastructure.

In contrast, Danish municipalities near the bridge experience welfare losses. For example, Copenhagen loses by 0.84% in total welfare, while the distant municipalities experience little change after the bridge was built. This seemingly counterintuitive result arises from an increase in labor supply due to commuting inflows from Sweden. The expanded labor pool puts downward pressure on wages in Denmark, reducing the ex-ante utility of Danish-born individuals in the affected areas. The model captures the general equilibrium feedback effects of open labor markets, emphasizing how gains from labor market integration due to commuting, are not evenly distributed—even within Denmark, where a country enjoys an influx of work population.



(a) Ex-ante Welfare in Sweden (b) Ex-ante Welfare in Denmark

Figure 15: Change in Welfare in Sweden and Denmark

Notes: This figure displays changes in ex-ante welfare across municipalities in Sweden and Denmark as a function of their distance to the bridge. Each point represents a single municipality. The red line depicts a fitted polynomial line, summarizing the spatial pattern of welfare gains.

The spatial patterns of welfare changes are further illustrated in Figures 16 and 17. These maps visually confirm the findings in Figure 15: welfare improvements in Sweden are concentrated around the bridge, while localized welfare reductions occur in adjacent Danish regions.

In addition to welfare, Figure 18 reports the impact of the bridge on sectoral output in manufacturing and services. In all figures, the horizontal axis represents the log of the distance to the bridge, and the vertical axis shows the change in output of manufacturing

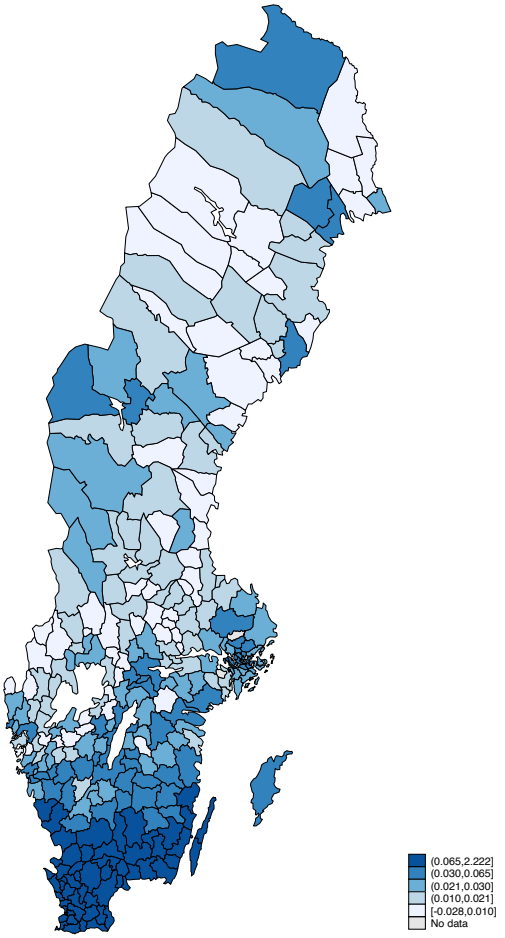


Figure 16: Map for Baseline (Full Model): Sweden

Notes: This figure illustrates the geographic distribution of changes in ex-ante welfare across Swedish municipalities. Darker shading indicates larger welfare gains for individuals born in a given municipality. Two municipalities, Nykvarn and Knivsta, does not have data on wage, population or output at the industry level in 1997. Therefore, we cannot calculate the change in the welfare for these two municipalities.

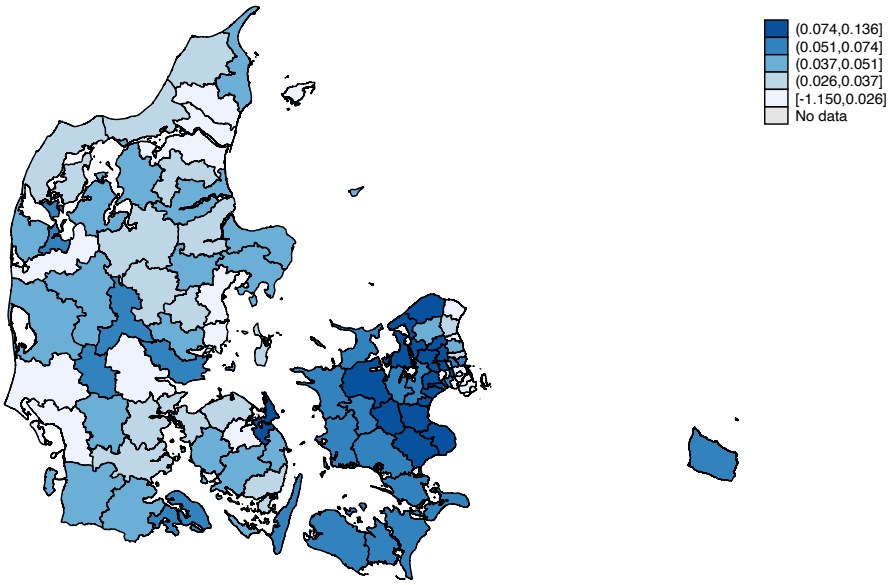


Figure 17: Map for Baseline (Full Model): Denmark

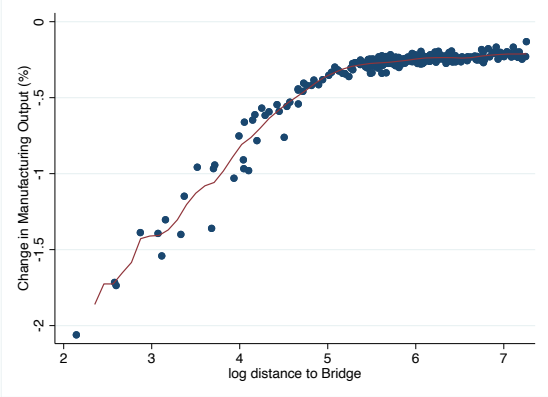
Notes: This figure illustrates the geographic distribution of changes in ex-ante welfare across Denmark municipalities. Darker shading indicates larger welfare gains for individuals born in a given municipality. One island municipality, Christiansø, does not have data in wage, population or output at the industry level in 1997. Therefore, we cannot calculate the change in the welfare for this municipality.

or services for each municipality. Each point on the graph corresponds to a municipality. In Sweden, municipalities near the bridge experience a decline in both sectors (by as large as -2.06% in manufacturing sector and -2.25% in service sector) as show in Panels 18a and 18c. This reflects the outflow of workers who now commute to Denmark, leading to a reduction in local labor supply and hence output. The result underscores the opportunity cost of losing productive capacity to external labor markets, particularly when local firms are unable to compete with foreign wages.

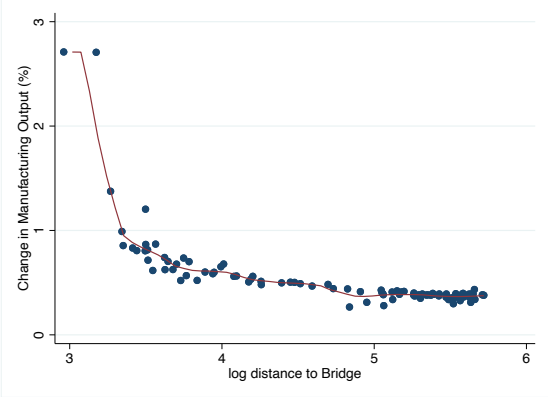
In Denmark, however, the bridge induces substantial increases in output, especially in municipalities near the border as shown in Panels 18b and 18d in Figure 18. Copenhangen alone enjoys an increase of 2.71% in manufacturing and 3.64% in service sectors. The influx of Swedish commuters expands the effective labor force, boosting productive capacity in both manufacturing and services. This increase in output occurs despite the aforementioned decline in individual welfare, revealing a tension between aggregate production gains and distributional consequences.

Taken together, these findings highlight the complex and spatially heterogeneous effects of cross-border infrastructure. While such projects can increase aggregate efficiency, they may also generate localized losses, underscoring the importance of targeted policy responses to ensure that gains are equitably shared. Sweden as a whole gains 0.17% in total welfare, though the total output of Sweden declined slightly, by 0.35% in manufacture and 0.1% in service sectors. To evaluate the economic viability of the bridge project, we compare its construction cost with the associated welfare gains. The total construction cost of the bridge is estimated at 2.66 billion US dollars in 2000 price. To quantify the benefits, we aggregate the ex ante welfare gains, expressed in monetary terms, across all municipalities in Sweden and Denmark. The total welfare gain amounts to 0.46 billion US dollars in 2000 price in Sweden per year and the welfare loss amounts to 0.18 billion US dollars in 2000 price in Denmark per year.[19] Summing across both countries, the cumulative welfare benefits imply that the bridge's construction cost would be recovered within approximately 9.5 years.

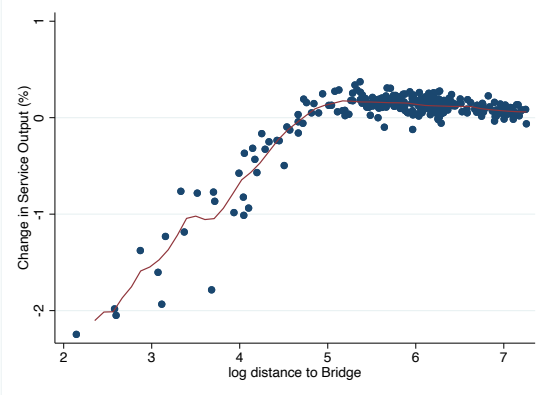
[19]We calculate the welfare gain in Euro value as an increase of total value-added. Source: `https://www.nordicstatistics.org/areas/economy/`



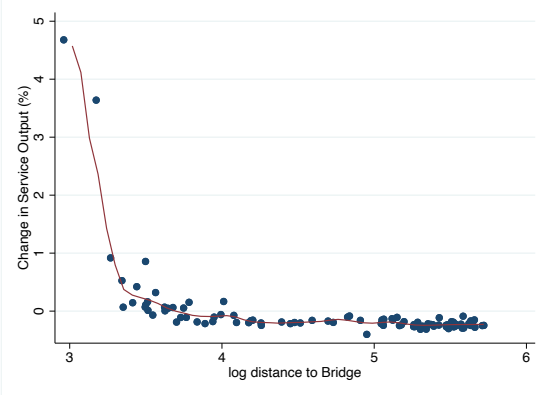
(a) Manufacturing Output in Sweden



(b) Manufacturing Output in Denmark



(c) Service Output in Sweden



(d) Service Output in Denmark

Figure 18: Change in Output in Sweden and Denmark

Notes: This figure displays changes in Manufacturing and Service output across municipalities in Sweden and Denmark as a function of their distance to the bridge. Each point represents a single municipality. The red line depicts a fitted polynomial line, summarizing the spatial pattern of welfare gains.

7.2 Labor Market Integration vs. Service Goods Market Integration

Figure 19 examines the relative importance of commuting, migration, and service trade in shaping the economic impact of the bridge. We conduct a series of counterfactual experiments in which each integration channel is sequentially shut down, allowing us to isolate its individual contribution to the observed outcomes. The analysis centers on Swedish municipalities, which are more strongly affected by both direct access to the bridge and indirect general equilibrium effects arising from cross-border integration.

Across all panels, the horizontal axis represents the logarithm of the distance to the bridge, while the vertical axis shows changes in key outcome variables—namely, welfare, service sector output, and service exports—for each municipality. The black line depicts results from the full model, incorporating commuting, migration, and service trade. The green line shows the results from the model without commuting. Finally, the purple line corresponds to a case where both commuting and migration are active, but service trade costs remain unchanged before and after the bridge, thereby identifying the marginal role of service trade liberalization.[20]

Panel 19a in Figure 19 shows that welfare gains from reduced service trade costs alone are modest in the economy where commuting is not permitted (green line). For municipalities closer to the bridge, the welfare gain reduces by about 2/3. This limited effect primarily reflects the small baseline share of service exports to Denmark—only 0.5% of Sweden's total service output. As Denmark represents a relatively minor external market compared to Sweden's domestic service economy, even a substantial reduction in trade costs results in limited aggregate welfare gains. This finding is further reinforced by the small gap between the purple and black lines: when trade costs remain unchanged, the benefits of the bridge diminish, but only slightly—confirming that reductions in service trade play a relatively smaller role compared to the reductions in commuting costs due to the relatively smaller share of services exports to Denmark.

By contrast, enabling the commuting channel yields markedly larger welfare gains, particularly for municipalities located near the bridge. This underscores the central role of commuting in cross-border economic integration. In settings where service trade is limited

[20]The migration channel turns out to have very small impact on the total welfare change, as we show in Appendix D.1

by high costs, commuting offers an alternative means of market access—enabling individuals to "export" their labor by working in neighboring countries with higher wages, without needing to physically relocate or ship goods.

Panels 19b and 19c in Figure 19 illustrate the effects of the bridge on service sector output and exports across Swedish municipalities. In the full model (black line), municipalities close to the bridge experience a substantial decline in service output. At first glance, this may appear counterintuitive given that the infrastructure improves market access. However, this result is explained by the interaction of two opposing forces—trade-driven demand expansion and labor supply contraction due to commuting.

On one side, the reduction in service trade costs enhances access to the Danish market, increasing service exports in municipalities near the bridge. This external demand effect pushes up local output as firms expand to meet new export opportunities. On the other side, improved commuting opportunities induce a sizable share of the local workforce to seek employment across the border in Denmark, where wages are higher. As workers leave, firms in these Swedish municipalities face a shrinking local labor pool, which constrains their production capacity. The net effect depends on the relative strength of these two forces.

To isolate these channels, we consider counterfactuals in which one integration mechanism is shut down. In Panel 19b, the green line corresponds to the scenario where commuting is not permitted, and only the service trade cost decreases due to the bridge. In these cases, municipalities near the bridge experience slight increases in service output (as high as 0.5% for closer municipalities), driven by the reductions in service trade costs. These gains are geographically concentrated, consistent with the fact that proximity to the border amplifies the reduction in effective trade costs. This trade-based interpretation is further supported by Panel 19c, where the green line shows that service exports rise sharply for municipalities near the bridge (by 40%). Since labor is immobile in these counterfactuals, firms can retain their workforce while benefiting from expanded market access, resulting in simultaneous increases in both exports and output.

However, the picture changes significantly when trade costs are held constant but commuting and migration are allowed (purple line). In Panel 19b, the drop in service output is much steeper for municipalities near the bridge (as large as 3%). Panel 19c confirms this pattern—exports remain flat along the purple line, as there is no change in trade costs to stimulate cross-border demand. Thus, the decline in output in this scenario is purely a

supply-side phenomenon, driven by a loss of local labor to the more attractive Danish labor market.

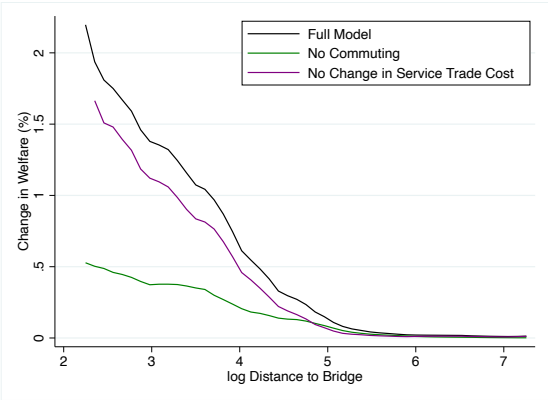
This analysis underscores the importance of considering general equilibrium interactions when evaluating the effects of cross-border infrastructure. While trade liberalization and labor mobility are both channels through which integration occurs, their effects may not be complementary. In fact, when only one channel is active, it may amplify or offset the gains from another. In the absence of increased export demand, labor mobility can hollow out the productive capacity of small open regions—particularly those adjacent to wealthier labor markets.

7.3 The Potential Relevance of Service Trade

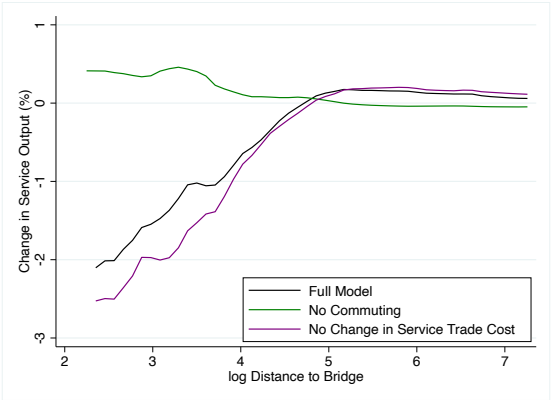
In 1997, service trade between Sweden and Denmark is small relative to total output. This low baseline level is consistent with substantial barriers to cross-border trade in services, and it also helps explain why the purple and black curves in Figure 19 lie very close to one another. As a result, it is difficult to clearly distinguish the effects of lower commuting costs from those of lower service-trade costs. To assess the potential importance of service trade in a setting where it plays a more prominent role, we conduct a hypothetical exercise that substantially increases Sweden's service-export share. Specifically, we simulate an economy in which all cross-border trade barriers for Swedish service exports to Denmark are removed. In this case, Sweden's service exports to Denmark, expressed as a share of total Swedish output, amount to 8.42%. We then perform counterfactual analyses to quantify the relative contributions of reduced service-trade costs and improved commuting access to overall welfare gains. This strategy allows us to isolate and compare the distinct mechanisms through which goods-market integration and labor-market integration shape economic outcomes.

Figure 20 illustrates how the mechanisms of economic integration—via trade and commuting—manifest differently across space and under alternative economic structures. Specifically, we compare the impact of reducing service trade costs versus commuting costs in both the baseline economy (with high service cross border trade barriers) and a hypothetical economy with no trade barriers in service sectors from Sweden to Denmark.

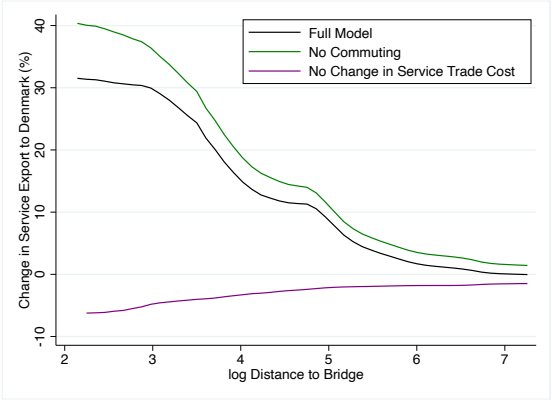
Across all panels, the horizontal axis represents the logarithm of the distance to the bridge, while the vertical axis shows changes in key outcome variables—namely, welfare,



(a) Ex-ante Welfare



(b) Y_l^S



(c) Service Export from SWE to DNK

Figure 19: Comparison across different models: Sweden

Notes: Across all panels, the horizontal axis represents the logarithm of the distance to the bridge, while the vertical axis shows changes in key outcome variables—namely, welfare, service sector output, and service exports—for each municipality in Sweden as a function of distance to bridge. The black line depicts results from the full model, incorporating commuting, migration, and service trade. The green line shows the results from the model without commuting. The purple line corresponds to a case where both commuting and migration are active, but service trade costs remain unchanged before and after the bridge.

service sector output, and service exports—for each municipality. The black line depicts results from the full model, incorporating commuting, migration, and service trade. The green line shows the results from the model without commuting. Finally, the purple line corresponds to a case where both commuting and migration are active, but service trade costs remain unchanged before and after the bridge.

Comparing Panels 20a and 20b, we see that the welfare gain through service trade only (green line) is much larger when the cross-border trade barriers from Sweden to Denmark are smaller. Also, comparing purple and green lines in Panel 20b, it shows that welfare gains from service trade liberalization are more spatially broad-based compared to the welfare gains from the reduction of commuting costs: municipalities across Sweden experience comparable improvements. This spatially uniform pattern reflects the nature of modern services, many of which can be delivered digitally or with relatively low marginal transportation costs once market access barriers are removed. As a result, the benefits from improved service trade access are not geographically concentrated but instead dispersed, driven by firms' ability to serve remote markets without incurring substantial distance-related costs. In contrast, welfare gains from reductions in commuting costs (purple line) exhibit strong spatial gradients, with benefits sharply declining with distance from the bridge. This reflects the fundamentally local nature of labor mobility: commuting is subject to hard spatial constraints due to time and transport costs, which limit daily cross-border employment to individuals residing within feasible travel distance. This results show concentrated gains near the bridge, where cross-border job opportunities are effectively unlocked, while distant regions see little change in labor market accessibility.

Panels 20c and 20d further illustrate the different general equilibrium responses across channels. Reductions in service trade costs (green lines) increase domestic service output by allowing firms to tap into larger foreign demand, boosting production, revenues, and in turn, local employment and wages in export-oriented service sectors. Conversely, reductions in commuting costs (purple lines) may lead to a contraction in local output as workers increasingly commute to Denmark in search of higher wages. This reallocation of labor across borders reduces the effective labor supply for Swedish firms, particularly those in non-tradable or locally oriented sectors. Thus, while individuals may gain from higher earnings, domestic firms face tighter labor constraints, leading to a possible decline in production. Comparing the black line in Panels 20c and 20d, the built of the bridge increases service output more in the case where service trade cost is low between Sweden and Denmark, ,

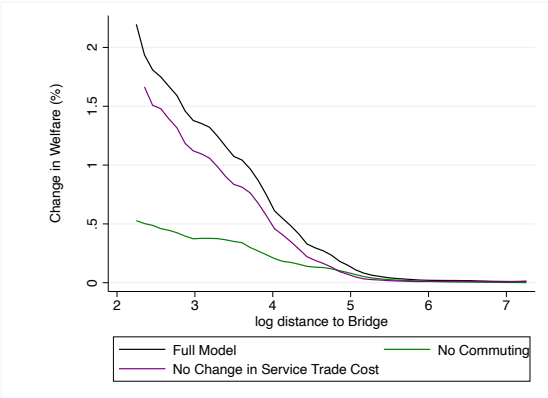
while the bridge reduces service output in the case service trade cost is high. This is because when the service trade flow is large between Sweden and Denmark, the force of reduction in service trade cost due to the bridge outweighs the force of reduction of the commuting costs. As a result, in Panel 20c we see an increase in total service output in Sweden while we see a reduction in total service output.

These results point to several broader economic implications. First, they underscore the multidimensionality of integration: trade and labor mobility operate through distinct economic mechanisms, and their spatial effects differ in magnitude and distribution. Second, the initial structure of the economy—especially the prominence of the service sector—critically shapes how integration affects welfare and output. Finally, these findings highlight the need for regionally differentiated policy responses. Infrastructure that facilitates commuting can generate large localized gains but may entail negative spillovers on domestic employers. In contrast, service trade integration can deliver widespread benefits, especially in a digitally connected economy, though the magnitude depends heavily on firms' capacity to engage in foreign markets. As such, complementary policies—such as digital infrastructure investment, skill development for tradable services, or support for firms adjusting to labor reallocation—may be required to fully realize the benefits of integration.

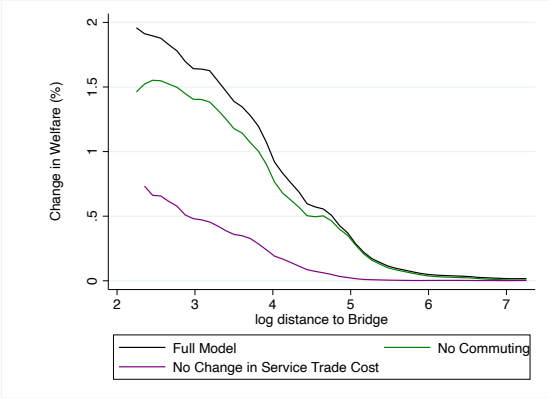
7.4 Reduction of the Overall Service Trade Costs

In Subsection 7.2, we emphasized the role of commuting and bilateral service trade costs in shaping cross-border market integration. In this subsection, we extend the analysis to explore the broader implications of reducing Sweden's overall service trade costs—not just with Denmark, but also with the rest of the world (ROW). Specifically, we assess the impact of a uniform reduction in both import and export trade costs in Sweden's service sector on national welfare and output, using data calibrated to the Swedish economy in 1997.

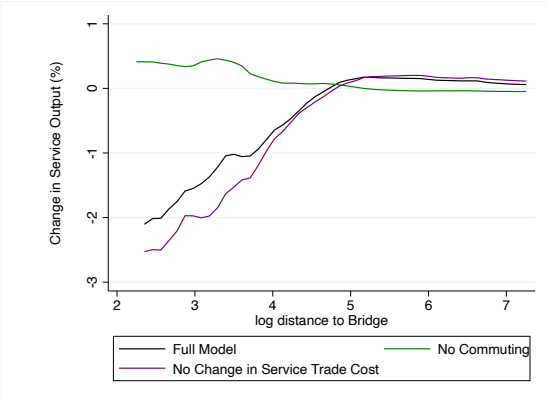
A reduction in service trade costs fosters deeper integration of Sweden's service sector into global markets and operates through three distinct mechanisms. First, lower import costs expose domestic firms to greater foreign competition in the provision of services, and may have negative impact on the production of service sector. Second, cheaper imported services reduce the cost of intermediate inputs for domestic firms, particularly in sectors that rely heavily on service-based inputs, thereby lowering production costs across the economy. Third, lower export costs expand market access for Swedish service firms, enabling them to



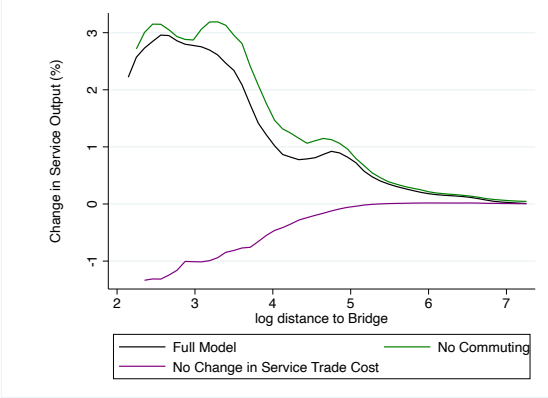
(a) Ex-ante Welfare in Current Economy



(b) Ex-ante Welfare with $\tau^k_{SWE,DNK} = 1$



(c) Service Output in Current Economy



(d) Service Output with $\tau^k_{SWE,DNK} = 1$

Figure 20: Change the Importance of Denmark as a Service Exporting Market of Sweden

Notes: Across all panels, the horizontal axis represents the logarithm of the distance to the bridge, while the vertical axis shows changes in key outcome variables—namely, welfare and service sector output-for each municipality in Sweden as a function of distance to bridge. The black line depicts results from the full model, incorporating commuting, migration, and service trade. The green line shows the results from the model without commuting. The purple line corresponds to a case where both commuting and migration are active, but service trade costs remain unchanged before and after the bridge. Panels (a) and (c) present counterfactual results under the current economic structure, whereas Panels (b) and (d) report results under a hypothetical scenario in which cross-border trade barriers for services from Sweden to Denmark are fully eliminated.

sell to a broader international customer base and scale up production.

To quantify these effects, we simulate counterfactual scenarios in which overall service trade costs are reduced incrementally from 5% to 30%, and we compute the resulting changes in total welfare and output in Sweden. The results are presented in Figure 21. Total output increases steadily, from 0.48% under a 5% trade cost reduction to 8.4% under a 30% reduction. However, the welfare effects are much larger than the effects on total output: even a modest 5% reduction in trade costs raises welfare by 1.0%, and a 30% reduction yields a welfare gain of nearly 15.7%.

These large welfare effects, despite the relatively modest role of service exports—only 5.5% of total service output—are explained by the general equilibrium spillovers of trade cost reductions. Service trade liberalization affects not only exporting firms, but also downstream producers across the entire economy who benefit from lower input prices. Because services are widely used as intermediates (e.g., IT, business consulting, logistics) in both service and manufacturing sector, even small reductions in service input costs can have disproportionately large effects on firm-level productivity and consumer prices. Take Sweden Input-Output Table as an example, 45% of the intermediate inputs of manufacturing in Sweden is service. Moreover, the welfare metric captures improvements in real income and consumption possibilities, which are amplified when both prices fall and production becomes more efficient.

Thus, while the direct export share may appear small, the system-wide effect of service trade liberalization—through competition, cost reductions, and expanded markets—is substantial. These results underscore the importance of including services in trade policy discussions and suggest that even modest reforms in service trade barriers can yield significant welfare gains for a modern, service-intensive economy like Sweden's.

8 Conclusion

Services dominate modern economies but they remain a relatively small share of international trade. One potential reason is that many services require face-to-face interaction or proximity between buyers and sellers. Yet causal evidence on how distance affects services trade remains scarce, largely due to limited data on services trade and the difficulty of isolating changes in effective distance that simultaneously affect commuting—thereby integrating labor markets—and the cost of providing services.

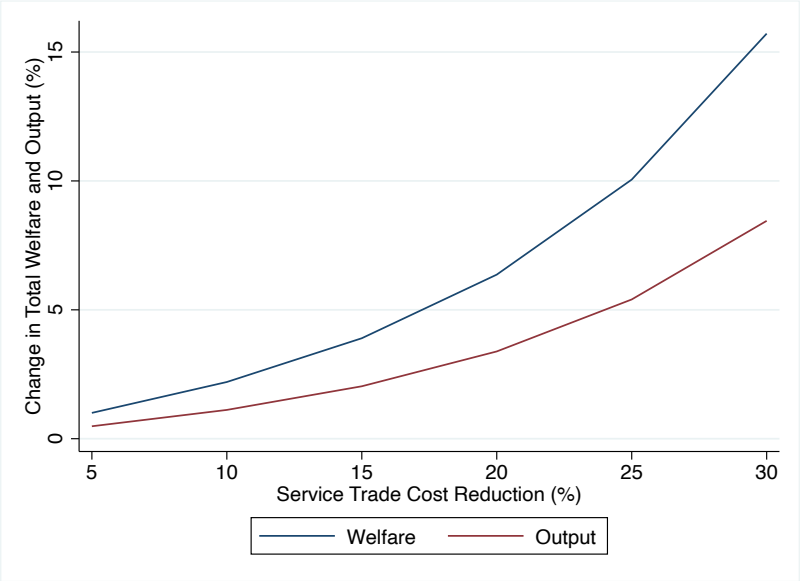


Figure 21: Change in Welfare and Output with a Reduction in Service Trade Cost

Notes: This figure shows the percentage changes in total welfare and total service sector output in Sweden resulting from a reduction in service trade costs to Denmark and the rest of the world. The green line represents changes in aggregate welfare, while the red line illustrates changes in total service output.

We estimate the distance elasticity of services trade using the opening of the Øresund Bridge in 2000 as a natural experiment, which sharply reduced travel times between southern Sweden and Denmark while leaving freight transport costs largely unchanged. Combining administrative firm-level services trade data, worker-level commuting records, and a structural spatial equilibrium model, we provide new evidence on how improvements in connectivity that facilitate the movement of people—rather than goods—affect trade in services, labor market integration, and regional economic outcomes.

Services trade is substantially more distance-elastic than goods trade, reflecting services' reliance on face-to-face interactions and frequent cross-location coordination. Consistent with this mechanism, not all services respond equally to distance: Services that could be delivered remotely such as IT services respond little while business services requiring frequent interactions dependent on commuting respond much more. The bridge simultaneously reduced commuting costs and service trade costs, but these mechanisms generated different spatial patterns. Commuting created sharply localized welfare gains near the bridge that fade rapidly with distance. While Swedish workers near the bridge gained access to the higher-wage Danish labor market, some Danish municipalities very close to the bridge ex-

perienced small welfare losses due to downward wage pressure from commuting inflows. On the other hand, Swedish service sector output fell by up to 2.25% despite improved market access, because Swedish firms lost some workers to Danish firms. Service trade liberalization, by contrast, generated more spatially uniform gains precisely because some services can be delivered remotely. One of the key insights of the paper is this tension between greater services trade enabled by cross-border commuting and the loss of workers such labor market integration entails. Our counterfactual experiments show that without increased service export opportunities (i.e., with service trade barriers unchanged), labor mobility alone would have hollowed out local Swedish production. This result highlights the importance of complementary public policies: infrastructure that facilitates commuting can generate large localized gains but also creates distributional trade-offs. Complementary policies such as reducing the barriers to services exports could mitigate some of these distributional trade offs as services trade is less sensitive to distance than commuting.

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Appendix

A Reduced Form Appendix

A.1 Travel Statistics

A.1.1 Computing Reduction in Travel Time

We use Google Maps to compute the reduction in travel time between Swedish municipalities and Copenhagen by car. We essentially compute the change in the fastest route prior to the bridge opened to the fastest route after the bridge was opened. See Figure A.1 for an illustration of the connections between Sweden and Denmark before and after the bridge was opened. There were two possible routes to Copenhagen prior to 2000, the ferry connections Helsingborg-Helsingør and Malmö-Dragør. Hence, to compute the fastest route prior to the bridge opened, we use Google Maps to compute the driving time between the largest city or town in each Swedish municipality to both Helsingborg and Malmö. Then we use old time table data for both ferries to compute the crossing time over the Orund Strait. Finally, we use Google Maps to compute the driving time from both Helsingborg and Dragør to Copenhagen. The driving time prior to 2000 is then simply the fastest of these two routes between each Swedish municipality city center and Copenhagen. After the bridge opened, the Malmö-Dragør ferry connection was replaced by the Oresund Bridge. Hence, to compute the travel time after 2000, we compute the shortest travel time by car from each Swedish municipal city center to Copenhagen using the Helsingborg-Helsingør ferry and the Oresund Bridge.

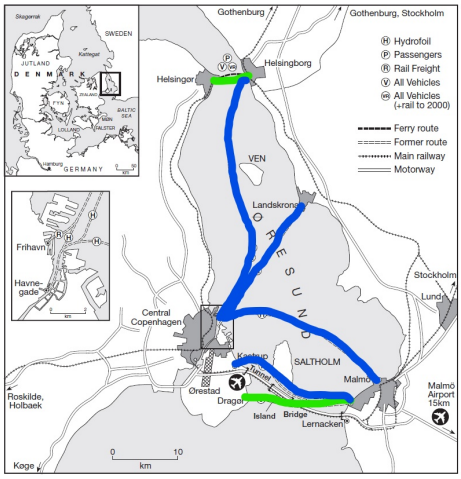
A.2 Services Trade

A.2.1 Balance of Treatment and Control

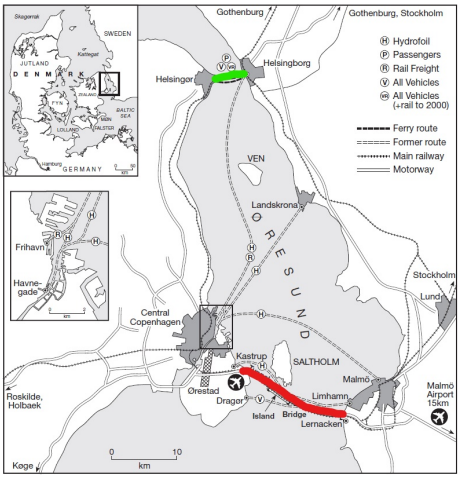
This section displays the balance of treated and control firms that trade services between Sweden and Denmark. Figure A.5 shows that composition of exports and imports across various types of services are very similar for firms close and far away from the bridge. A.6 shows that the size distribution of firms close and far away from the bridge have very similar size distributions measured by the log of sales.

Figure A.1: Connections Between Sweden and Denmark Before and After the Oresund Bridge Opened

Before Bridge



After Bridge



Notes: The green lines indicate ferry connections that transport cars, the blue lines indicate ferry connections that transport only people, and the red line shows the Oresund Bridge.

Figure A.2: Number of Trips across Oresund by Mode of Travel

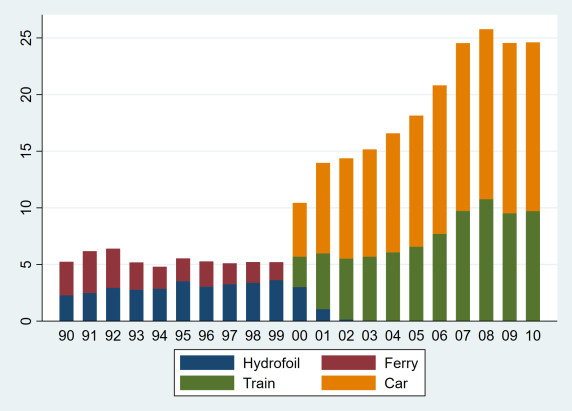


Figure A.3: Purpose of Trip across Oresund by Country

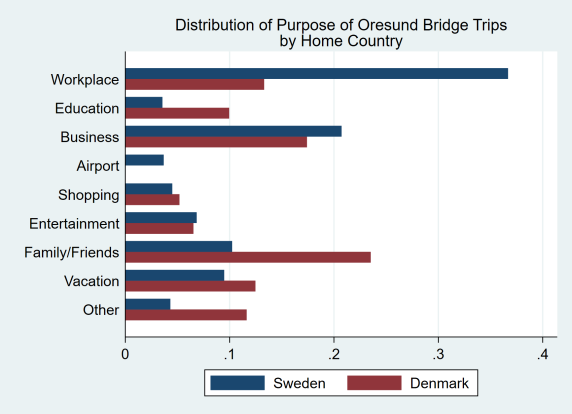


Figure A.4: Share of Trips by by Origin Country

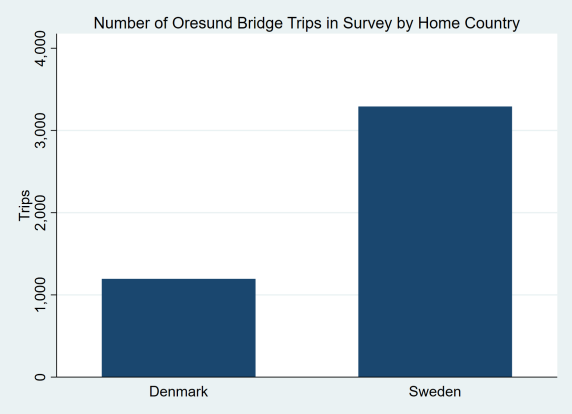
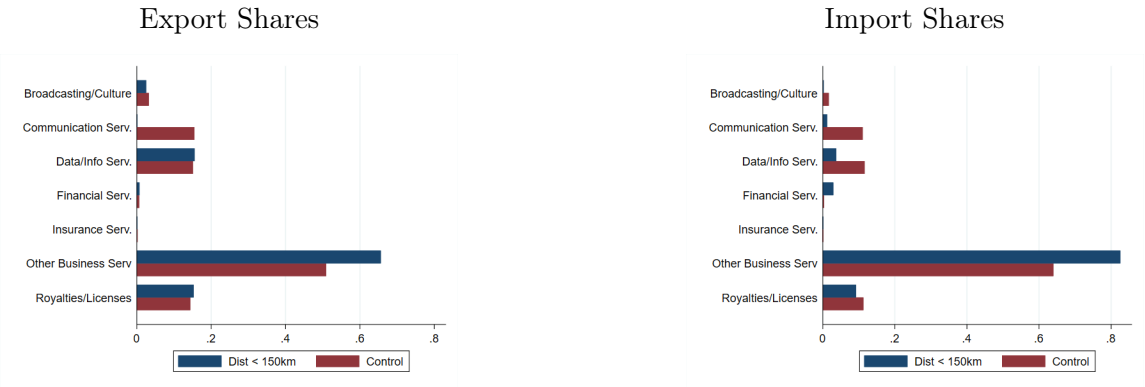
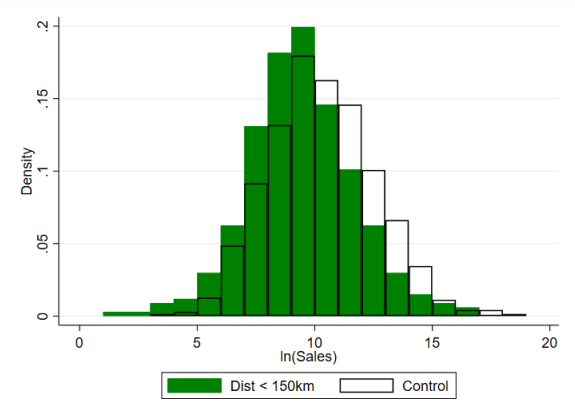


Figure A.5: Composition of Services Trade with Denmark for Firms Close and Far Away from The Oresund Bridge in 2000



Notes: The control group consists of firms that are located 150 kilometers or farther from the Oresund Bridge.

Figure A.6: Size Distribution of Service Exporters Close and Far Away from The Oresund Bridge in 2000



Notes: The control group consists of firms that are located 150 kilometers or farther from the Oresund Bridge. The size distribution looks very similar for importers.

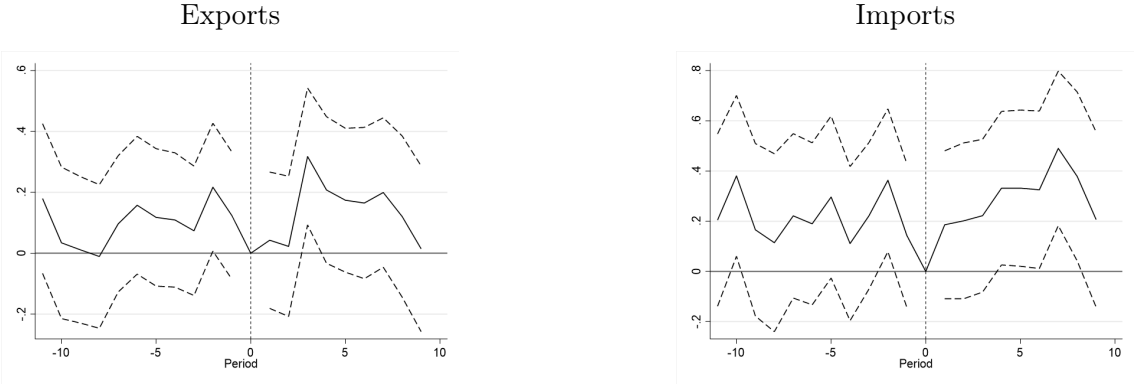
A.2.2 Extensive Margin Effects on Service Trade

The increase in services trade between Sweden and Denmark could potentially be driven by various extensive-margin channels. For instance, more firms located close to the bridge may start trading services with Denmark after the bridge opens. To assess the extensive margin of trade, we estimate the following regression:

$$trader_{it} = \alpha \ + \sum_{t=-10}^{-1} \beta_t \ Close_i \times \mu_t + \sum_{t=1}^{9} \beta_t \ Close_i \times \mu_t + \delta_i + \gamma_t + \varepsilon_{it} \tag{A.24}$$

where $trader_{it}$ takes the value 1 if firm i trades services with Denmark in period t and 0 otherwise. We carry out this analysis for both imports and exports. To be able to reduce the number of regressions, we redefine the variable $Close_i$ which takes the value 1 of a firm is located less than 5 kilometers from the bridge and takes the value 0 if a firm is located more than 150 kilometers from the bridge. Firms that are located a distance between 50 kilometers and 150 kilometers from the bridge are dropped from the sample.

Figure A.7: Impact of the Bridge on the Extensive Service Trade Margin



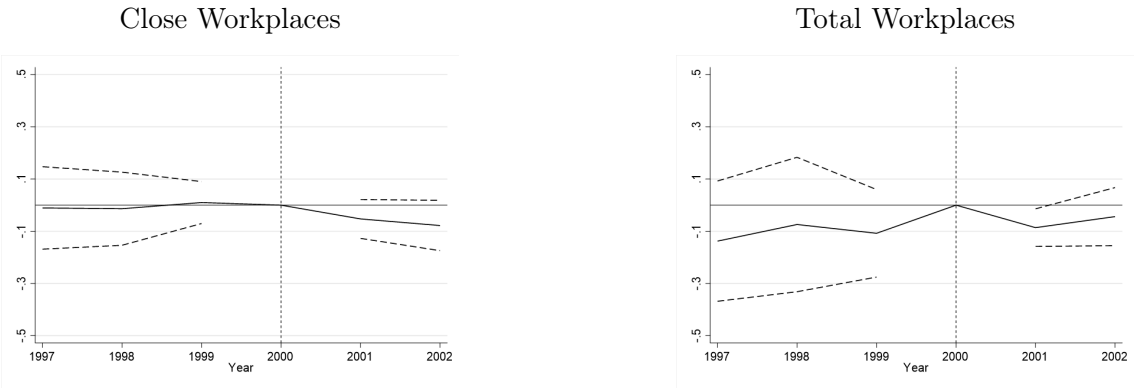
Results indicate that the extensive margin is not contributing to higher volumes of services trade between Sweden and Denmark.

Another driver of services trade on the extensive margin could be if firms close to the bridge increases their general economic activity by opening more workplaces. To capture this effect, we estimate the following regression:

$$\ln workplace_{it} = \alpha \; + \sum_{t=1997}^{1999} \beta_t \; Close_i \times \mu_t + \sum_{t=2001}^{2002} \beta_t \; Close_i \times \mu_t + \delta_i + \gamma_t + \varepsilon_{it} \quad \text{(A.25)}$$

where $workplace_{it}$ is the number of workplaces of firm i in time t. This variable is defined as both workplaces located close to the bridge and total workplaces. Note that the firm's location is defined by the location of the largest workplace.

Figure A.8: Impact of the Bridge on Workplaces of Service Traders Close to the Bridge



The Oresund Bridge does not seem to have had an impact on the number of workplaces of firms located close to it.

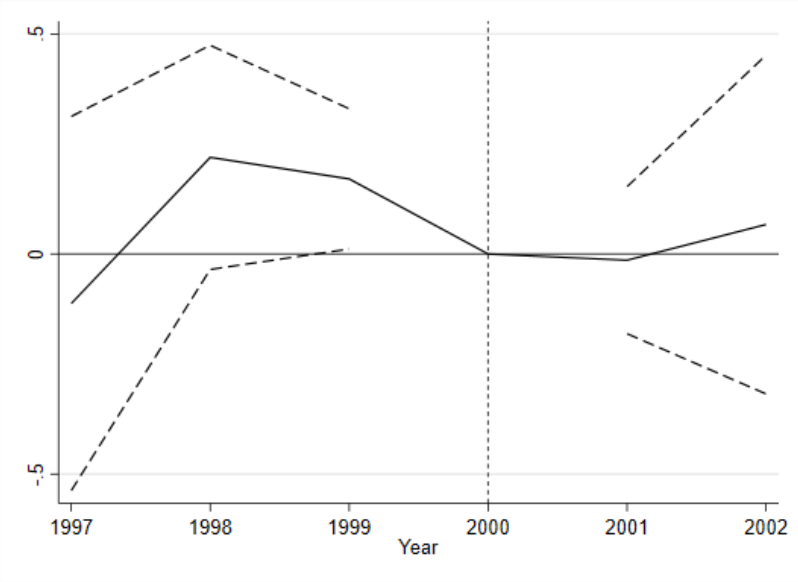
A.2.3 Impact of the Bridge on the Mode of Delivery of Services

The opening of the Oresund Bridge could also have affected trade by altering the mode of how firms deliver services. Before the bridge opened, firms may have relied on a foreign affiliate to provide services, but after the bridge opened, they may have opted to deliver services directly from a Swedish-based firm. Such a change would result in an increase in recorded services trade, even if the value of services delivered to Danish customers remained unchanged. Using data on foreign employment of Swedish owned multinational firms, we estimate if firms located close to the bridge see and increase in the amount of danish employees compared to firms farther away form the bridge. We formulate the following estimating equation:

$$\ln workers_{nt} = \alpha \; + \sum_{t=1997}^{1999} \beta_t \; Close_n \times \mu_t + \sum_{t=2001}^{2002} \beta_t \; Close_n \times \mu_t + \delta_n + \gamma_t + \varepsilon_{nt} \quad \text{(A.26)}$$

where $workers_{in}$ is the number of danish employees of multinational firm n in year t. Here, $Close_n$ takes the value 1 of the municipality where the firm employs most people is located less than 150 kilometers from the bridge. If there is a positive treatment effect on Danish employees close to the bridge, we would suspect that part of the increase in services trade could be driven by changes in the geographical composition of the workforce. However, the figure below show no evidence of such an effect.

Figure A.9: Impact of the Bridge on Number of Danish Workers Employed by Swedish Multinational Firms



A.2.4 Alternative Estimating Equation for Services Trade

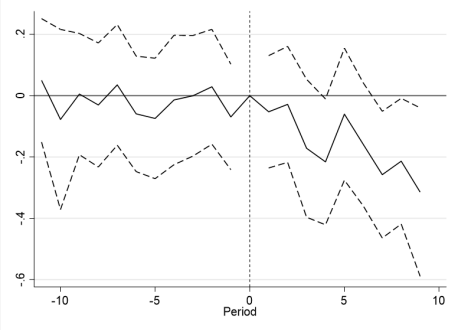
We also formulate an alternative estimating regression with a continuous treatment variable that captures the distance to the Oresund Bridge:

$$\ln service_{it} = \alpha \ + \sum_{t=-10}^{-1} \beta_t \ ln(Dist_i) \times \mu_t + \sum_{t=1}^{9} \beta_t \ ln(Dist_i) \times \mu_t + \delta_i + \gamma_t + \varepsilon_{it} \quad \text{(A.27)}$$

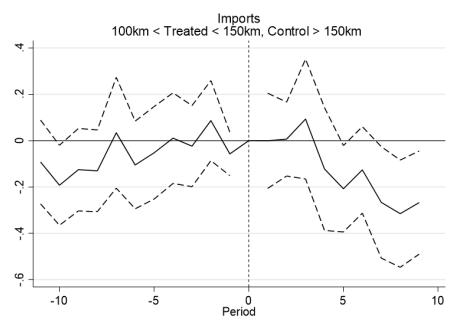
where $ln(Dist_i)$ is the log distance of firm i to the Oresund Bridge. β_t captures the impact on services trade of having a lower distance to the bridge. Since we expect that firms close to the bridge should see a larger effect of the bridge, we expect that β_t is negative. This is indeed what we find.

Figure A.10: Impact of Distance to the Oresund Bridge on Services Trade

Exports



Imports



A.3 Goods Trade

A.3.1 Impact of Bridge on Goods Trade

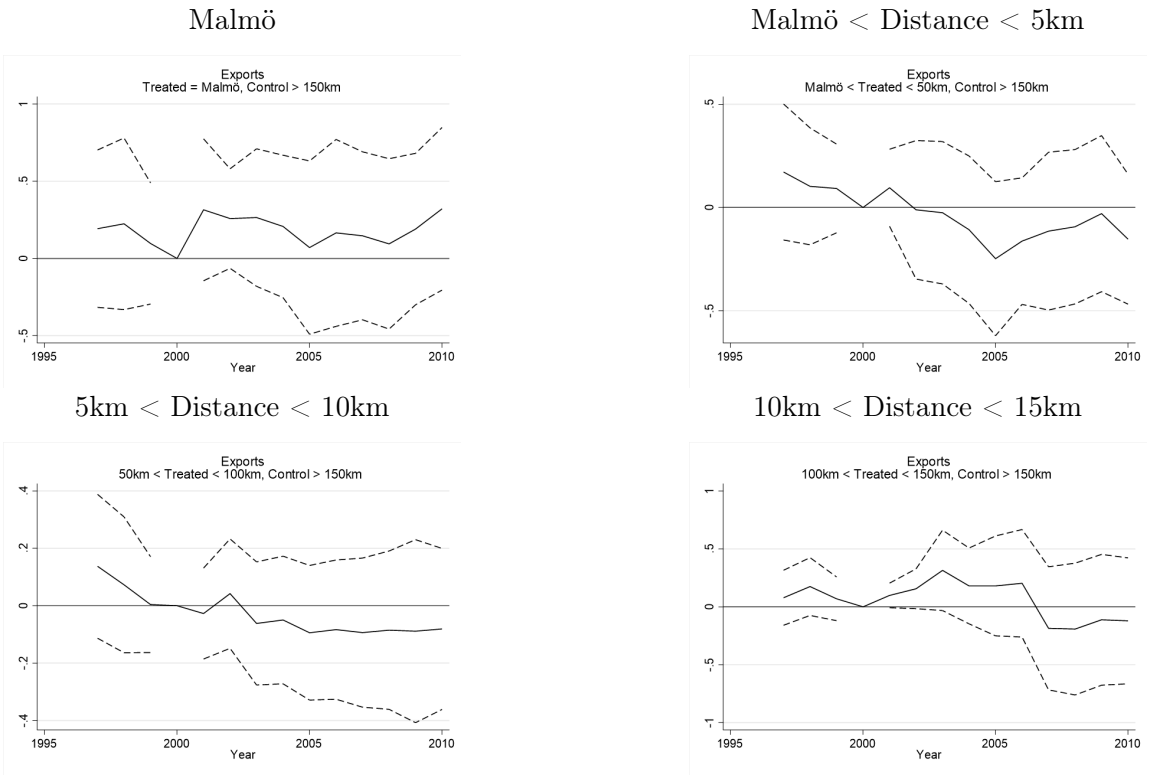
We estimate the impact of the Oresund Bridge on goods trade in a similar way as services in Equation 2. The difference being that we only observe goods trade annually but for a much longer time span. Hence, we estimate the effect year-by-year from 1997 to 2010 as follows:

$$\ln goods_{it} = \alpha \ + \sum_{t=1997}^{1999} \beta_t \ Close_i \times \mu_t + \sum_{t=2001}^{2010} \beta_t \ Close_i \times \mu_t + \delta_i + \gamma_t + \varepsilon_{it} \quad \text{(A.28)}$$

Figure A.11 and A.12 show no impact on goods trade for firms close to the bridge in any

of the distance bands.

Figure A.11: Impact of the Oresund Bridge on Goods Exports



Notes: The control group consists of firms that are located 150 kilometers or farther from the Oresund Bridge.

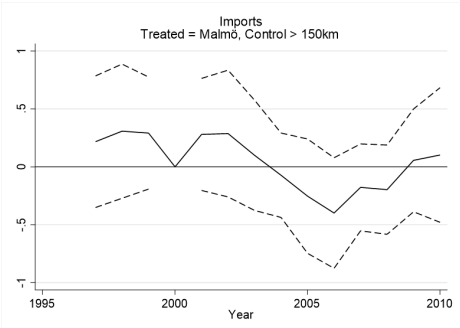
A.3.2 Replication of Previous Papers on the Impact on Goods Trade

Both Åkerman (2009) and Arnarson (2016) find a positive impact on goods trade for Swedish firms due to the opening of the Oresund Bridge. Both papers are currently not published and use a static difference-in-difference specification to estimate their results. Both papers compare firms located in Malmö to firms located in Gothenburg and Stockholm which were much less affected by the opening of the bridge. We replicate their analysis using a dynamic difference-in-difference specification instead and estimate results using both OLS and PPML.

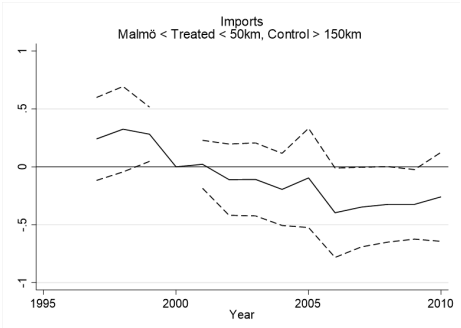
Figure A.13 show that both specifications suffer from pre-trends and that this is likely

Figure A.12: Impact of the Oresund Bridge on Goods Imports

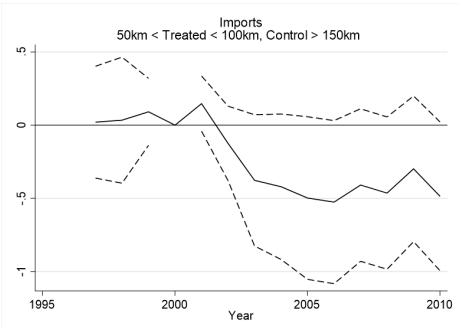
Malmö



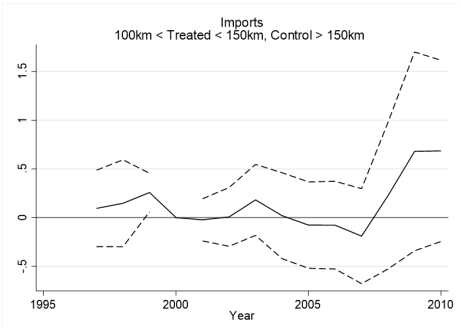
Malmö < Distance < 5km



5km < Distance < 10km



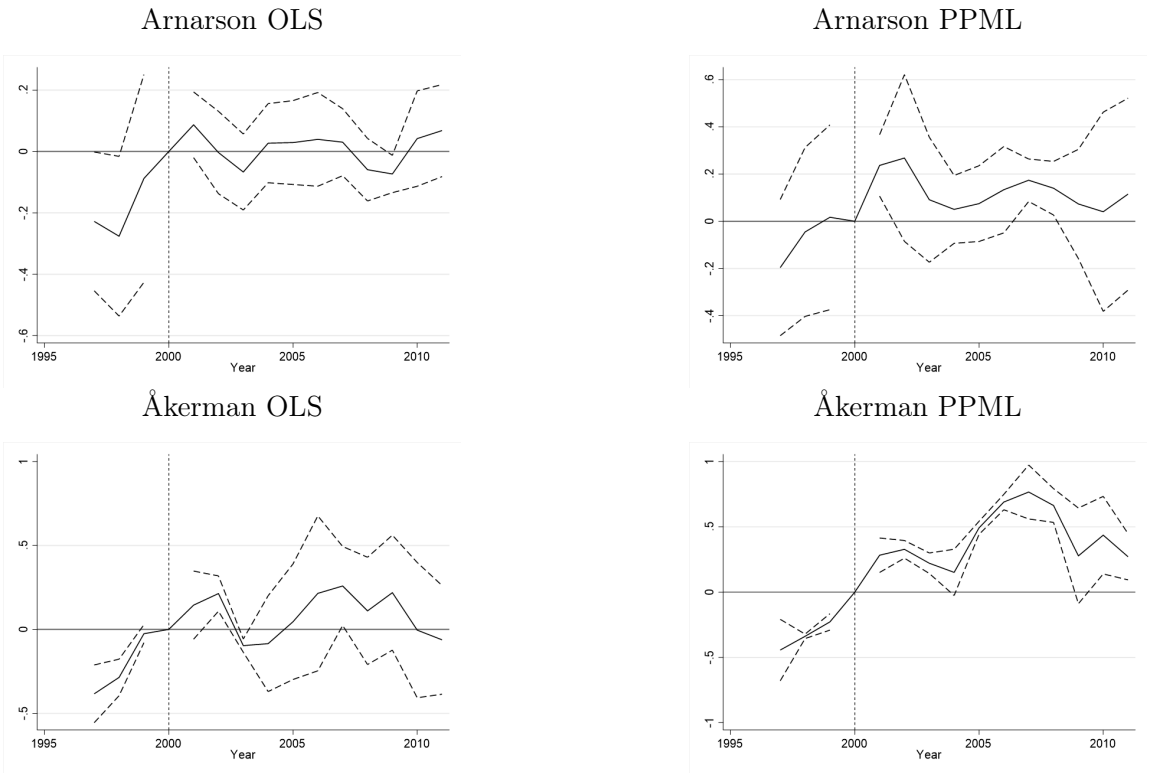
10km < Distance < 15km



Notes: The control group consists of firms that is located 150 kilometers or farther from the Oresund Bridge.

what are driving the positive results in the static estimation. Hence, the conclusion that the bridge did not have an impact on goods trade remains.

Figure A.13: Replication Results on the Impact of the Oresund Bridge on Goods Exports



A.3.3 Impact on Bi-Exporters

An emerging literature have analyzed firms that exports both goods and services, so called bi-exporters, see for instance Breinlich et al (2018), Ariu et al (2020), and Lodefalk (2014). One question of interest is if goods and services are primarily complements or substitutes. If the Oresund Bridge lowers trade frictions for services but not for goods, we would still expect an increase in goods exports if services and goods are complements. On the other hand, if goods and services are substitutes we would only expect to see an increase in services trade exports.

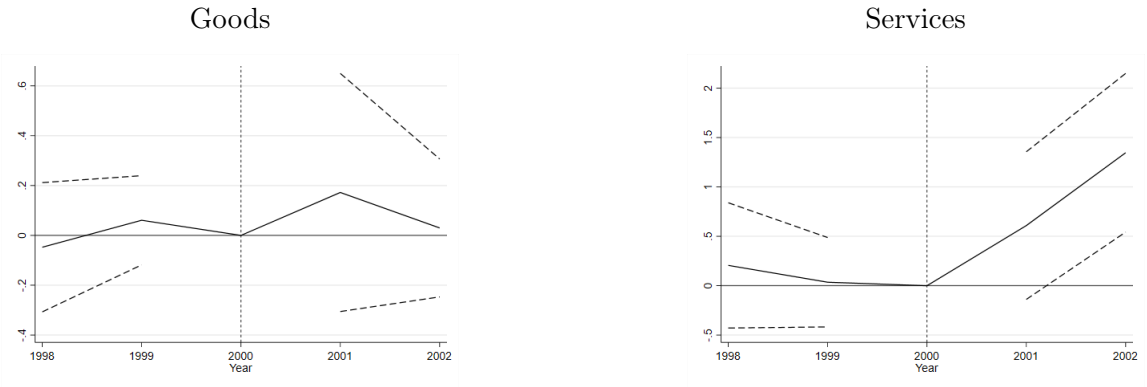
Bi-exporters are large but few in numbers. In 1999, the year before the bridge opened, there were 7508 firms that recorded positive exports to Denmark. Out of these, 4966 exported only goods, 2274 exported only services, and 268 bi-exporters. These number were virtually unchanged two years after the bridge was opened.

We estimate the effect on goods and services exports for firms that at some point between 1998 and 2002 recorded both positive service and goods exports using the following regression:

$$\ln export_{it} = \alpha \; + \sum_{t=1998}^{1999} \beta_t \; Close_i \times \mu_t + \sum_{t=2001}^{2002} \beta_t \; Close_i \times \mu_t + \delta_i + \gamma_t + \varepsilon_{it} \qquad \text{(A.29)}$$

where $export_{it}$ captures goods or services exports. As the number of bi-exporters is limited, we compare the impact on these firms within 150 kilometers of the bridge to the impact on those located beyond 150 kilometers. Doing this, Figure A.14 shows that the opening of the Oresund Bridge had a significant positive impact on services exports but not goods exports for bi-exporters. Hence, these results provide evidence that goods and services acts as substitutes rather than complements.

Figure A.14: Impact on Exports for Bi-Exporters



B Calibration

In this section, we explain our calibration of the model to real data in details, and present the calibrated numbers in this section.

The production share in the production function is calibrated using the WIOD dataset. We employ the input-output tables for Sweden, Denmark, and the Rest of the World (ROW) from the WIOD database to determine these shares. Table B.1 presents the calibrated production shares based on 2000 data, which is the midpoint of our analysis period.

To determine the output of the manufacturing and service sectors in municipalities across Sweden and Denmark, as well as the Rest of the World (ROW), denoted by $Y^k(l)$ where $l \in \mathcal{N}$, we start by calculating total sectoral output values in dollar terms ($) using the WIOD data. Specifically, we obtain Y_S^k, Y_D^k, and Y_{ROW}^k for $k = S, M$, where S denotes Sweden, D denotes Denmark, and ROW refers to the rest of the world. To allocate this output to individual municipalities in Sweden and Denmark, we use data from Statistics Sweden and Statistics Denmark. These data provide the output shares of municipalities, which we then apply to the total sectoral output figures from the WIOD data. The output for each municipality is thus calculated by multiplying total sectoral output from WIOD by the corresponding output share from the microdata. Additionally, average wages by municipality in Sweden and Denmark are sourced from Statistics Sweden and Statistics Denmark. Table B.2 summarizes the calibrated output and average wages of municipalities in Sweden and Denmark for the years 1997, 2002, and 2006. On average, wages in Danish municipalities are higher than those in Swedish municipalities.

Table B.1: Production Share in 2000

		Sweden				
		Output				
		Manu	Business	IT	Others	Transport
Labor Share		0.34	0.54	0.54	0.59	0.37
	Manu	0.37	0.05	0.08	0.10	0.11
	Business	0.09	0.17	0.09	0.08	0.07
Input Share	IT	0.02	0.04	0.14	0.02	0.03
	Others	0.13	0.16	0.13	0.17	0.11
	Transport	0.06	0.03	0.02	0.03	0.31
		Denmark				
		Output				
		Manu	Business	IT	Others	Transport
Labor Share		0.37	0.56	0.48	0.61	0.34
	Manu	0.35	0.04	0.07	0.10	0.07
	Business	0.05	0.16	0.12	0.08	0.05
Input Share	IT	0.01	0.06	0.14	0.03	0.02
	Others	0.18	0.16	0.16	0.15	0.10
	Transport	0.04	0.02	0.03	0.03	0.42
		Rest of the World				
		Output				
		Manu	Business	IT	Others	Transport
Labor Share		0.33	0.57	0.53	0.61	0.48
	Manu	0.42	0.05	0.08	0.12	0.13
	Business	0.06	0.22	0.11	0.09	0.10
Input Share	IT	0.01	0.04	0.14	0.02	0.02
	Others	0.15	0.10	0.12	0.15	0.12
	Transport	0.03	0.01	0.02	0.02	0.14

Table B.2: Summary Statistics of Output and Wage by Municipality in Sweden and Denmark for 1997, 2002, and 2006

	Num of Obs	Output (million $)					Wage (thousand $)
		Manu	Business	IT	Others	Transport	
Year				Sweden			
1997	288	519.00(2038.85)	180.36(1361.64)	56.85(746.33)	760.16(4139.99)	117.53(820.34)	19.86(2.43)
2002	288	510.63(1980.35)	189.85(1640.74)	74.86(927.20)	750.53(4487.79)	115.74(733.47)	18.82(2.61)
2006	288	821.70(3010.11)	307.70(2666.94)	134.11(1457.26)	1242.11(7079.68)	188.73(1236.30)	28.15(3.74)
				Denmark			
1997	88	688.86(606.92)	287.40(644.06)	87.56(211.96)	1467.70(2027.76)	209.41(396.42)	28.19(3.91)
2002	88	683.12(578.18)	338.97(798.48)	132.42(335.96)	1525.20(2133.60)	255.02(496.18)	28.62(4.28)
2006	88	1027.20(881.23)	591.35(1353.91)	206.65(512.16)	2499.85(3453.27)	467.95(839.91)	42.64(6.14)
				ROW			
1997		1.70E+07	6.55E+06	1.76E+06	2.54E+07	2.39E+06	4.46
2002		1.73E+07	7.90E+06	2.38E+06	2.89E+07	2.62E+06	4.70
2006		2.78E+07	1.21E+07	3.35E+06	4.30E+07	4.25E+06	6.84

We calibrate the labor force using output and wage data combined with commuting and migration shares. The workforce in each municipality is determined based on labor demand from firms. The calibration is given by:

$$\begin{aligned} w_n L_n^k &= \alpha_L^k \frac{\sigma^k - 1}{\sigma^k} Y_n^k \quad \text{for } k = M, S; n \in \mathcal{N} \cup \{W\} \\ L_n &= L_n^M + L_n^S \end{aligned}$$

where, L_n^k denotes the number of workers in municipality n for sector k, and L_n is the total workforce in municipality n, summing workers from both sectors.

To compute the number of residents in each municipality, we use the commuting share matrix. Let $\mathbf{R}$ be the vector of residents in municipalities in Sweden and Denmark $\mathbf{R} = [R_1, R_2, ..., R_N]$, $\mathbf{L}$ be the vector of workforce in these municipalities $\mathbf{L} = [L_1, L_2, ..., L_N]$, and $\boldsymbol{\lambda}^L$ be the matrix of commuting patterns $\boldsymbol{\lambda}^L = [\lambda^L_{1|1}, \lambda^L_{2|1}, ..., \lambda^L_{N|1}; \lambda^L_{1|2}, \lambda^L_{2|2}, ..., \lambda^L_{N|2}; ...; \lambda^L_{1|N}, \lambda^L_{2|N}, ..., \lambda^L_{N|N}]$. According to Equ (10), the number of workforce in each municipality comes is the sum of workers who commute from different municipalities. By matrix manipulation, the number of residents is calculated as the inverse of the commuting share matrix times the vector of workforce,

$$\lambda^{L'} \cdot \mathbf{R} = \mathbf{L} \Rightarrow \qquad \mathbf{R} = inv(\boldsymbol{\lambda}^{L'}) \cdot \mathbf{L}$$

Similarly, the number of residents in a municipality is the sum of workers born in different municipalities and who move there as described in Equ (12). Let $\overline{\mathbf{L}}$ be the vector of workers born in municipalities in Sweden and Denmark $\overline{\mathbf{L}} = [\overline{L}_1, \overline{L}_2, ..., \overline{L}_N]$, and $\boldsymbol{\lambda}^R$ be the matrix of migration shares $\boldsymbol{\lambda}^R = [\lambda^R_{1|1}, \lambda^R_{2|1}, ..., \lambda^R_{N|1}; \lambda^R_{1|2}, \lambda^R_{2|2}, ..., \lambda^R_{N|2}; ...; \lambda^R_{1|N}, \lambda^R_{2|N}, ..., \lambda^R_{N|N}]$. By matrix manipulation, the number of workers born in each municipality is calculated as the inverse of the migration share matrix times the vector of residents:

$$\boldsymbol{\lambda}^{R'} \cdot \overline{\mathbf{L}} = \mathbf{R} \Rightarrow \qquad \overline{\mathbf{L}} = inv(\boldsymbol{\lambda}^{R'}) \cdot \mathbf{R}$$

For the Rest of the World (ROW), where workers do not migrate or commute, the number of residents and the number of workers are equal:

$$\overline{L}_{ROW} = R_{ROW} = L_{ROW}$$

Next, to calibrate the consumption shares of Sweden, Denmark, and the Rest of the World (ROW) with the trade imbalances from the World Input-Output Database (WIOD), we follow these steps. First, we calculate trade flows by using the cross-border input-output tables from WIOD to determine the trade flow between regions. Specifically, you need the trade flow $Y^k_{C,C'}$, where k denotes sectors (e.g., S for Services and M for Manufacturing), and C and C' are regions (Denmark, Sweden, and ROW). This trade flow represents the value of goods and services exported from region C to region C'. Table B.3 presents the export shares by region. It shows that the manufacture sectors in Sweden and Denmark are integrated well with the world economy by importing and exporting a fairly large share of their output. However, the service sector is much less integrated in the world economy. Though the export share of service sector increases over time, overall more than 84% - 94% of Sweden and Denmark's service output sells domestically. With the trade flows, we compute the trade imbalances. The trade imbalance for a country C can be defined as the difference between the total value of exports and imports for that country. C can be defined as the difference between the total value of exports and imports for that country, with $TB_C > 0$ as trade surplus and $TB_C < 0$ as trade deficit.

Second, we calibrate the trade deficit/surplus per municipality. For each municipality l in Sweden or Denmark, the trade deficit/surplus TB_l can be expressed as proportional to the income of that municipality. Specifically:

$$TB_l = \frac{\overline{w}_l R_l}{\sum_{d \text{ in } C} \overline{w}_d R_d} TB_C$$

where, $\overline{w}_l$ is the average wage in municipality l. R_l is the total income of municipality l. $\sum_{d \text{ in } C} \overline{w}_d R_d$ is the sum of incomes (weighted by average wages) of all municipalities in country C. TB_C is the total trade imbalance of country C. This formula assumes that the trade imbalance of the entire country C is distributed proportionally across its municipalities based on their income. Next, We calibrate consumption shares to match the demand for each industry to its supply, use the following equations for each country C.

$$Y^k_{SWE,C} + Y^k_{DNK,C} + Y^k_{ROW,C} = \frac{\sigma^M - 1}{\sigma^M} \alpha^M_k Y^M_C + \frac{\sigma^S - 1}{\sigma^S} \alpha^S_k Y^S_C + ConsumpDemand^k_C$$

where, $Y^k_{SWE,C}+Y^k_{DNK,C}+Y^k_{ROW,C}$ represents the total value sold in region C. $\frac{\sigma^M-1}{\sigma^M}\alpha^M_k Y^M_C + \frac{\sigma^S-1}{\sigma^S}\alpha^S_k Y^S_C$ is the demand for product k as intermediate inputs, based on total output and

Table B.3: Export Share by Sweden, Denmark and ROW

Exporting Country	Destination Country	Export Share				
		Manu	Business	IT	Others	Transport
				Year = 1997		
	Sweden	56.43%	86.94%	91.95%	92.60%	83.66%
Sweden	Denmark	2.48%	0.53%	0.53%	0.49%	2.19%
	ROW	41.09%	12.53%	7.52%	6.91%	14.15%
	Sweden	3.84%	1.40%	1.07%	1.20%	4.04%
Denmark	Denmark	63.50%	92.13%	94.53%	91.42%	45.98%
	ROW	32.66%	6.47%	4.40%	7.38%	49.98%
	Sweden	0.23%	0.15%	0.12%	0.05%	0.22%
ROW	Denmark	0.12%	0.04%	0.04%	0.03%	0.34%
	ROW	99.64%	99.81%	99.83%	99.92%	99.44%
				Year = 2002		
	Sweden	56.38%	82.48%	90.22%	92.18%	82.66%
Sweden	Denmark	2.37%	0.83%	1.15%	0.57%	3.66%
	ROW	41.26%	16.69%	8.62%	7.25%	13.68%
	Sweden	4.25%	1.70%	2.34%	1.31%	3.83%
Denmark	Denmark	61.41%	89.32%	87.31%	90.27%	37.42%
	ROW	34.34%	8.98%	10.35%	8.42%	58.74%
	Sweden	0.23%	0.14%	0.10%	0.05%	0.24%
ROW	Denmark	0.12%	0.12%	0.06%	0.08%	0.03%
0.38%						
	ROW	99.65%	99.79%	99.82%	99.92%	99.38%
				Year = 2006		
	Sweden	54.12%	80.47%	87.90%	91.13%	79.41%
Sweden	Denmark	3.14%	0.85%	1.26%	0.69%	4.89%
	ROW	42.74%	18.68%	10.83%	8.18%	15.70%
	Sweden	4.18%	1.57%	3.00%	1.44%	3.85%
Denmark	Denmark	62.34%	89.84%	87.34%	89.43%	28.60%
	ROW	33.47%	8.60%	9.66%	9.14%	67.55%
	Sweden	0.26%	0.14%	0.16%	0.06%	0.24%
Denmark	Denmark	0.14%	0.06%	0.07%	0.04%	0.62%
	ROW	99.60%	99.80%	99.77%	99.91%	99.15% height

production shares. $ConsumpDemand_C^k$ is the value of goods consumed by labor as consumption goods. The consumption share β_C^k for each industry k in region C is calculated as:

$$\beta_C^k = \frac{ConsumpDemand_C^k}{ConsumpDemand_C^M + ConsumpDemand_C^S} * (1 - \beta^H)$$

where β^H is the housing consumption share, calibrated to 13% from **an external report**. Table B.4 presents the calibrated consumption share β_C^k according to the data in 1997, 2002 and 2006.

Table B.4: Consumption Share in Sweden, Denmark and ROW in 1997, 2002 and 2006

	Manu	Business	IT	Others	Transport
			Year = 1997		
Sweden	0.17	0.05	0.02	0.60	0.03
Denmark	0.17	0.04	0.01	0.64	0.01
ROW	0.20	0.05	0.01	0.58	0.03
			Year = 2002		
Sweden	0.17	0.05	0.04	0.58	0.03
Denmark	0.14	0.07	0.03	0.63	0.01
ROW	0.16	0.06	0.02	0.59	0.03
			Year = 2006		
Sweden	0.17	0.04	0.04	0.59	0.03
Denmark	0.15	0.07	0.02	0.59	0.03
ROW	0.18	0.06	0.02	0.57	0.03

B.1 Manufacturing Trade-Cost Estimation

B.1.1 Estimation of Distance Elasticity in the Manufacturing Sector

To estimate the distance elasticity in the manufacturing sector, we use the export shares of each Swedish municipality to Denmark and the ROW. We derive the estimation equation for the distance elasticity in goods trade as the following. For $d \in$ SWE, the export share

to Denmark for $k = 1$ is given by:

$$\frac{Y^1_{d,DNK}}{Y^1_d} = \frac{(c^1_d)^{1-\sigma^1} \sum_{l\in \text{DNK}} (\tau^1_{dl})^{1-\sigma^1} \frac{MS^1_l}{(P^1_l)^{1-\sigma^1}}}{\sum_{n\in\overline{\mathcal{N}}} (c^1_d)^{1-\sigma^1} (\tau^1_{dn})^{1-\sigma^1} \frac{MS^1_n}{(P^1_n)^{1-\sigma^1}}} = (dist_{d,port})^{\psi^1(1-\sigma^1)} \frac{\sum_{l\in \text{DNK}} (\tau^1_{\text{SWE,DNK}} \frac{MS^k_l}{(P^1_l)^{\sigma^1-1}})}{RMA^1_d}$$

Similarly, the export share to ROW for municipality d in Sweden is:

$$\frac{Y^1_{d,ROW}}{Y^k_d} = \frac{(c^1_d)^{1-\sigma^1} (\tau^1_{d,ROW})^{1-\sigma^1} \frac{MS^1_{ROW}}{(P^1_{ROW})^{1-\sigma^1}}}{\sum_{n\in\overline{\mathcal{N}}} (c^1_d)^{1-\sigma^1} (\tau^1_{dn})^{1-\sigma^1} \frac{MS^1_n}{(P^1_n)^{1-\sigma^1}}} = (dist_{d,port})^{\psi^k(1-\sigma^k)} \frac{\tau^{1-\sigma^1}_{\text{SWE,ROW}} \frac{MS^1_{ROW}}{(P^1_{ROW})^{1-\sigma^1}}}{RMA^1_d}$$

Taking the log of the export shares $\frac{Y^k_{d,DNK}}{Y^k_d}$, $\frac{Y^k_{d,ROW}}{Y^k_d}$ and adding a time dimension with a subscript t, we obtain:

$$\log \frac{Y^1_{d,DNK,t}}{Y^1_{d,t}} = \psi^1(1-\sigma^1) \log dist_{d,port} - \log(RMA^1_{d,t}) + \mu_{DNK,t} \tag{B.30}$$

$$\log \frac{Y^1_{d,ROW,t}}{Y^1_{d,t}} = \psi^1(1-\sigma^1) \log dist_{d,port} - \log(RMA^1_{d,t}) + \mu_{ROW,t} \tag{B.31}$$

where $RMA_{d,t}$ can be solved using the following equation system:

$$\begin{aligned} RMA^1_d &= \sum_{n\in\overline{\mathcal{N}}} (\tau^1_{dn})^{1-\sigma^1} \frac{MS^1_n}{(P^1_n)^{1-\sigma^1}} \\ (P^1_n)^{1-\sigma^1} &= \sum_d \left(c^1_n\right)^{1-\sigma^1} (\tau^1_{dn})^{1-\sigma^1} \\ Y^1_n &= (C^1_n)^{1-\gamma^1} RMA^1_n \end{aligned}$$

The cross-border trade barriers $\tau^1_{C,C',t}$ ($C, C' =$ SWE, DKN, ROW) are calibrated such that the aggregate export share of each country (Sweden, Denmark, and ROW) matches the trade share in the OECD input-output table, $\frac{Y^1_{C,C}}{Y^1_C}$.

As the distance elasticity ψ^k contributes to the calculation of $RMA^M_{d,t}$, Equations (B.30) and (B.31) are nonlinear in ψ^k. Thus, we apply nonlinear least squares to estimate ψ^k. The estimated parameters (ψ^k, $\mu_{DNK,t}$, $\mu_{ROW,t}$) minimize the discrepancy between model

predictions and data:

$$\psi^1, \mu_{DNK,t}, \mu_{ROW,t} \in$$
$$\arg\min \sum_{d,t} \left(\log \frac{Y^1_{d,DNK,t}}{Y^1_{d,t}} - \psi^1(1-\sigma^1) \log dist_{d,port} + \log RMA^1_{d,t} - \mu_{DNK,t} \right)^2$$
$$+ \sum_{d,t} \left(\log \frac{Y^1_{d,ROW,t}}{Y^1_{d,t}} - \psi^1(1-\sigma^1) \log dist_{d,port} + \log RMA^1_{d,t} - \mu_{ROW,t} \right)^2$$

To estimate ψ^1 in the manufacturing industry, we take advantage of the manufacturing export shares of Sweden municipalities in the years 1997, 2002, and 2006.

C Model Fit

In this section, we evaluate the model's performance by comparing its predictions against data not used in the calibration process.

C.1 Workforce, Employment, and Residents

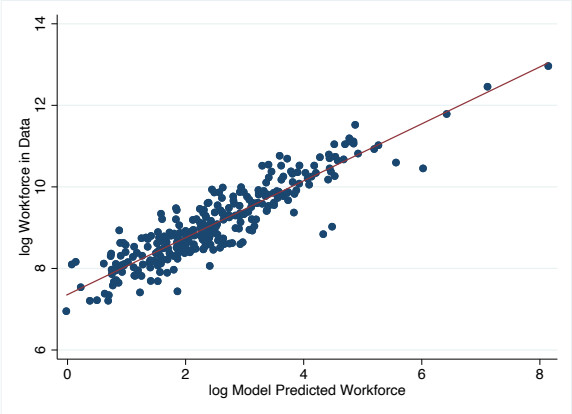
To assess the model's fit, we compare the model-predicted labor force against actual data. We derive the workforce from the output by industry and municipality, average wages, and the production function. Additionally, we compare the model's predictions for the number of residents by municipality and employment by industry and municipality with actual data.

Figure C.15 illustrates the comparison between the model-predicted labor force and actual data. Panel C.15a shows that the number of workers predicted by the model aligns closely with the actual workforce data. This indicates that the total workforce is calibrated well.

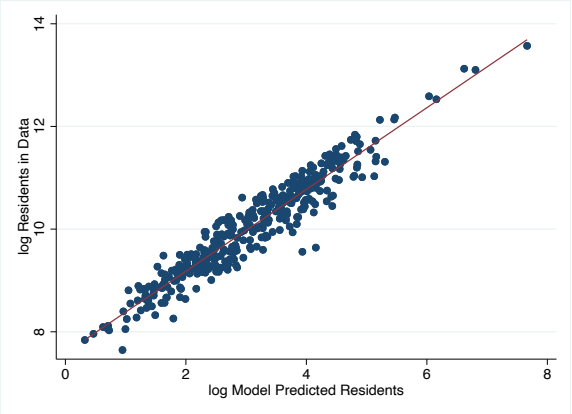
Further, C.15c and Panel C.15d present the model-calibrated employment by industry for each municipality compared to actual employment data sourced from Statistics Sweden. These panels demonstrate that the model's predictions for employment in manufacturing and services industries are closely aligned with observed data.

Finally, Panel C.15b shows a comparison of the model-predicted number of residents in each municipality against actual resident data. The figure indicates that the predicted and

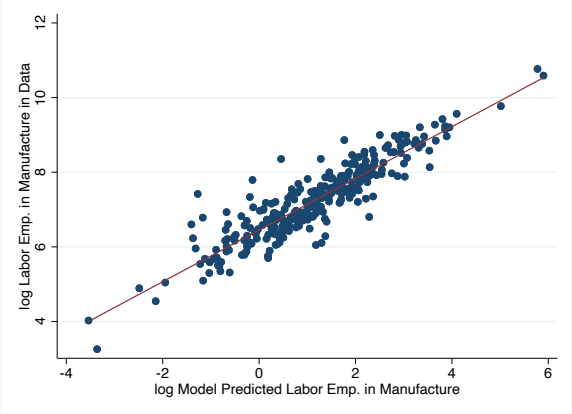
actual resident numbers are closely aligned along the 45-degree line, suggesting a strong fit between the model and observed data.



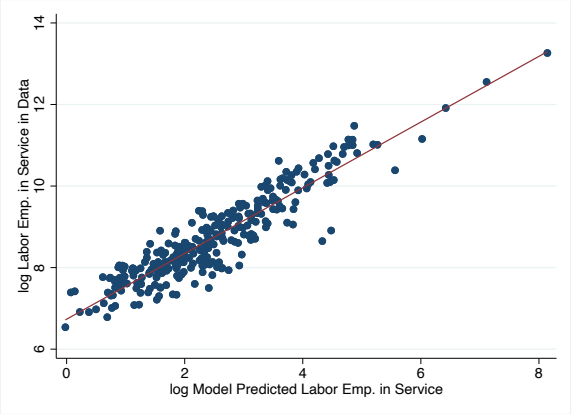
(a) Workforce



(b) Residents



(c) Labor Employment in Manufacture



(d) Labor Employment in Service

Figure C.15: Model Fit of Workforce, Residents and Employment

C.2 Link to Empirical Results

In this section, we study the impact of bridge on service trade, commuting and etc, and compare the model prediction to the empirical results in Section 4. After calibrating the model to the economy in 1997, we compute the counterfactual with a change in commuting, and service trade costs due to the bridge while keeping other parameters such as productivity fixed at the 1997 level.

Fact 1: The Oresund Bridge Significantly Reduced Travel Time and Increased Commuting to Denmark in Swedish Regions Close to the Bridge In our counterfactual analysis, we calculate the change in the total number of workers residing in Swedish municipalities who commute to Denmark for work, due to the Oresund Bridge. We then plot this change against the logarithm of the distance from each municipality to the Oresund Bridge. Figure C.16 illustrates the model-predicted changes in the total number of cross-border commuters from Sweden to Denmark for each municipality. Each data point represents a municipality, and the red line denotes a kernel-weighted local polynomial smoothing line.

The figure shows that the municipalities closer to the bridge experienced a more significant increase in the number of trans-border commuters, which is consistent with the empirical findings in Section 4. This is because the bridge considerably reduced travel time for workers living in nearby areas, facilitating greater cross-border commuting.

Fact 2: Services Trade Increased for Firms Close to the Bridge, with a Larger Magnitude for Imports. To assess the impact of the Oresund Bridge on service trade, we plot the model-predicted changes in service trade against the logarithm of the distance from each municipality to the bridge in Figure C.17. The figure shows that municipalities closer to the Oresund Bridge experienced a more significant increase in service trade, particularly in imports. This pattern aligns with the empirical findings, demonstrating that firms located nearer to the bridge saw a notable rise in service exports across borders from both Sweden and Denmark.

Fact 3: Goods trade was generally not affected by the bridge.

Fact 4: The bridge caused wages to converge between Sweden and Denmark in regions close to the bridge. Figure C.18 illustrates the model-predicted changes in wages following the construction of the Oresund Bridge. Each point represents a municipality, with the horizontal axis showing the distance to the bridge. The figure demonstrates that, according to the model, wages offered by Swedish firms increased more significantly in municipalities closer to the bridge. Conversely, wages offered by Danish firms decreased, albeit to a lesser extent, in areas nearer to the bridge. This pattern of wage convergence aligns with the empirical findings, confirming that proximity to the Ore-

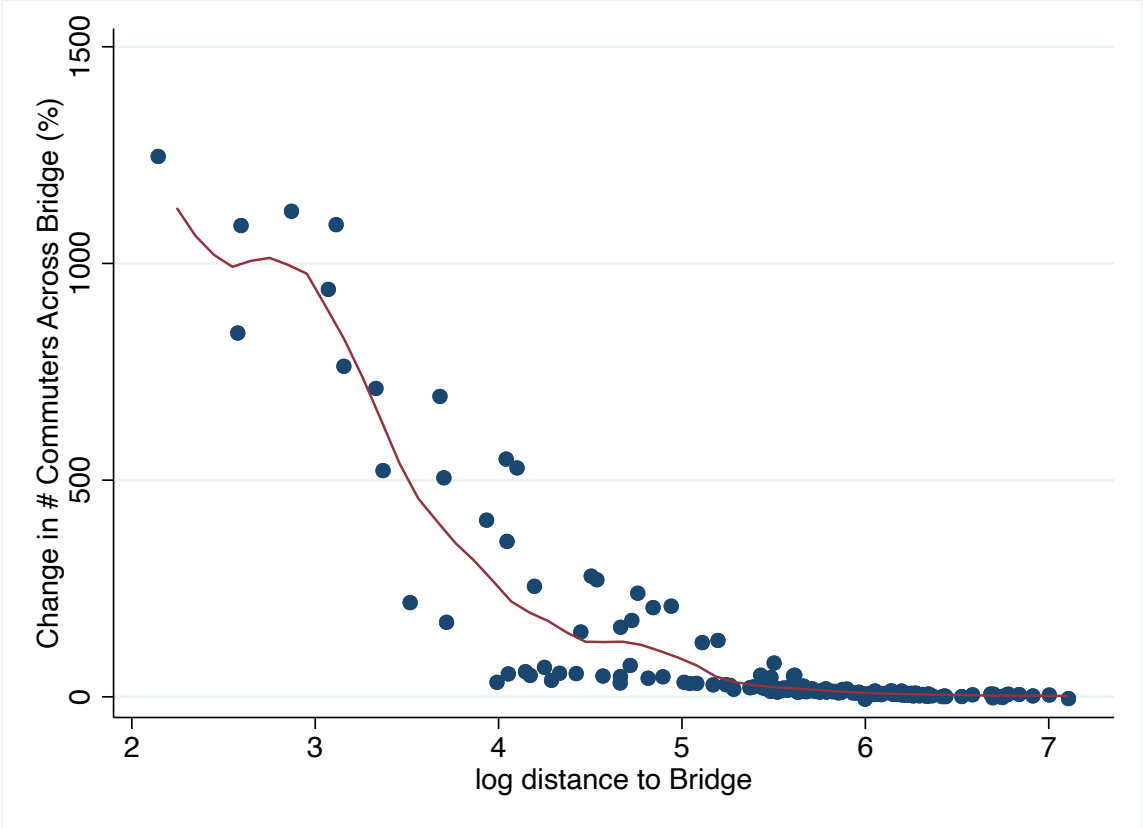
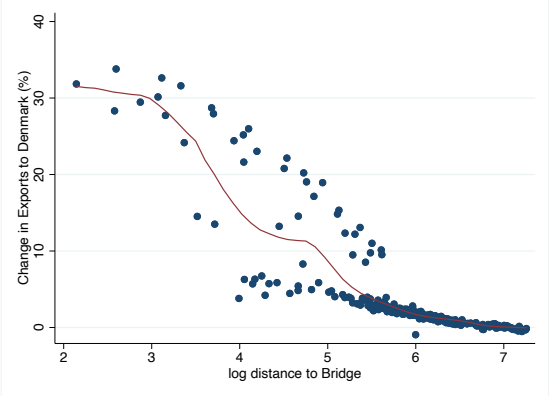
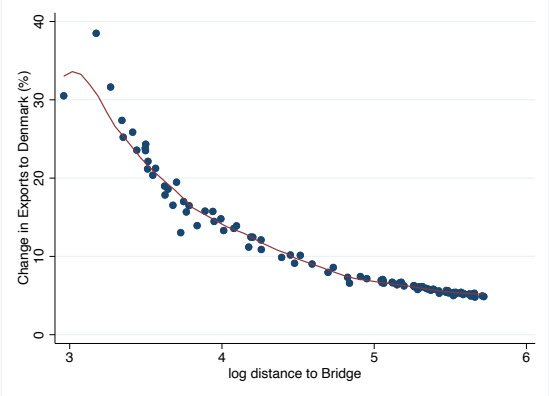


Figure C.16: Change in the Total Number of Commuters from Sweden to Denmark



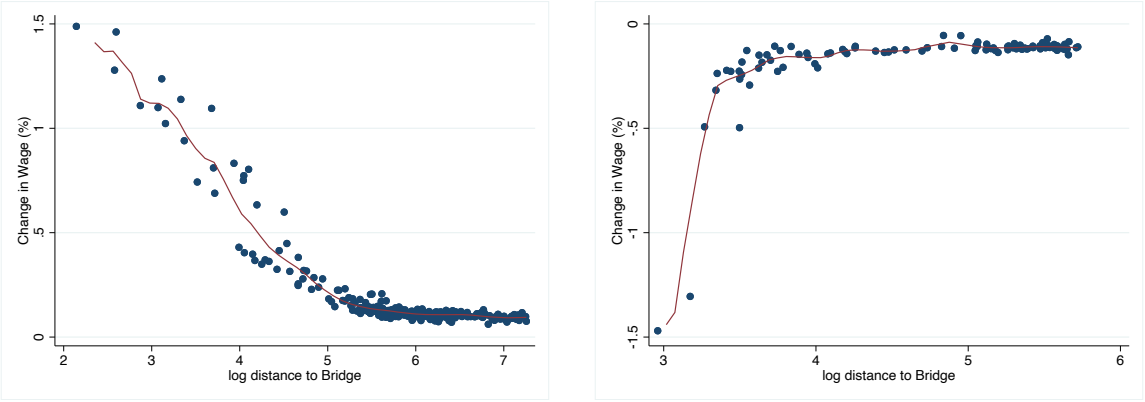
(a) Service Exports from Sweden to Denmark



(b) Service Exports from Denmark to Sweden

Figure C.17: Service Trade between Sweden and Denmark

sund Bridge influenced wage dynamics in both countries. In addition to the direct wage



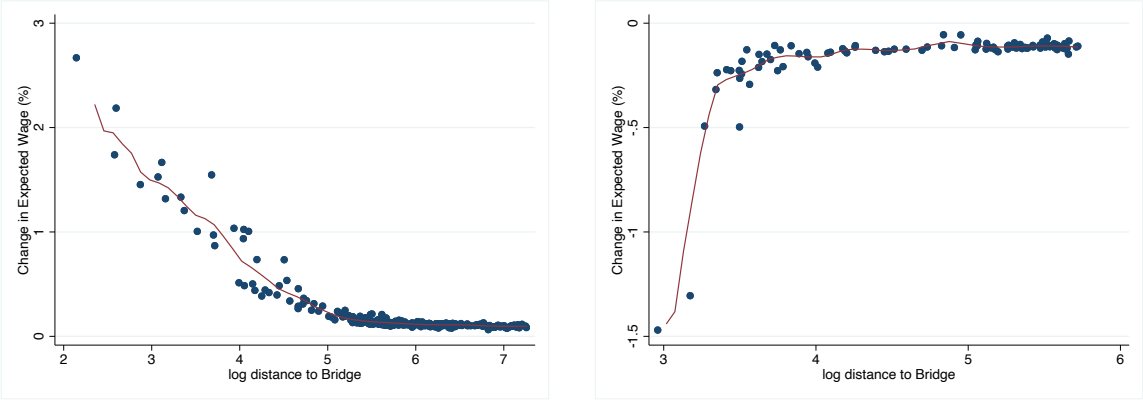
(a) Change in Wage in Sweden (b) Change in Wage in Denmark

Figure C.18: Change in Wage in Sweden and Denmark

changes, Figure C.19 presents the model-predicted changes in the weighted expected wage through commuting, $\widetilde{w}_l$. For municipalities on the Swedish side, the weighted expected wage increased more significantly as the distance to the bridge decreased. Conversely, in municipalities on the Danish side, the weighted expected wage decreased more as proximity to the bridge increased. This pattern further confirms the impact of the bridge on wage dynamics, highlighting how both direct wages and the benefits of commuting influenced wage convergence between the two countries.

Fact 5: The Bridge Had a Positive Impact on the Swedish Worker Population Size in Regions Close to the Bridge, Primarily Driven by Commuters, but No Similar Impact in Denmark Figures C.20a and C.20b present the model-predicted changes in workforce size, demonstrating strong alignment with empirical findings. On the Swedish side, municipalities closer to the Oresund Bridge experienced a notable decline in the local workforce due to an increase in cross-border commuting to higher-paying jobs in Denmark.

In addition to the reduction in local workforce size, municipalities near the bridge on the Swedish side saw an increase in residents as shown in Figure C.20c. This growth is attributed to higher migration rates to these areas, as they offer better commuting opportunities to Denmark. The figure also illustrates that the change in the number of residents exhibits a



(a) Change in $\widetilde{w}$ in Sweden

(b) Change in $\widetilde{w}$ in Denmark

Figure C.19: Change in Wage in Sweden and Denmark

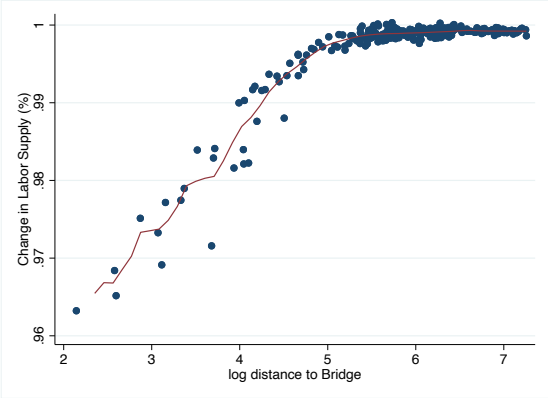
nonlinear relationship with distance to the bridge, suggesting that most new residents are migrating from municipalities situated at intermediate distances from the bridge.

On the Danish side, however, there was no similar increase in worker population size. The data suggest that while Swedish municipalities experienced shifts in workforce and population due to the bridge, the impact on Danish municipalities was relatively muted.

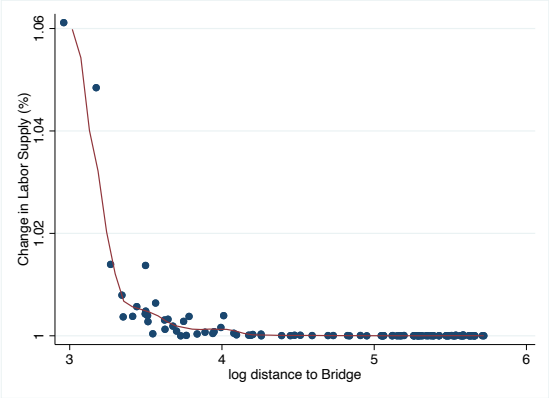
Fact 6: The Bridge Had a Positive Impact on House Prices in Sweden Close to the Bridge, with No Significant Impact in Denmark In Sweden, the construction of the Oresund Bridge led to a noticeable increase in house prices in municipalities situated close to the bridge as shown in Figure C.23a. This price increase can be attributed to rising total incomes and higher population inflows into these areas, driven by enhanced commuting opportunities to Denmark. As more people moved to municipalities nearer to the bridge, the demand for housing increased, resulting in faster growth of house prices.

In contrast, the impact on house prices in Denmark was minimal as shown in Figure C.23b. Since the bridge had a relatively small effect on the Danish side in terms of increased population and income, the change in housing prices there was correspondingly limited.

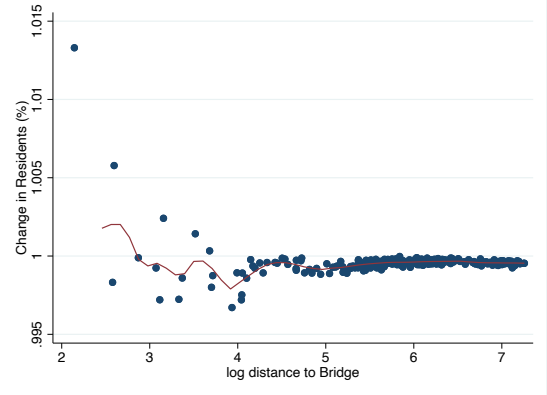
Fact 7: Change in Labor Supply and Wage in Denmark Figure C.22 presents the relationship between distance to the Oresund Bridge and the change in the share of



(a) Change in Labor Supply in Sweden

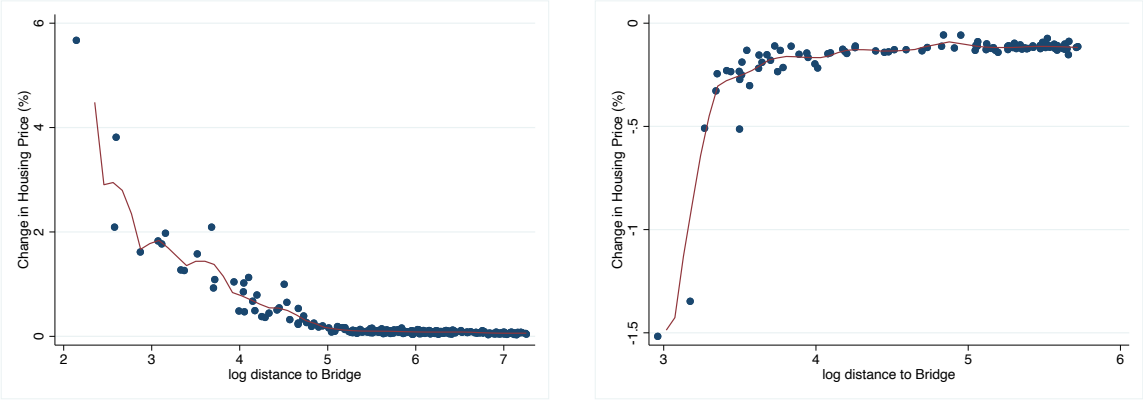


(b) Change in Labor Supply in Denmark



(c) Change in Residents in Sweden

Figure C.20: Change in Workforce and Residents in Sweden and Denmark



(a) Housing Price (b) Housing Price

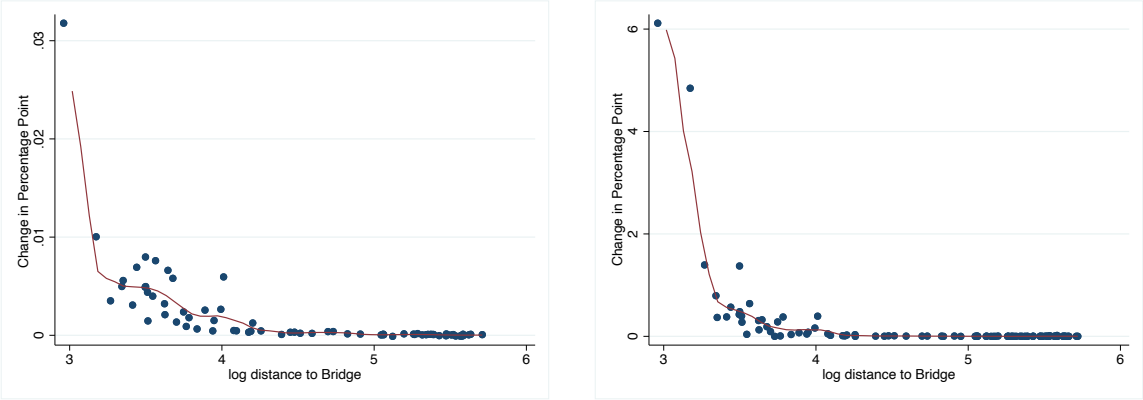
Figure C.21: Change in Housing Price in Sweden and Denmark

Swedish commuters in the Danish population, using both empirical data and model-implied counterfactuals. The empirical evidence in Panels (a) and (b) shows that Danish municipalities closer to the bridge experienced larger increases in the share of Swedish commuters, with the effect declining with distance. This pattern is consistent with the reduction in commuting costs induced by the bridge, which disproportionately benefits locations within feasible commuting distance.

The model-generated counterfactual in Panel (c) reproduces this spatial gradient and further sharpens the relationship. In the model, municipalities closer to the bridge experience a substantially larger increase in the share of Swedish commuters, reflecting the strong sensitivity of commuting flows to distance. This result highlights the role of commuting cost reductions as the primary driver of cross-border labor market integration. Compared to the empirical patterns, the counterfactual delivers a smoother and more pronounced relationship because it isolates the effect of reduced commuting costs while holding other factors constant. Overall, Figure C.22 provides additional evidence that the bridge led to a highly localized increase in cross-border commuting, with effects that decay rapidly with distance.

Figure C.23 presents the relationship between distance to the Oresund Bridge and wage changes in Denmark, using both empirical data and model-implied counterfactuals.

In the model-generated counterfactual, Danish municipalities closer to the bridge experience larger negative wage effects, whereas municipalities farther away display only modest or



(a) Actual Data 1997-2006 (b) Counterfactual

Figure C.22: Change in Percentage Points of Swedish Commuters as a Share of Danish Population

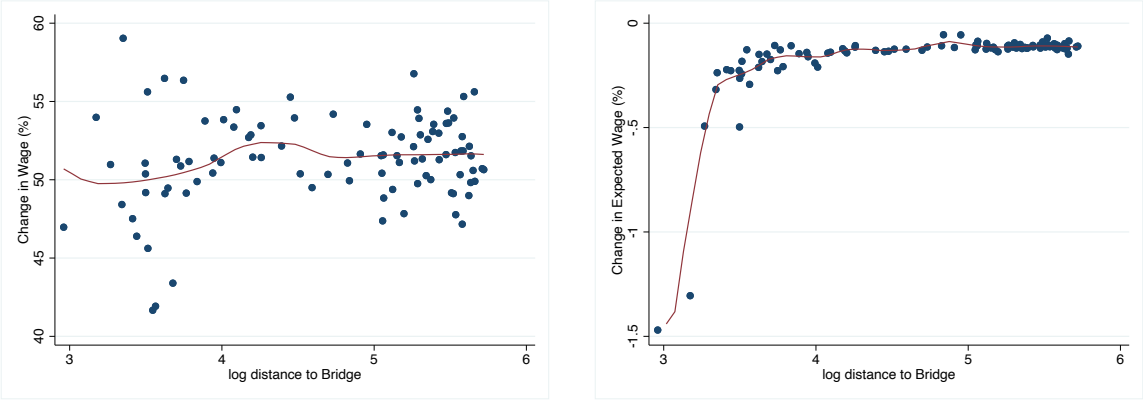
negligible changes. This pattern is consistent with the mechanism highlighted in the paper: by lowering commuting costs, the bridge increases cross-border commuting from Sweden to Denmark, generating a localized labor supply shock in nearby Danish municipalities and thereby exerting downward pressure on wages.

The corresponding pattern in the empirical data is less sharp. One plausible explanation is that the empirical comparison spans the period from 1997 to 2006, during which many other factors may also have influenced Danish wages. Such confounding forces make it difficult to isolate the bridge effect directly from the raw data. The counterfactual therefore plays an important role by isolating the effect of reduced commuting costs while holding other determinants fixed, thereby making the underlying mechanism more transparent.

D Counterfactual

D.1 The Role of Migration

Finally, the proximity of the black and blue lines, as well as of the red and green lines, suggests that migration has relatively limited marginal influence in this context. Whether individuals are allowed to permanently relocate across borders does not meaningfully alter the spatial pattern or magnitude of welfare effects. This result highlights the dominant



(a) Actual Data 1997-2006 (b) Counterfactual

Figure C.23: Change in Wages in Denmark as a Function of Distance to Bridge

role of short-term mobility—through commuting—over long-term migration in shaping the economic consequences of the bridge in this model.

E Migration Cost

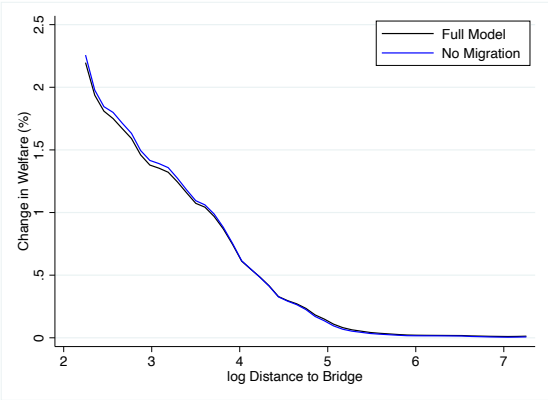
To estimate the distance elasticity of migration costs, we parameterize the cost function analogously to that of commuting costs:

$$\kappa_{ln}^R = \widetilde{\kappa}_{ln}^R \cdot dist_{ln}^{\nu^R},$$

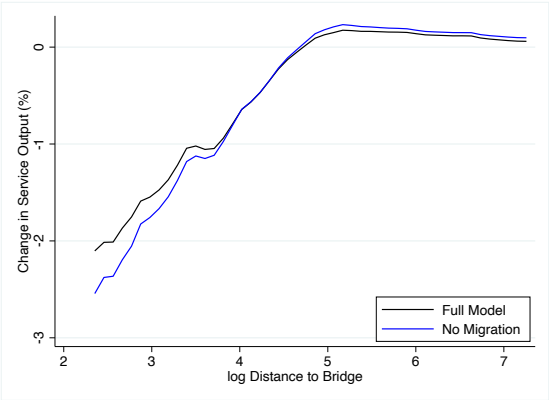
where $dist_{ln}$ denotes the distance between birthplace l and destination n. The term $\widetilde{\kappa}_{ln}^R$ is location-pair specific and may vary over time, while ν^R captures the elasticity of migration costs with respect to distance. Thanks to the DEK procedure, we do not need to calibrate $\widetilde{\kappa}_{ln}^R$ or the locational amenity B_n^R, and we focus instead on estimating the elasticities ν^R and ϵ^R.

We adopt a similar procedure for estimating ν^R and ϵ^R as the commuting cost. After log-linearizing the migration share equation, i.e. Equation (11), we get:

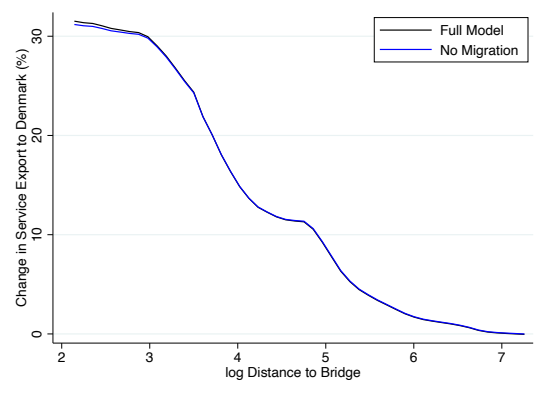
$$\begin{aligned} \log \lambda_{n|l,t}^R &= \log B_{n,t}^R + \epsilon^R \log \left(\frac{\widetilde{w}_{n,t}}{(P_n^M)^{\beta^M} (P_n^S)^{\beta^S} (r_n^H)^{\beta^H}} \right) - \epsilon^R \log \widetilde{\kappa}_{ln,t}^R \\ &\quad - \nu^R \epsilon^R \log dist_{ln,t} - \log \Phi_l^R \end{aligned} \tag{E.32}$$



(a) Ex-ante Welfare



(b) Y_l^S



(c) Service Export from SWE to DNK

Figure D.24: Comparison across different models: Sweden

We estimate ν^R and ϵ^R using a two-step approach, similar to the strategy used for commuting costs. In Step 1, we estimate the composite parameter $\nu^R\epsilon^R$ by exploiting the relationship between observed migration shares and inter-municipality distances. Specifically, we estimate the following linear equation:

$$\log \lambda^R_{n|l,t} \quad = \quad -\nu^R\epsilon^R \log dist_{ln,t} + \mu_{l,t} + \mu_{n,t} + \varepsilon_{n|l,t}, \tag{E.33}$$

where $\mu_{l,t}$ captures origin-time fixed effects related to the birthplace, such as $\log \Phi^R_l$, and $\mu_{n,t}$ captures destination-time fixed effects, including the composite term $\log\left(\frac{\widetilde{w}_{n,t}}{(P^M_n)^{\beta^M}(P^S_n)^{\beta^S}(r^H_n)^{\beta^H}}\right)$. The residual $\varepsilon_{n|l,t}$ absorbs the term $\epsilon^R \log \widetilde{\kappa}^R_{ln,t}$, which we assume to be exogenous with respect to $\log dist_{ln,t}$. Under these assumptions, OLS estimation of Equation (E.33) provides a consistent estimate of $\nu^R\epsilon^R$.

We compute the migration shares $\lambda^R_{n|l}$ using individual level data from Statistics Sweden that tracks the location choices of workers born in Swedish municipalities who relocate to other municipalities within Sweden over two five-year periods: 1995–2000 and 2000–2005. Unfortunately, the dataset does not include migration patterns for individuals born in Denmark or Swedish workers who relocate to Denmark. We therefore assume no cross-border migration and no migration between Danish municipalities. This assumption is supported by the negligible wage changes observed in Denmark during the period and by the limited levels of cross-border migration. Accordingly, the estimation is restricted to the observed migration decisions of individuals born in Swedish municipalities and relocating within Sweden. We further exclude the Norrland region—a sparsely populated, agriculturally dominant area in northern Sweden as migration from the Norrland region to the southern region was low even before the bridge was built. The results are reported in Table E.5.

Column (1) presents OLS estimates from Equation (E.33), showing a significantly negative elasticity with respect to distance. Given the large number of zeros in the migration share data, we also estimate the model using Poisson pseudo-maximum likelihood (PPML) to account for zero-inflation bias. The PPML estimate, reported in Column (2), yields a statistically significant value of $\nu^R\epsilon^R = 3.461$.

Table E.5: Estimation of $\nu^R \epsilon^R$

	(1)	(2)
	Sample Excluding Norrland Area	
	FE	PPML
$\log Dist_{nd,t}$	-1.247	-3.461
	(0.0121)***	(0.0164)***
Cons	-1.637	7.284
	(0.0654)***	(0.0392)***
Origin-Year FE	YES	YES
Destin-Year FE	YES	YES
N	55209	146592

Note: This table presents the estimation of Equation (E.33) using migration share data in Sweden. We exclude the Norrland Area as the Norrland Area is very faraway from the bridge and few people migrate to the south region before or after the bridge was built.
Standard deviations are reported in parentheses. Statistical significance is denoted by asterisks: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In Step 2, we rearrange Equation (E.32) using the estimate $\nu^R \cdot \epsilon^R = 3.767$:

$$\log \lambda^R_{n|l,t} + \nu^R \epsilon^R \log dist_{ln,t} = \epsilon^R \log \left(\frac{\widetilde{w}_{n,t}}{(P^M_n)^{\beta^M} (P^S_n)^{\beta^S} (r^H_n)^{\beta^H}} \right) + \mu_{l,t} + \varepsilon_{n|l,t},$$

where $\mu_{l,t}$ captures birthplace-time fixed effects. The error term $\varepsilon_{n|l,t}$ includes $\epsilon^R \log \widetilde{\kappa}^R_{ln,t}$ and the time-varying amenity term $\log B^R_{n,t}$, both of which may be correlated with wages. Therefore, we need to deal with the endogeneity problem.

To address this endogeneity, we estimate the following first-difference equation for municipalities l, n in Sweden:

$$\Delta \log \lambda^R_{n|l,t} + \nu^R \epsilon^R \Delta \log dist_{ln,t} = \epsilon^R \log \left(\frac{\widehat{\widetilde{w}}_{n,t}}{(\widehat{P}^M_n)^{\beta^M} (\widehat{P}^S_n)^{\beta^S} (\widehat{r}^H_n)^{\beta^H}} \right) + \mu_{l,t} + \varepsilon_{n|l,t} \quad \text{(E.34)}$$

where $\widehat{\widetilde{w}}_{n,t}$ is calculated using the estimated $\widehat{\epsilon}^L$ and the data on commuting shares $\lambda^L_{d|n}$.

$$\widehat{\widetilde{w}}_n = \frac{\Gamma\left(\frac{\epsilon^L-1}{\epsilon^L}\right)\left[\sum_{d\in\mathcal{N}} B_d^L\left(\frac{w'_d}{\kappa^{L'}_{nd}}\right)^{\epsilon^L}\right]^{\frac{1}{\epsilon^L}}}{\Gamma\left(\frac{\epsilon^L-1}{\epsilon^L}\right)\left[\sum_{d\in\mathcal{N}} B_d^L\left(\frac{w_d}{\kappa^{L}_{nd}}\right)^{\epsilon^L}\right]^{\frac{1}{\epsilon^L}}} = \left[\sum_{d\in\mathcal{N}} \lambda^L_{d|n}\left(\frac{\hat{w}_d}{\hat{\kappa}^L_{nd}}\right)^{\varepsilon^L}\right]^{\frac{1}{\varepsilon^L}}$$

However, $\frac{\widehat{\widetilde{w}}_{n,t}}{(\widehat{P}^M_n)^{\beta^M}(\widehat{P}^S_n)^{\beta^S}(\widehat{r}^H_n)^{\beta^H}}$ is endogenous, as $\hat{w}_n$ may be affected by locational amenities such as $\log B^R_{n,t}$

To address this endogeneity, we use the driving time to the bridge before the bridge was built as an IV for $\log \frac{\widehat{\widetilde{w}}_{n,t}}{(\widehat{P}^M_n)^{\beta^M}(\widehat{P}^S_n)^{\beta^S}(\widehat{r}^H_n)^{\beta^H}}$. This approach is inspired by Ahlfeldt et al. (2015). As the bridge affects wages more significantly for municipalities closer to it, we expect $\frac{\widehat{\widetilde{w}}_{n,t}}{(\widehat{P}^M_n)^{\beta^M}(\widehat{P}^S_n)^{\beta^S}(\widehat{r}^H_n)^{\beta^H}}$ to increase disproportionately for municipalities closer to the bridge. Therefore, the distance to the bridge serves as a valid instrument for $\log \frac{\widehat{\widetilde{w}}_{n,t}}{(\widehat{P}^M_n)^{\beta^M}(\widehat{P}^S_n)^{\beta^S}(\widehat{r}^H_n)^{\beta^H}}$.

Table E.6 presents the IV estimates. We estimate Equation (E.34) using the sample excluding the Norrland area, which is far from the bridge. Since the bridge affects expected wages and living costs mainly in closer areas, it should be more relevant for workers born in nearby municipalities. Column (1) presents the OLS estimate of Equation (E.34). The coefficients are negative, contrary to our expectations, because the estimates are biased by the endogeneity issue. Column (2) presents IV estimates using the driving time to the bridge before construction as an instrument. The first-stage result indicates a significant negative relationship between distance to the bridge and the change in $\log \frac{\widehat{\widetilde{w}}_{n,t}}{(\widehat{P}^M_n)^{\beta^M}(\widehat{P}^S_n)^{\beta^S}(\widehat{r}^H_n)^{\beta^H}}$. The first stage of the IV estimation also passes the weak-identification test. As shown in Column (2), the second stage estimates the elasticity of migration to be approximately 4.135. We adopt $\epsilon^R = 4.135$ for subsequent analyses.

Table E.6: Estimation of ϵ^R

	(1)	(2)
	Sample Excluding Norrland Area	
	OLS	IV Second Stage
$\frac{\tilde{w}_{nd}}{P_{nd}}$	-2.382	4.135
	(0.239)***	(1.788)*
		IV First Stage
$\log DrivingTime2Bridge$		-0.00387
		(0.000127)***
Origin FE	YES	YES
N	18677	18677
Cragg-Donald Wald F statistic (Weak identification test)		503.0

Note: This table presents the estimation of Equation (E.34) using migration share data in Sweden. We exclude the Norrland Area as the Norrland Area is very faraway from the bridge and few people migrate to the south region before or after the bridge was built.

Standard deviations are reported in parentheses. Statistical significance is denoted by asterisks: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.