

# Trading Non-Tradables: The Implications of Europe's Job Posting Policy

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## JOB MARKET PAPER

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### Abstract

Are local services jobs, such as plumbers or drivers, sheltered from globalization? Posting policies, that were first introduced in the European Union, allow firms in one country to send (“post”) their workers to perform such services in another country. I combine novel administrative data on posting missions in Europe, quasi-experimental variations in the policy, and a model of trade in services, to evaluate the redistributive implications of exposing novel jobs to international competition. I show that the staggered liberalization of posting to low wage countries permanently increased trade in services in Europe: 2% of EU GDP is offshored “on-site” through posting, mostly in “non-tradable” sectors, while within-EU geographic mobility is twice as large once accounting for posted workers. In receiving countries, domestic employment in exposed sectors and local labor markets differentially decreased following the liberalization. These market-level employment effects are driven by posted workers being substitutes for domestic blue collar workers at receiving firms, and posting services being cheaper. I then demonstrate that posting openness triggered large economic gains in low-wage sending countries: firms in formerly “non-tradable” sectors increase their sales, profits and wages when accessing foreign markets through posting. Calibrating a model of trade in services with estimates of the posting elasticity, I finally quantify that the liberalization increased European consumers’ welfare by 0.3% on average. My results suggest that expanding the range of tradable jobs through posting policies, as proposed in several major recent trade agreements, hurts low-paid workers in high wage countries, benefits sending firms in low wage countries, and has small efficiency effects for consumers.

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*About 7.6 million Americans worked in construction (...) their jobs were not in danger of moving offshore. (You can't hammer a nail over the Internet.).*

— Alan S. Blinder in “Offshoring: The New Industrial Revolution”, Foreign Affairs (2006)

## 1 Introduction

Because *tradable* goods or services have traditionally been defined as produced in one country and consumed in another ([Grossman and Rossi-Hansberg \[2008\]](#), [Blinder and Krueger \[2013\]](#)), controversies surrounding winners and losers from globalization have so far focused on manufacturing (factories moving to China) or intangible services (call centers moving to India). Most workers in advanced economies, however, are employed in *non-tradable* industries, which consist of services provided locally. These drivers, caregivers, or plumbers are often considered sheltered from direct import competition, unlike manufacturing laborers ([Autor, Dorn, and Hanson \[2013\]](#)). Conversely, operating under the premise that firms in these sectors cannot access foreign markets, the analysis of export opportunities generally focuses on manufacturing businesses ([Bernard, Jensen, Redding, and Schott \[2007\]](#)).

This paper challenges this assumption by showing that non-tradable jobs can be offshored “on-site”, as novel trade policies allow foreign firms to perform services in the country of the customer’s residence. Exploiting the largest episode to date of trade liberalization in services, the European *posting* policy, I assess the implications of opening novel sectors to international competition for workers, firms, and consumers.

Posting was first introduced in the European Union (EU) in 1959, and broadly consists of temporary contracts performed locally by foreign firms. Under the posting policy, a firm located in France is allowed to subcontract a job to a firm located in Poland. Posted workers stay formally employed by the Polish (sending) firm but cross the border to perform the activity at the French (receiving) establishment. Unlike standard trade, the service exported by Poland is produced on France’s territory. Unlike standard migrants, posted workers are paid by the Polish firm and have no employment contract in France.

These novel offshoring transactions, that depart from canonical models of trade and migration, are quantitatively large, and increased dramatically over the past decade. Services exported through posted workers currently represent 30% of service offshoring in the EU, or 2% of EU GDP, while the number of workers posted abroad by service suppliers each year is *twice* as large as the number of within-EU migrants.<sup>1</sup> Posting flows within the EU have doubled since 2005, and grew even more in some destination markets: for instance, the number of service contracts performed by posted workers in France was 8,000 in 2000, but more than 600,000 in 2018.

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<sup>1</sup>See Eurostat statistics on within-EU trade in services (balance of payment definition), and the European Commission (2018) report on international mobility.

As the share of manufacturing in developed economies is shrinking while employment in services rises, many recent trade agreements, from the Asia Pacific Economic Cooperation (APEC) to U.S.-Mexico-Canada Agreement (USMCA), have proposed to liberalize posting as a way to pursue international integration, following the EU example.<sup>2</sup> Potentially, posting policies could allow receiving firms to access cheaper labor, sending firms to access new markets, and posted workers to benefit from higher wages. However, mounting protests from local workers and governments in receiving countries suggest the alleged benefits of these policies may not be uniformly shared.<sup>3</sup> Against this backdrop, the lack of reliable data on service flows has been an obstacle to the assessment of the welfare impacts of these policies.

I fill this gap by gathering novel social security information on workers posted abroad. To track the cross-border provision of services in Europe, I collect exhaustive social security posting forms aggregated at the bilateral level for all EU countries. To measure granular exposure of workers and firms to posting, I further assemble novel administrative registries on posted workers. In two major receiving countries (France and Belgium), I use exhaustive linked employer-employee data merged with information on a firm's use of posted workers. In two major sending countries (Luxembourg and Portugal), I use granular firm-level tax returns merged with information on the provision of posting services abroad.

Armed with these novel datasets, I answer four fundamental questions raised by this growing offshoring channel: (i) are firms and workers more exposed to globalization when services can be offshore “on-site”? (ii) in receiving countries, are domestic employees displaced by posted workers, and what are the gains derived by receiving firms? (iii) in sending countries, how much do firms and workers gain when accessing foreign markets through posting? (iv) overall, are there aggregate efficiency gains from allowing firms to offshore formerly “non-tradable” jobs through new generation trade agreements?

The first finding of my paper is that non-tradable services are effectively traded in substantial amounts through posted workers, making firm and worker exposure to globalization broader than previously thought. I start by showing that the liberalization of the posting policy to low-wage Eastern European countries between 2004 and 2013 permanently increased the offshoring of services within the EU. Exploiting the differential timing of liberalization across country pairs and a dynamic difference-in-differences

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<sup>2</sup>For the U.S, see for instance recent [USMCA negotiations](#) regarding the list of occupations for foreign employees allowed to temporarily enter in the U.S to provide services “on-site” or [Yost \[1996\]](#) for an early discussion on the scope for posting policies under the NAFTA. Posting policies have been recently implemented in ECOWAS, APEC or in [Argentina-Chile](#) bilateral agreement (see [IACML \[2015\]](#), p.22 for a debate on posted workers in Argentina). Worldwide, posting policies liberalize “mode 4 supply of services” in the WTO framework and are part of the general commitments for the trade liberalization in services in GATS. In the words of Lakshmi Puri, the Head of the UN trade in goods, services and commodities division, “Mode 4 is an area where developing countries stand to make clear gains (...) progress on mode 4 in the the GATS would allow developing countries to exploit their natural comparative advantages in international trade, including in labour as a factor of production.”.

<sup>3</sup>For instance, see [protests](#) against posted workers in the German meat processing industry. In the past, the fear of competition through the posting policy led French voters to reject the European Constitution in 2005 ([Perrineau \[2005\]](#)). More recently, conflicts regarding the posting policy led to a [political crisis](#) in Europe, as Emmanuel Macron has put reforming the policy high on the EU’s agenda, while Eastern and Southern European countries abstained over [concerns](#) that these reforms would hurt some of their industries.

model, I evidence that posting flows in affected country pairs increase immediately by 500% in the year of the liberalization event, without crowding-out standard migration. Services exported through posted workers are predominantly supplied by low-wage countries and almost exclusively imported by high-wage countries. Posting occurs in sectors commonly insulated from international trade, such as construction, cleaning or truck driving, and consists mostly of manual service tasks performed by blue-collar workers. In sending countries, firms in “non-tradable” sectors, such as temporary employment agencies or construction firms, export as much as commonly studied exporters, such as wine manufacturers or programmers.

The second finding is that the trade liberalization in services had negative employment effects for exposed workers in receiving countries. To estimate the effect of the posting policy on domestic employment, I combine the large and permanent supply shock caused by the liberalization of the policy to low-cost suppliers with French administrative data on posting inflows at the local and sectoral level. I start with a difference-in-differences strategy, exploiting the heterogeneity in French provinces’ exposure to the liberalization of posting, predicted by their spatial exposure to the posting scheme *before* the reform. While following parallel trends during the ten years preceding the reform, exposed domestic employment in high exposure provinces decreases differentially by 6% after the liberalization compared to labor markets less exposed to the shock. Leveraging all variations in imports of services across provinces, I estimate that moving from the 25th to the 75th decile of exposure to the supply-driven component of posting inflows after the reform decreases the share of working age population employed in exposed sectors by 1.5 percentage points. Turning to the overall local labor market effects of the reform, I find no evidence that workers differentially migrated away from exposed provinces after the liberalization. Domestic employment in occupations sheltered from posting competition did not evolve differentially after the import shock, suggesting displacement effects in exposed industries were not followed by a large reallocation of domestic workers within affected provinces. As a result, unemployment remains permanently higher in provinces more exposed to imports of posting services, emphasizing the long-lasting effects of posting policies on exposed local labor markets. Those results are remarkably close to the local labor market effects of standard manufacturing import shocks ([Autor et al. \[2013\]](#)), suggesting that the adverse effects of trade on workers have also been noticeable through the novel trade-migration channel documented in my paper.

I explain these market-level employment effects in exposed industries by two main mechanisms at the receiving-firm level. I first investigate the evolution of domestic employment at firms that offshore services through posting. Using an event study design comparing firms that start purchasing posting services to firms that are yet to offshore, I show that receiving firms significantly scale down their domestic employment when they start outsourcing tasks to posted employees. Those effects are exclusively driven

by offshored tasks that are similar to those performed by domestic workers at the receiving firm, suggesting that posted workers can be used as substitutes for domestic, blue collar workers.

I then show that displacement effects can also be rationalized by receiving firms lowering labor costs through the use of posting services. While administrative measures of inputs and outputs' prices at offshoring firms are usually hard to come by, payroll tax data allow me to compare wages of domestic and posted workers. I first show that firms using posting services are those initially paying a higher wage premium to their domestic employees, consistent with cost-saving motives of posting. Posted workers are paid 30% less than comparable domestic incumbent workers at the same workplace, a wage penalty twice larger than for domestic temporary agency workers, suggesting that the posting policy was used by high-wage firms to economize on labor costs.<sup>4</sup>

The third finding is that the posting policy triggered large but unequally distributed economic gains in sending countries. Availing myself of granular firm-level data from a major sending country, Portugal, I use an event study design comparing firms posting services abroad to either matched control firms in sectors without posting opportunities, or to future posting firms. Firms undergo a significant scale-up in their activity once they access foreign markets through posting, with turnover, employment, wages, profits, and cash balances rising immediately after they start providing non-tradable services abroad. The large export-mobility surplus is unequally shared between workers and capital-owners: profits increase by 37% after a posting event, while wages rise by 14%. Posted workers' wage gains are entirely accounted for by destination-level minimum legal wages rather than surplus sharing at sending firms. The posting policy generates a positive fiscal externality for sending governments: sending firms pay more social security contributions and corporate taxes when they start supplying services abroad. Given the size of the export-mobility opportunities opened by the posting policy, low-wage countries with a competitive advantage in services have large incentives to lift barriers to cross-border provision of services.

To gauge the magnitude of the export gains triggered by trade liberalization in services, as compared to standard trade in goods liberalization, I repeat the analysis for manufacturing exporters in the same dataset. I find that gains from posting opportunities are of similar magnitude to gains from exports of goods, the usual focus of industrial policy. However, their incidence is substantially different, distinguishing the redistributive implications of posting policies from traditional trade instruments. Firms benefitting from the novel integration channel induced by posting are significantly smaller, younger, less capital intensive, and less profitable, than manufacturing exporters. While manufacturing firms benefit from permanent effects of international integration through exports ([De Loecker \[2007\]](#), [Atkin, Khandelwal, and](#)

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<sup>4</sup>This finding holds after controlling for workers' permanent characteristics, as workplace premia for posted workers at receiving firms are 53% lower than for domestic employees. The pass-through of regular firm fixed effects in wages to posted workers is almost nil, with an estimated elasticity of 0.1 (0.01).

[Osman \[2017\]](#)) or supply chains integration ([Alfaro-Ureña, Manelici, and Vasquez \[2019\]](#)), I show that sales growth among services exporters does not last beyond the end of the posting mission, and there is no long-lasting effect on investment or profitability. My results thus suggest that services are characterized by weaker scope for productivity gains and “learning by exporting” than standard manufacturing.

Finally, I quantify the efficiency gains from new generation trade agreements in services. To this end, I calibrate a model building on [Eaton and Kortum \[2002\]](#) and [Arkolakis, Costinot, and Rodríguez-Clare \[2012\]](#), where manual services can be traded through posting.

I consider the liberalization of the posting policy to low-wage countries as my main experiment. The model yields a tractable formula to measure changes in real wages from the trade liberalization in services, accounting for general equilibrium effects in the service sector. Applying the [Dekle, Eaton, and Kortum \[2008\]](#) “exact hat algebra” to my set-up, welfare effects can be obtained from current posting service flows, the elasticity of these flows, and a measure of the liberalization shock. I observe the first empirical moment, and identify the other two fundamental parameters with policy variations. In place of standard import tariffs, I use payroll tax and minimum wage reforms to estimate the structural elasticity of posting service flows. Combining quasi-experimental evidence with a theory-consistent estimation strategy, I find that the posting elasticity lies between 1.3 and 1.6 in the reduced-form settings, with a median estimate of 1.1 in the structural gravity estimation. Using the structure of the model and these estimates, I can convert the reduced-form effect of the liberalization shock into the structural policy shock needed for the counterfactual analysis.

The liberalization shock, or decrease in trade costs of services for low-wage countries, acts as a positive productivity shock in the model, allowing all countries to source services from newly available suppliers. My calibration shows that after accounting for general equilibrium effects, liberalization increased welfare for consumers of services by 0.3% on average in Europe. This effect masks heterogeneous gains: sending low-wage countries such as Slovenia, Croatia, or Slovakia emerge as the main winners of the liberalization, while countries such as France or the Netherlands derived much smaller gains. While the finding of small aggregate consumer gains from trade liberalization is close to what has been found for manufacturing, it is explained by two countervailing forces. On the one hand, posting services represent a small share of the overall expenditures of European consumers, as compared to imported goods. This small “share effect” is however counterbalanced by a much more limited substitutability of foreign and domestic services relative to standard traded goods. I estimate that the structural elasticity of posting services is four times lower than the usual trade elasticity ([Head and Mayer \[2014\]](#)), providing a key parameter to inform current policy discussions of further trade liberalization in services.

This paper relates to several strands of research. First, it expands the standard concept of offshora-

bility usually based on job's requirement of face-to-face contact and geographic proximity (Helpman and Krugman [1985], Blinder [2006], Grossman and Rossi-Hansberg [2008], Blinder and Krueger [2013], Goos et al. [2014], Jensen et al. [2005]).<sup>5</sup> I show that posting policies lead the scope of globalization to be substantially larger than previously thought.<sup>6</sup> This paper thus provides an empirical counterpart to Saint-Paul [2007], who theoretically studies the political economy of trade policies widening the range of tradability. By documenting the magnitude and consequences of a new type of trade agreements in services (or mode 4 of service supply in the WTO classification), my paper complements the theoretical literature on trade agreements in services (Francois and Hoekman [2010], Antràs and Staiger [2012], Staiger and Sykes [2021]) or non-tariffs trade instruments (Grossman et al. [2021]).<sup>7</sup> On the empirical side, recent papers have assessed the magnitude of international integration in Europe (Dorn and Zweimüller [2021], Head and Mayer [2021]). My findings emphasize that posting flows must be integrated to more standard measures of international trade and migration to measure globalization accurately. Identifying trade in services through payroll tax information on posted workers, my research also fills a major gap on the measurement of trade in services at the micro level (Francois and Hoekman [2010]).<sup>8</sup>

Second, my paper provides novel evidence on the labor market effects of immigration, trade and outsourcing. A large literature studies the effects of immigration on domestic workers' employment and earnings, establishing that displacement and wage effects tend to be moderate or non-existent (Butcher and Card [1991], Ottaviano and Peri [2012]).<sup>9</sup> In contrast, the surging literature on local labor market exposure to import competition finds that manufacturing employment is heavily affected by foreign competition (Autor et al. [2013], Autor et al. [2014], Choi, Kuziemko, Washington, and Wright [2021]), and that the reallocation of workers following trade shocks can be slow (see Dix-Carneiro [2014], Kambourov [2009] or Dix-Carneiro and Kovak [2019] for instance). Liu and Trefler [2019] also investigate the occupation-level effects of services offshoring and insourcing between the US and China and India and find small effects in a context where trade in services mostly consists of services exchanged electronically. A substantial amount

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<sup>5</sup>To measure the extent of services tradability, Jensen et al. [2005] for instance look at the geographic concentration of service activities in the United States to identify industries and occupations that appear to be traded domestically. The intuition follows Helpman and Krugman [1985], where the production of non-tradable services should be distributed equally across space as compared to tradable goods. Based on geographic concentration in the U.S., Jensen et al. [2005] find that occupations in construction, maintenance or transport appear as the least tradable services, contrary to what is observed in the novel datasets on posting flows.

<sup>6</sup>I this contribute to the literature on complementarity between migration and trade, starting from Mundell [1957]. Recently, Caliendo, Oromolla, Parro, and Sforza [2017] consider the joint effect of trade and migration liberalization on overall welfare in Europe.

<sup>7</sup>Staiger and Sykes [2021] provide a recent characterization of trade agreements in services by mostly focusing on trade in services through commercial presence abroad (mode 3 supply of services under the WTO general classification). Those service flows are not accounted for in the standard balance of payment measures of service trade because they occur through FDI and the transaction does not "cross the border".

<sup>8</sup>By assembling novel administrative data on the posting of workers, I also relate to De Wispelaere and Pacolet [2017], De Wispelaere and Pacolet [2019], that describe the evolution of posting of workers in Europe.

<sup>9</sup>Dustmann et al. [2017] find important employment effects in a context that is closer to mine: short-term workers who do not live and consume in the area.

of work has investigated firm-level effects of offshoring practices in both manufacturing (Bernard et al. [2020], Hummels et al. [2014]) or tradable services (Crino [2010], Becker et al. [2013], Eppinger [2019]).<sup>10</sup> A nascent and growing literature finally studies the outsourcing of tasks to (domestic) temporary employment agencies and finds substantial negative wage effects for outsourced workers (Bilal and Lhuillier [2020], Drenik et al. [2020], Goldschmidt and Schmieder [2017]). Bringing these four bodies of research together, I show that the trade-migration flows triggered by the liberalization of trade in services impose large adjustment costs on domestic, blue-collar employment, both at the industry and receiving-firm level. Similar to what has been found for manufacturing imports, trade shocks for “on-site” services are not followed by a smooth reallocation of domestic workers across sectors, and have long-lasting effects on exposed labor markets. Similar to the mechanisms at play with standard outsourcing, “trading non-tradables” partially works by eroding the wage premium of workers in high-wage countries and firms through the use of foreign suppliers of services that pay even lower wages than domestic temporary employment agencies.

Third, this paper contributes to our understanding of granular gains from international integration, a topic of research usually focused on manufacturing firms (De Loecker [2007], Atkin et al. [2017] for trade, Alfaro-Ureña et al. [2019] for global value chains).<sup>11</sup> I show that new generation trade agreements liberalizing trade in services through temporary migration generate gains of similar magnitude to more standard integration channels for firms in sectors formerly insulated from international trade. While the firms benefitting from this novel class of trade instruments are smaller, younger and less capital intensive than standard exporters (Bernard et al. [2007]), these gains are however more temporary, suggesting that unlike manufacturing industries, non-tradable sectors exhibit a weaker scope for productivity gains. Studying wage gains for workers at firms exporting non-tradable services, my results also help to characterize the effects of trade policies for workers in exporting countries.<sup>12</sup> I evidence a new channel through which workers can benefit from trade liberalization: because of the unique export-migration intersection introduced by trade in non-tradables, posting policies can enforce destination-level minimum legal wages and generate direct wage gains for workers posted abroad.

Finally, I extend the “gains from trade” approach developed by the seminal paper of Arkolakis, Costinot,

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<sup>10</sup>Firm-level evidence mostly focuses on the offshoring of standard “tradable” services, rather than the new form of trade through temporary migration studied in this paper. Crino [2010] focuses mostly on trade in services through electronical mean (mode 1) in the U.S and its effects on white-collar employment. Eppinger [2019] for instance focus on “tradable commercial services” offshored by Germany, mostly to high-income countries. Recently, Ariu et al. [2021] also focus on imports of mostly standard “tradable” services in Finland and find a decrease in low-skill employment at manufacturing firms.

<sup>11</sup>Some studies have also emphasized the interplay between trade in services and trade in goods. Bernard and Fort [2015] for instance show that manufacturing firms in the U.S increasingly rely on imported goods while specializing in the production of new services domestically. Ariu, Mayneris, and Parenti [2020] show that the production and exports of goods and services can be complementary. As they document, the simultaneous exports of services and goods mostly concerns firms that primarily produce goods (e.g manufacturing firms). In my set-up, I find that firms exporting non-tradable services through posting policies very rarely export standard goods.

<sup>12</sup>See Goldberg and Pavcnik [2005] for Colombia, Facchini et al. [2019] for China or McCaig [2011] for Vietnam.

and Rodríguez-Clare [2012]) to service industries.<sup>13</sup> My results outline that the general equilibrium gains from posting policies are driven by different forces. In particular, manual services are characterized by smaller structural elasticities than imported goods (Head and Mayer [2014]), leading to different efficiency implications for similar consumption shares.<sup>14</sup>

The rest of the paper is organized as follows. Section 2 describes the institutional framework of posting policies in the European Union and describes the data used in the analysis. Section 3 documents novel facts on exposure to globalization. Section 4 explores the consequences of posting policies for firms and workers in receiving labor markets, and Section 5 estimates export surpluses in sending countries. Section 6 quantifies the aggregate consumer gains following the trade liberalization of services, and Section 7 concludes.

## 2 Institutional Framework and Data

### 2.1 On-Site Offshoring and New Generation Trade Agreements

This paper documents a trade mobility channel where firms' cross-border services supply relies on workers' mobility across space. Posting policies broadly consist in temporary contracts performed locally by foreign firms. To export non-tradable services, foreign suppliers temporarily send their employees abroad to perform a service mission, a phenomenon I call *cross-border provision of services* or *on-site offshoring*. Services suppliers are not physically located in the receiving country: the service is accounted for in the sending country's production while being performed abroad.<sup>15</sup>

We usually describe standard international trade as an exchange of good or service that is produced in one country while being consumed in another country. Posting policies departs from the canonical conceptual framework of trade in services, where a task is produced remotely in a foreign country and is then imported by electronic means by domestic entities. Services exported through posted workers are

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<sup>13</sup>A number of quantitative papers have used the reduced form effects of trade shocks to calibrate general equilibrium gains from trade accounting for distributional effects of trade exposure, such as Adao et al. [2019a], Caliendo et al. [2019] or Galle et al. [2021]. These models usually combine Roy models of the labor market with a gravity model of trade to get to the distributional effects of trade shocks. More closely related to my calibrations, Hsieh and Ossa [2016] or Amiti et al. [2017] focus on the overall price effects of liberalizing trade from China.

<sup>14</sup>I thus contribute to the large literature on the effects of traditional trade instruments on trade flows. Francois and Hoekman [2010] stress that while the literature on standard service trade and policy is growing, there is still no evidence on cross-border services supply due to a lack of data. Assembling an array of new datasets on trade mobility flows allows me to fill this gap and to estimate the distinct responsiveness of services' trade. My estimates thus also contribute to a small but growing body of literature, recently surveyed in Kleven, Landais, Munoz, and Stantcheva [2020], that establishes that top-income workers react to taxation through international migration. I extend this result to the international mobility of blue collar workers intermediated by firms.

<sup>15</sup>A service performed by a services supplier located in country A in the territory of country B through posted workers will be accounted for in country A's GDP and exports country B's imports. It has a different incidence compared to FDI (mode 3 services supply), where foreign firms open an establishment in a receiving country. In that case, foreign establishment's sales are included in destination-level GDP, not origin-level GDP.

performed by a foreign supplier *in the territory* of the domestic consumer. The services involved in these transactions cannot be exchanged by electronic means, for example, cleaning or plumbing.

The international mobility of employees triggered by trade in services is also conceptually different from standard migration. Posted workers do not change their residence country, in contrast with immigrants who integrate their receiving country's labor market.<sup>16</sup> Posted workers have no employment contract nor tax liability in the receiving country, while standard immigrants are hired "on-site" like other domestic workers.

Export of services through posted workers is called *mode 4 service supply* in the WTO general framework for trade in services. Posting policies regulating these novel trade-migration flows have thus been discussed in most of recent trade agreements, and are systematically negotiated in multilateral GATS (*general agreements on trade in services*). Because of the unique intersection between foreign services provision and consumer location that is absent in standard trade, posting policies imply that receiving countries choose what taxes, entry, and regulations apply to posted workers in their territory. As noted by [Bhagwati et al. \[2004\]](#), when trade in services was brought into the fold of international trade rules via the General Agreement on Trade in Services (GATS), trade in services through temporary migration (posting) was the most controversial. In their words, "at the time, developed countries opposed the inward movement of people through mode 4, while developing countries pushed for the liberalization of Mode 4 services, which offers their unskilled populations the possibility of offering services in developed countries."

## 2.2 The European Laboratory: Posting Policy

Established in 1959, the EU posting policy allows firms located in the territory of one member state to send their workers in any other member state to perform a temporary service mission, without having to open an establishment in that country. Posted workers can be employees posted by their permanent employer, by a temporary employment agency, or between firms of the same group. Firms are allowed to hire workers for the sole purpose of posting them; self-employed workers can also post themselves abroad.

The posting policy, described in Figure A.1, further determines what taxes and regulations apply to these novel migration trade flows in the receiving country. Receiving countries must grant large exemptions to posted workers: sending firms only have to pay payroll taxes in the sending country.<sup>17</sup> Posted workers are also not liable to most employment regulations in the receiving country. However, to combat social dumping and prevent distortion of competition, the EU provided posted workers with a legal right

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<sup>16</sup>Posted workers are therefore not accounted for in destination-level employment and economic statistics. Another difference is that posting flows are only driven by firms' transactions. Unlike standard migration, posting flows should not be explained by non-economic factors that affect permanent location choices of individuals.

<sup>17</sup>Sending firms pay the corporate income tax in the country of origin, while the VAT on the service mission is paid by the client in the receiving country.

to the *basic minimum* rights and conditions in receiving countries. Since 1996, posted workers have thus benefited from destination-level minimum legal wages and maximum work durations. In receiving countries without a minimum legal wage, and for the self-employed, the prevailing minimum pay rule does not apply. Since 2020, posted workers must receive the same *pay* as domestic employees at the receiving firm and are covered by some collective labor agreements.

While the posting policy is meant to regulate “temporary” services provision between member states, there is not a legal limitation to posting mission. The sending firm must, however, have a “substantial” activity in the country of establishment. Exemptions from receiving payroll taxes are also granted for a limited duration: 12 months until 2010, 24 months from 2010-2020, and 18 months since 2020.<sup>18</sup> If firms located outside the EU want to provide a service in the EU, they must obtain a work authorization and temporary visa for each of their workers. In some cases, they must open an establishment in the destination country, and are not able to use cross-border provision of services.

Receiving countries have no right to refuse the foreign intervention of supplier of services in their territory, but can control that the posting mission follows the rules established by the EU posting policy.

## 2.3 Data

The lack of evidence on cross-border provision of services can be traced to the absence of reliable data to measure these novel trade-migration flows. This subsection discusses the novel administrative datasets on postings within the EU that fill this gap. Datasets are summarized in Table A.1 and Table A.2 and are described in separate data appendices.

### 2.3.1 Europe-Wide Dataset on Bilateral Posting Flows

The first dataset leveraged for the analysis builds on administrative social security certificates E101/A1 issued for each posting mission within the EU. This certificate is a mandatory document that posted workers must hold during their mission to prove their affiliation to their sending country’s social security system.<sup>19</sup> The posting certificates are issued by sending countries and are linked to the work mission rather than to the worker: a unique worker may be linked to several posting forms. One E101/A1 form identifies simultaneously a flow of a worker moving abroad and a service mission export.

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<sup>18</sup>Until 2010, labor tax exemptions could be renewed without restrictions. Since 2010, these exemptions are only granted for a new posting mission if two posting periods involving the same worker, sending and receiving firms are separated by a two-month break.

<sup>19</sup>The absence of the E101/A1 social security forms implies a fine for services supplier and receiving firms and can lead social security contributions to be paid in both sending and receiving countries. The E101/A1 only concerns trade-related mobility within the EU and does not apply to postings from outside the EU. As these flows are very heavily regulated, they are, however, very small, as shown in the rest of this paper.

Using exhaustive information on issued posting forms by receiving countries for each sending member state each year collected from the EC, I build the full matrix of bilateral posting flows from 2005 to 2017.<sup>20</sup> I merge this dataset with measures of countries' wages, employment and GDP from Eurostat. The final dataset allows me to track yearly bilateral posting service flows within the EU from 2005 to 2017 with joint information on sending and receiving countries' income.<sup>21</sup> That dataset allows me to recover standard "gravity" information on bilateral trade-in-services in Europe, overcoming two major measurement challenges usually faced by trade economists. First, unlike for standard exports, social security forms do not have a minimum declaration threshold: I thus have limited missing flows in my dataset.<sup>22</sup> Second, while services' transactions are usually poorly measured due to their intangible nature, payroll tax information on posted workers helps reconstruct reliable administrative records of trade in services.

To quantify the *monetary value* of service trade through posting, I use additional data on within-EU trade in services through the posting of workers abroad collected from Eurostat for 2017.

### 2.3.2 Country-Level Micro Data on Posting

To measure granular exposure of firms and workers to the posting policy, I complement the EU-wide posting dataset with micro administrative data on posting in six countries.

**Administrative Registries of Posted Workers in Receiving Countries** Linked employer-employee data in receiving countries allow me to study the consequences of posting for domestic workers. I use administrative registries on incoming posted workers in receiving countries where these registration requirements exist: France and Belgium, which are the top second and third importers of posting services.

All firms that post their employees to France (respectively, Belgium) to perform a service are required to file a DPD/SIPSI (respectively, LIMOSA) posting declaration. If the declaration is missing, both sending and receiving firms are liable to sanctions and fines and the posting mission is interrupted. For France, I use exhaustive received posting declarations by province-year-sector from 2000 to 2015 and disaggregated declaration data for 2017-2020. For Belgium, I use the universe of disaggregated posting declarations for 2010-2020. While the LIMOSA and DPD/SIPSI are separate datasets, they have the same structure and are based on similar declaration requirements, hence I describe them in the same section.

In each datasets in each of these two receiving countries, I use the unique receiving firm identifier to link posting registries with linked employer-employee and balance sheet administrative data on domestic

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<sup>20</sup>Historical data on E101/A1 forms also exist for the 1988-2000 period but are aggregated for the entire EU.

<sup>21</sup>To document the relationship between labor cost and posted worker flows, I also merge this dataset with measures of employers' labor cost measured by Eurostat in each member state from 2009 to 2017. The final dataset allows me to track yearly bilateral posting service flows within the EU from 2009 to 2017 with joint information on sending and receiving countries' wages, employer payroll taxes, and minimum legal wages.

<sup>22</sup>Silva and Tenreyro [2006] discuss the issue of missing or zero flows in standard trade datasets.

workers and receiving firms.<sup>23</sup> I can identify which firm purchased a service performed by posted workers, which foreign supplier and posted workers performed this mission, and detailed information on the posting mission. The final merged datasets allow me to observe jointly posted and domestic workers' hours of work, tenure, wages, occupation, and demographics and to link them to their common workplace in receiving countries.<sup>24</sup> To summarize, I observe: (i) all local-sectoral-year inflows of posting services in France from 2000 to 2015 (ii) all granular purchases of posting services by French firms from 2017 to 2020 with detailed information on domestic, posted workers and the posting mission and (iii) all granular purchases of posting services by Belgian firms from 2010 to 2020 with detailed information on domestic, posted workers and the posting mission. The datasets are further described in the [Online Appendix](#).

In Germany, all companies posting workers in the construction sector must pay a compulsory contribution to the national fund for holiday leave, SOKA-BAU. I use data provided by SOKA-BAU on the universe of workers posted to the construction sector in Germany since 2000.

In Austria, all companies that post workers in the construction sector must contribute to the national fund for holiday leave by making a payment to the national building union BUAK. I use data provided by BUAK on the universe of workers posted to the construction sector in Austria since 2006.

**Administrative Registries of Posted Workers in Sending Countries** Firm-level administrative data in sending countries allow me to analyse services export gains for sending firms and posted workers.

I use administrative employer-employee data on the universe of workers employed in Luxembourg merged with information on posting social security forms at the worker level for 2002-2019.<sup>25</sup> I observe all job spells in Luxembourg for posted and domestic workers, together with detailed information on employers, employees, and jobs characteristics, such as wages, tenure, hours of work, employer's two-digit sector code, and employee demographics. This dataset is described in the [Online Appendix](#).

To obtain granular data on posting companies and their performance, I finally leverage administrative tax data on firms in Portugal, one of the top exporters of posting services. The dataset provides detailed information on firms' five-digit sector code, wages, employment, investments, sales, and other balance sheet components. Each year, firms established in Portugal report to the tax administration the amount of services performed abroad by the geographical market of destination. I use this information to identify the universe of Portuguese firms that supplied posting services in another EU country between 2006 and

<sup>23</sup>All domestic registries on firms and workers are listed in Table A.2 and in the [Online Appendix](#). The matching procedure is described with extensive details in each separate data appendix as well.

<sup>24</sup>Extensive information on the posting mission include duration of the work mission, location of the work performed, and whether the foreign supplier provided food/housing to the posted workers. Posted workers' wage is only observable in the DPD/SIPSI dataset (France), as the Belgian authorities do not keep this information.

<sup>25</sup>Because small countries are more exposed to trade, Luxembourg has one the highest postings-to-employment ratio.

2017.<sup>26</sup> The [Online Appendix](#) provides more detail on the dataset.

### 3 Trading Non-Tradables: Who is Getting Globalized?

In this section, I use my datasets on posting in Europe to document two core facts that motivate my analysis: (i) globalization is larger once we account for the novel trade-migration flows caused by the posting policy, and (ii) it has a radically different incidence compared to standard trade and standard migration.

#### 3.1 Globalization is Larger Once Accounting For Posting Flows

##### 3.1.1 Rethinking Standard Measures of Globalization

I start by assessing briefly the current magnitude of export of services through posted workers in Europe. Data on export of services through posted workers within the EU suggest that posting transactions are currently worth around 280 billion euros in 2017; which accounts for 27% of overall trade in services within the EU and roughly 10% of within-EU manufacturing trade (Figure 1, Panel A). Interestingly, these computations suggest that cross-border exchanges of services through posting of workers are as large as financial and ICT services between European countries, the usual focus of trade in service policies. Overall, these numbers suggest that almost 2% of EU GDP is additionally traded through the novel migration-trade channel opened by the posting policy.

Cross-border provision of services also affects measures of international mobility of workers. My administrative datasets allow me to compare the number of *unique* workers posted abroad with the number of *unique* working immigrants in receiving countries. Using administrative data on incoming posted workers and migrants in France, I show that incoming flows of (unique) posted workers account for almost 70% of all unique foreigners entering in the French labor market each year (Figure 1, Panel B). Turning to the entire EU, comparing flows of posted workers with the number of workers changing their residence country each year to work abroad, I show that trade-related mobility flows are *twice* as large as international migration flows of workers within the EU (Figure 2, Panel B).<sup>27</sup> Our standard measures of international mobility of workers and trade in factors thus appear to be severely biased downward.

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<sup>26</sup>The dataset also includes information on manufacturing exports, allowing me to compare non-tradable services exporters to standard manufacturing exporters.

<sup>27</sup>This is consistent with the lastest estimates of the European Commission (2018) report on intra-EU labor mobility that gives an estimate of 1.8 million posted workers against 1 million within-EU movers, including children, retirees, students and non-active working-age individuals.

### 3.1.2 Causal Effect of the Posting Policy on Trade-Migration Flows

After showing that the posting of workers account for a substantial share of standard international (trade and migration) flows, I turn to the causal effect of the posting policy on cross-border service trade.

I focus on the transition from quasi-autarky to full liberalization of cross-border service trade for 13 new EU member states (henceforth NMS) from 2004 onwards. Postings from non-EU to EU countries face entry barriers and are regulated as in other free trade areas. When a country is an EU member, entry restrictions for its firms' employees are lifted in all other EU countries. The EU enlargements of 2004, 2007, and 2013 triggered the service trade liberalization for successively 10 (Poland, Lithuania, Hungary, Estonia, Latvia, Slovakia, Slovenia, Czech Republic, Malta, and Cyprus), 2 (Bulgaria and Romania), and 1 (Croatia) low wage countries located in Eastern Europe (Figure A.2, Panel A).<sup>28</sup> Different timings of the liberalization for workers posted from these countries were further allocated to different receiving countries by the EC. Austria and Germany kept the pre-enlargement entry restrictions in some sectors for the seven years that followed EU accession events.<sup>29</sup> All other EU countries had to grant free access to services suppliers from new member states right after each EU accession event. The timing of services' trade liberalization events is exemplified in Figure A.2, Panel B. Importantly, in most cases, the timing of posting liberalization reforms differs from the timing of standard migration liberalization for NMS.<sup>30</sup>

To estimate the causal effect of the posting policy, my identification strategy uses a triple differences approach where I compare posting flows from treated versus control countries before and after services' trade liberalization to countries that did or did not lift entry barriers. The origin-destination staggered dimension of these reforms allows me to effectively control for any unobserved posting determinants that vary at the country-by-year level. For instance, Poland's entry in the EU in 2004 may enhance its economic relationships with France, which could in turn increase posted worker flows from Poland to France in 2004. I control for origin-year and destination-year fixed effects to filter out these confounders.

One may be concerned that the timing of the service trade liberalization in a given origin-destination country pair is correlated with the future evolution of posting flows in that country pair after the event. For instance, if countries lifted entry restrictions right after EU accession because they expected to receive more service flows compared to countries that kept the restrictions, my estimates could be biased upward. The EC held posting restrictions in Austria and Germany because these countries were "at risk" to be heavily

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<sup>28</sup>These 13 countries represent 20% of the current EU population.

<sup>29</sup>The sectors that kept posting restrictions were in Germany: construction, industrial cleaning, and interior decorators; and in Austria: horticulture, stone cutting, metal structure manufacturing, construction, security activities, industrial cleaning, home nursing, and social work

<sup>30</sup>For instance, France lifted entry restrictions for posted workers from NMS of 2004 in 2004, but kept entry restrictions for standard migrants until 2008. Similarly, Belgium opened its labor market to workers posted from NMS of 2004 in 2004, while migrants were only able to come in 2009. I exploit these differences to document potential substitution between posting and standard migration.

affected by foreign suppliers' competition from lower cost countries.<sup>31</sup> If any, keeping entry barriers at EU accession is correlated with expecting large posting inflows compared to other receiving countries, leading my estimates to be biased downward. The inspection of pre-trends before the event will allow me to test directly whether posting flows from treated versus control countries evolved differentially before the event. Ultimately, the inclusion of origin-year and destination-year fixed effects controls for potential demand shocks that would be simultaneously correlated with (or even cause) the decision to open labor markets to posted workers.

To observe posting flows from NMS *before* the posting policy, I use data on posting flows in receiving countries that have a country-level registration tool: France, Belgium, Austria, and Germany, that are the top four importers of posting services in EU and represent roughly 60% of all imported flows.<sup>32</sup> Figure 3 illustrates how postings from countries treated by the service trade liberalization event (red series) evolved compared to postings from countries not affected by it (blue series), before and after the reform (vertical red line). In the six country-level experiments, postings from treated and control countries do not exhibit differential trends before the reform. Panels A, C, and E show that posting flows increase immediately after mobility barriers are lifted at EU accession. In countries where restrictions are kept, no differential evolution of posting flows is observed at EU accession, while postings from treated countries start to differentially increase when regulatory entry barriers are lifted later on (Panels B, D, and F).

To pool all entry reforms, I estimate a dynamic staggered difference-in-differences model:

$$\ln S_{ijt} = \alpha_{ij} + \alpha_{jt} + \alpha_{it} + \sum_{k=c}^{\bar{c}} \beta_k D_{ijt}^k + \varepsilon_{ijt}, \quad (1)$$

where  $S_{ijt}$  is the number of postings from country  $i$  to country  $j$  at time  $t$  and  $\alpha_{ij}$  is an origin-destination fixed effect. The treatment is defined as country  $i$  gaining the right to post workers without entry restrictions to country  $j$  at time  $t$ . I define the event dummy as  $\mathbb{1}.[t = d_{ij} + k]$ , where  $d_{ij}$  is the year at which country  $j$  lift mobility barriers for employees sent from country  $i$ .  $D_{ijt}^k$  is equal to one for treated country pairs in year  $k$  of the liberalization event while is equal to zero for country pairs that are never or yet to be affected by a liberalization reform. Including origin-year and destination-year fixed effects controls for all time-varying factors in sending and receiving countries that affect the equilibrium level of bilateral posting flows. I normalize  $\beta = -1$ , set  $\underline{C} = -5$  and  $\bar{C} = +9$  and  $D_{ijt}^{\bar{c}} = \mathbb{1}.[t = d_j \geq \bar{C}] \times \mathbb{1}.[T_i = 1]$  and  $D_{ijt}^c = \mathbb{1}.[t = d_j \leq \underline{C}] \times \mathbb{1}.[T_i = 1]$ . I estimate Equation (1) using the OLS two-way fixed-effects estimator

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<sup>31</sup>The geographical proximity between Austria and Germany and the 10 new member states of 2004 was the key argument for allowing some services sectors in these receiving countries to be "protected" from the service trade liberalization at EU accession.

<sup>32</sup>Unlike the A1/E101 data, country-level registration tools record postings from non-EU countries. The [Online Appendix](#) shows postings from new member states using the E101/A1 dataset. For Germany and Austria, I focus on postings to the construction sector (recorded in BUAK and SOKA-BAU datasets), as the liberalization only affected a subset of sectors including construction in these countries.

and the [De Chaisemartin and d'Haultfoeuille \[2019\]](#) estimator accounting for heterogeneous treatment effects. I also estimate Equation (1) in its multiplicative form, using a Poisson Pseudo Maximum likelihood (PPML) estimator to account for potential biases induced by the log transformation, following [Silva and Tenreyro \[2006\]](#).

The coefficient of interest estimated from Equation (1) compares postings between country pairs that are treated by a posting liberalization reform in event year  $k$  compared to postings between country pairs that are never or yet to be treated by such a reform.<sup>33</sup> I plot the series of estimated  $\beta_k$  and their 95% confidence intervals in Figure 4, and report the estimates in Table 1.

I find no evidence of differential pre-trends, which indicates that the timing of the liberalization reform is not correlated with differential evolution of postings between control and treated country pairs before mobility barriers are lifted. The Fstatistic for joint significance of treatment effects before the reform is 0.32 (p-value of 0.802). The number of workers posted from countries that benefit from the the posting liberalization reform starts to increase right after the event, indicating that the reform causally increases cross-border services supply. The estimated treatment effects are large and statistically significant at the 1% level. Posting flows between treated country pairs increase by 500% the year of the liberalization event relative to the year before, and the effects last permanently after the end of posting restrictions. The estimated trade-migration effects of the posting policy are unchanged by the inclusion of origin-year and destination-year fixed effects that filter out the overall effects of EU accession for NMS. Using alternative estimators accounting for heterogeneous treatment effects across events, or using the PPLM transformation, leaves the estimates unchanged. Figure 4 confirms that the posting policy causally affects trade-migrations flows, and that the liberalization of posting mobility from 2004 onwards dramatically increased cross-border service trade in the EU. I refer to this episode as “liberalization” in the rest of the paper.

A natural question raised by Figure 4 relates to crowding-out effects of the posting policy on standard migration. To understand if posting and migration flows are substitutes, I exploit the fact that most countries liberalized posting and migration flows in different years. In Figure A.5, Figure B, I estimate posting flows responses to bilateral migration reform events in place of posting reforms. Posting flows do not react to the migration reforms, suggesting posting is not used as a substitute for standard migration. Hence, baseline results are unchanged when controlling for bilateral migration reforms implemented in different years than posting reforms (Figure A.3, Panel B). That is consistent with migrants being very different in terms of characteristics compared to posted workers, as showed in Figure A.5, Panel A.<sup>34</sup> I further show in Figure A.3, Panel A, that the estimated effects of the liberalization reform are robust to excluding events

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<sup>33</sup>For instance, it compares how posting flows from Poland to France evolved in 2005 (one year after the liberalization event for France-Poland) compared to the evolution that is observed the same year for postings from Spain to France (never affected by an entry liberalization reform over the estimation periods and treatment window) and from Poland to Germany (yet to be affected).

<sup>34</sup>The [Online Appendix](#) discusses the question of complementarity between posting and migration in more details.

where posting and migration liberalization occur simultaneously, confirming that the baseline results are driven by posting reforms only.

### 3.2 Novel Exposure to Globalization

Cross-border provision of services increased international trade and international mobility of workers in the European economy. The incidence of those novel flows is different compared to standard trade and standard migration: the posting policy exposes novel sectors, workers and firms to globalization.

#### 3.2.1 Formerly Non-Tradable Jobs Become Offshored Through Posting

The posting policy is mostly used by firms to offshore services commonly sheltered from trade. Using detailed data on posting missions in France, the second importer of posting services in the EU, Figure 5, Panel A shows that almost 35% of the missions performed by posted workers occurs in the construction sector, 35% in manufacturing services (e.g., welding, electronic installation, or pipe-fitting), 18% in business services (e.g., driving, cleaning or food catering), and 10% in agriculture.<sup>35</sup> Those offshored jobs are mostly manual services: blue collar workers account for 65% of all workers posted abroad and 58% of all on-site offshored services (Figure 5, Panel B). Top occupations of the workers posted to France include builders, plumbers, electricians, welders, pipe fitters, farm workers, mechanics, and drivers, who are typically thought as sheltered from direct import competition.<sup>36</sup>

The intensive use of the posting scheme observed since 2005 led to a relatively large international integration of “non-tradable” sectors within the EU compared to other areas of the world. Comparing service trade statistics within the EU and between NAFTA members, I show that in Europe, the international integration of standard “tradable” services such as finance or communication is in fact as important as international integration of locally-provided services such as construction, road transport and industrial services performed abroad. In contrast, trade in non-tradables within the NAFTA, where exports of services through posted workers are still heavily restricted, has been much lower than trade in services easily exchangeable across borders. In 2017, the gap between non-tradable services’ trade and standard “tradable” services’ flows was 15% in Europe, but 65% in the NAFTA. Figure A.6 emphasizes the scope for potential service trade expansion in “non-tradable” sectors following policies that liberalize posting of workers.

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<sup>35</sup>In comparison, construction represents roughly 7% of French domestic employment, while it is 2.5% for agriculture. The amount for overall within-EU postings based on E101/A1 forms are similar: Figure A.4 shows that construction represents more than 40% of postings in the EU but less than 10% of EU employment.

<sup>36</sup>Note that 22% (56%) of posting contracts involve firms buying posting services in the same five-digit (two-digit) sector as their main sector. See online [Appendix](#) for additional figures on the sectoral proximity of receiving and sending firms.

### 3.2.2 Firms Formerly Sheltered From Export Opportunities Become Exporters Through Posting

Following the different type of jobs offshored through posting, firms in sectors usually thought as “non-tradables” are in fact internationally integrated. Using detailed firm-level tax and trade data on firms located in Portugal, Figure 6, Panel A, shows that firms formerly sheltered from export opportunities in fact access foreign markets through posting. The share of firms in non-tradable sectors exporting services each year is large: 34% for temporary employment agencies, 29% for road transport, 15% for building completion, and 7% for residential construction. As a consequence of this large international integration of services’ suppliers, cross-border provision of services represents a sizeable share of sending countries’ economic activity in non-tradable sectors. The weight of non-tradable services’ exports in total sectoral turnover is 28% for the road transport industry, 25% for floor covering, 19% for temporary employment agencies and 13% for painting. In contrast, exports of goods represent less than 2%, on average, of services suppliers sales, confirming that these sectors would be sheltered from export opportunities in the absence of cross-border services.

As a result, Figure 6, Panel B, shows that exports of residential construction and road transport services are much larger in absolute than, for instance, exports of wine ([Ricardo \[1891\]](#)). In the words of [Grossman and Rossi-Hansberg \[2006\]](#), “it’s not wine for cloth anymore”. But perhaps surprisingly, Portuguese drivers and builders rather than programmers have replaced wine manufacturers. Another surprising finding is that temporary employment agencies make almost as much abroad than firms specialized in computer services.

### 3.2.3 Workers’ Usually Sheltered From International Mobility Become Mobile Through Posting

Using detailed posting data from France and Belgium, Figure A.5, Panel A, shows that posted workers are older than migrants, work more frequently in non-tradable manual jobs such as construction, originate more from Eastern European countries, and are less likely to have a tertiary level of education, even after controlling for sending countries. Cross-border provision of services thus also exposes a different set of workers to international mobility compared to standard migration.

## 4 Employment Effects of Posting Flows in Receiving Countries

I have provided substantial evidence that the posting policy increased the level of international integration in Europe and affected workers in “non-tradable” sectors. In this section, I study how posting affects receiving labor markets and domestic workers exposed to this novel form of foreign competition. I start by investigating the effects of the posting policy on domestic employment at the *market-level*, focusing on

local-labor markets exposure to the posting shock. I then investigate two receiving-firm-level mechanisms that could drive these displacement effects: decrease of domestic employment at firms that use posting services, and lower prices of newly offshored inputs.

## 4.1 Effects of the Posting Policy on Local Labor Markets

To estimate the effect of the posting policy on domestic employment, this section studies local labor markets' responses to a large and exogenous shock in the supply of posting services: the liberalization of the posting policy for firms located in NMS countries that started in mid 2004 and was fully implemented in 2005. I focus on France, the second largest importer of posting services in Europe, where I am able to measure local labor markets exposure to posting with the longer time period. I observe province  $\times$  sector  $\times$  origin  $\times$  year posting flows to France from 2005 to 2015, and region  $\times$  sector  $\times$  year before that. I combine the posting dataset with administrative data on employment produced by INSEE ("emploi salarié localisé") that measures the number of (salaried) employees in France by year, sector, and province since 1989.<sup>37</sup> Importantly, posted workers are not accounted for in the French employment data, as they are employed by foreign firms and do not have an employment contract in France.

### 4.1.1 Identification Strategy

Identifying the effects of the supply of posting services on domestic employment is challenging because unobserved shocks could simultaneously affect demand for posted and domestic workers. Such confounding shocks would lead the estimated employment effects of the posting policy to be biased upward, e.g., would lead to underestimating potential displacement effects from posting. To circumvent that issue, I exploit supply-driven changes in posting competition that come from different exposure to a large supply shock in posting services driven by regulatory changes. In a difference-in-differences spirit, I study the differential effect of the liberalization reform on the employment of domestic workers in sectors exposed to posting competition that are in local labor markets more or less initially exposed to the shock. It allows me to gauge the plausibility that pre-reform differences in exposure *levels* to the trade liberalization are not correlated with *changes* in the outcome of interest (domestic employment), by performing pre-trend tests as suggested by the recent literature on pre-exposure designs ([Goldsmith-Pinkham et al. \[2020\]](#), [Borusyak et al. \[2021\]](#)).

The first dimension of my identification strategy uses the large and exogenous posting supply shock that followed the opening of the French labor market to services performed by employees NMS countries

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<sup>37</sup>This dataset is based on micro administrative data on all employers' administrative payroll declaration in France. Due to a lack of available data on sectoral wages at the province-year level before and after the shock without a break in data serie, the local labor market analysis focuses on employment effects rather than wages.

in mid-2004, that was fully effective in 2005.<sup>38</sup> As already showed in Figure 3, Panel A, the liberalization led postings from NMS countries to France to increase dramatically in 2004-2005. As a result, posting exposure measured as the number of imported posting services in *total* French employment increased dramatically after 2004-2005, from 0.01% in 2000 to almost 1% in 2015. The supply shock has been exclusively concentrated on a set of occupations. Some jobs require a set of skills, such as language, that make them hardly substitutable with posted workers. Other occupations are further covered by additional licensing for posted workers. Sectors like agriculture or construction are heavily exposed to posting competition, as they require little domestic-specific skills and sending countries are relatively well endowed in this type of labor. By contrast, other services like public administration, skilled services (accounting, administrative staff, engineering services), or health have almost zero exposure to posting. I thus focus on the effects of the shock on domestic employment in sectors experiencing a non-zero import exposure through posting.

**Measuring Local Exposure to the Liberalization Shock** The second dimension of the difference-in-differences exploits large geographical heterogeneities in posting exposure that have been persistent over time. To isolate supply-driven shocks in posting exposure per worker across French provinces, I exploit pre-existing trade relationships with foreign suppliers of posting services before the reform. The intuition is that provinces located in regions with relatively more pre-existing relationships with suppliers of posting services should benefit more from the nation-wide supply shock of mid 2004.<sup>39</sup> This measure of exposure to imports of posting services is close in spirit to “enclave designs” ([Card \[2001\]](#)) that exploit the persistent spatial heterogeneities in immigrations flows across space. My main measure of local labor market exposure to posting import competition is pre-reform import exposure per worker in a province. Because I do not observe imports of posting services at the province but at the region level before the shock, pre-reform imports in a region are apportioned to the province according to its share of regional industry employment:

$$e_{p \in r}^{pre} = \sum_s \frac{Emp_{p,s}^{pre}}{Emp_{r,s}^{pre}} \times \frac{P_{r,s}^{pre}}{Emp_p^{pre}} \quad (2)$$

In this specification,  $Emp_{p,s}^{pre}$  is employment of province  $p$  in sectors  $s$  in 2003,  $Emp_{r,s}^{pre}$  is overall employment in sector  $s$  in region  $r$  the same year, and  $P_{r,s}^{pre}$  measures posting flows to region  $r$  in sector  $s$  the year before the shock. Following [Autor et al. \[2014\]](#) or [Dustmann et al. \[2017\]](#), exposure to the shock is normalized by pre-reform province’s total employment. The term  $e_p^{pre}$  captures province’s geographical  $\times$  industrial exposure to information on posting, but is not directly linked to province-specific

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<sup>38</sup>Note that the French labor market opened to standard migrants from NMS-2004 only in 2008, not in 2004-2005. The “standard migration” shock is thus not simultaneous to the posting shock. I come back to this point later in the analysis.

<sup>39</sup>In spirit, the idea is similar to exploiting pre-existing trade or immigration relationship. There are 5 provinces by region on average in France. In 2003, I observe sectoral posting flows to each French region, not provinces, and thus have to allocate regional flows to each province within a region.

demand of posting services after the shock. Variations in  $e_p^{pre}$  stems from provinces being located in regions with different pre-existing posting relationships, and provinces being differentially exposed to that specific information through their pre-reform industrial composition. In this set-up, and in contrast with standard “shift-share” designs, provinces with similar industry composition have differential exposure to the supply shock because they are located in regions with different pre-existing knowledge of the posting policy. The resulting pre-reform province imports of posting services per worker can be viewed as an exposure index to the liberalization reform that is constant over time, in an approach similar to Choi et al. [2021]. Following Tabellini [2020] or Abramitzky et al. [2021], I can alternatively combine a province pre-reform share of posting services with *national* sectoral shocks in posting inflows after the reform to predict exposure to posting after the reform:

$$\hat{e}_p^{post} = \sum_s s_{ps}^{pre} \times \frac{\Delta P_s^{post}}{Emp_p^{pre}} \quad (3)$$

Where  $s_{ps}^{pre}$  is the share of posting services in sector  $s$  performed in province  $p$  before the liberalization and  $\Delta P_s^{post}$  is the national average inflows of posting services in the post-liberalization period (2005-2015) in sector  $s$ .<sup>40</sup> As total employment after the reform will be affected by the posting shock, I normalize  $s_{ps}^{pre}$  by pre-reform total employment in the province. I use pre-reform exposure  $e_s^{pre}$  as my main exposure indicator and use predicted exposure  $\hat{e}_p^{post}$  as an alternative measure of local labor market exposure to the liberalization reform.

**Identifying Assumptions** The identification strategy rests on two assumptions: pre-shock spatial-industrial exposure to posting (i) is correlated with imports of posting services after the shock and (ii) is not correlated with factors that would differentially affect changes in French employment in exposed sectors after the reform, in the absence of the reform.

If my strategy is similar in spirit to studies using past immigrants settlements as predictor of future inflows of workers (Card [2001], Lee et al. [2017], Abramitzky et al. [2021]), my variable of interest is imports of services. Posting inflows are exclusively driven by temporary cross-border service contracts and are therefore less likely to be explained by unobserved local factors, as compared to standard migration flows (Lewis and Peri [2015]). I am also able to observe pre-reform posting relationships in a quasi-autarky framework, where postings represent less than 0.1% of French employment before 2004. It is therefore unlikely that I will be capturing employment adjustments to pre-reform posting shocks instead of the effects of the 2004-2005 liberalization itself, a concern particularly salient in standard immigration frameworks

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<sup>40</sup>This share is computed from sectoral imports of posting services in a province before the shock (imputed as in 2) to national imports of posting services in this sector before the reform.

(Jaeger et al. [2018]). Because I exploit pre-reform regional imports posting services, provinces with similar industrial composition are differentially exposed to the shock when located in regions with different initial trading networks, which also restricts worries related to cross-regional correlation in residuals across observations with similar pre-reform industry composition (Adao, Kolesár, and Morales [2019b]).

Ultimately, my set-up provides me with two major advantages for identification. First, observed data on province-level posting flows make it possible to verify that pre-existing exposure to the posting scheme is a good predictor of provinces differential exposure to the nation-wide liberalization. Figure A.7 first shows that French provinces at the top of pre-shock posting use distribution are permanently more exposed to posting inflows after the reform. Table A.6, column 1, confirms that this is the case: my baseline measure of pre-existing exposure predicts province-level posting inflows after the reform with a F-statistic of 19.49.<sup>41</sup>

Second, I observe differential evolution of employment in high and low exposure provinces up to 10 years before the reform. Given that my design exploits level differences in pre-existing exposure, I can assess the plausibility of the assumption that the common shock caused the change in the changes, or whether there were pre-existing differences in the changes<sup>42</sup>. To already address worries of spurious correlation with other local factors, Table A.5 confirms that a province exposure to pre-existing trade relationships with suppliers of services is exogenous to a province pre-reform changes in working age population (column 1), employment in exposed sectors (column 2), employment in sheltered service sectors (column 3) and unemployment rates (column 4). Provinces with different exposure to the posting scheme before the liberalization were not facing differential labor shortages in yet to be exposed sectors, nor differential demographic changes that would affect both future employment evolution and use of posting services after the reform. I also show in Table A.3 differences in pre-liberalization characteristics by exposure to posting. Provinces initially more exposed to the posting liberalization shock relied more on blue collar workers and manufacturing employment compared to less exposed provinces, albeit those differences are small, in particular for manufacturing employment. Provinces with high and low exposure to posting also had similar employment to population ratio before the liberalization. A striking feature is that more exposed provinces are disproportionately more likely to have an international border, suggesting that distance to sending countries may play an important role in explaining local labor market exposure to the posting policy. Interestingly, more exposed provinces also had lower share of foreign born in their population. One concern is that my estimates could capture the effects of secular trends in employment that are driven by

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<sup>41</sup>The first stage of the pre-exposure variable is robust to the “delete one” sensitivity test Young [2019]. The average F-statistic excluding one observation at a time is 19.3, which is very close to the baseline F-statistic for excluded instruments of 19.49 (Figure A.8). The Anderson-Rubin statistic is 15.36.

<sup>42</sup>Goldsmith-Pinkham et al. [2020] emphasize the importance of relying on difference-in-differences design, when data is available, to test the assumption that differences in exposure to a common shock are not correlated with future changes in the outcome of interest, in my case exposed employment. Similarly, Borusyak et al. [2021] suggest that researchers should perform “pre-trend” tests, regressing the instrument or exposure variable on lagged outcome.

other factors than the liberalization of the posting policy and that would be correlated with some of those characteristics. For instance, if a province relies more on blue-collar workers and is also more initially exposed to the posting policy, one would be worried that I am capturing the long-term decline in blue-collar employment due to technological change rather than the effects of posting competition. To account for the fact that different pre-liberalization demographics may result in different trends in employment, my estimation strategy will flexibly control for those initial characteristics, allowing their effects to vary over time.

To test the sensitivity of my results to measures of pre-reform exposure, I use four alternative indicators of local labor market exposure to posting. I first normalize pre-reform posting inflows by 2000 total employment in a province, to alleviate worries that total employment just before the shock is more likely to be affected by it, and to avoid having the same normalization on both sides of the regression. Table A.6, column 2, confirms that pre-reform imports normalized by 2000 total employment are strong predictors of a province exposure after the reform. Second, I check that pre-reform posting flows in a region do not reflect province-specific demand shocks correlated with future evolution of exposed employment. To do so, I correct  $e_p^{pre}$  with a leave-out approach, interacting a province pre-reform industry share with regional posting flows *minus* import flows to that province.<sup>43</sup> Third, I use a province geographic distance to NMS countries as a measure of its exposure to the reform that is independent of past use of the posting scheme. Table A.6, column 4, and Figure A.12 confirm that French provinces located closer to countries benefitting from the liberalization experienced larger posting inflows after the liberalization. Finally, I use predicted posting imports per worker  $\hat{e}_p^{post}$  computed by interacting initial posting shares with national sectoral flows. Column (5) shows that this alternative instrument is also a strong predictor of a province actual posting imports per workers after the reform.

**Empirical Specification** To obtain the differential evolution of exposed employment in high and low exposed local labor markets following the exogenous shock, I estimate the following equation:

$$Emp_{it} = \alpha + \lambda_t + \gamma_2 \mathbb{1}_{\{i=1\}} + \zeta \mathbb{1}_{\{treated_i=1\}} \times \mathbb{1}_{\{t \geq 2004\}} + u_{it}, \quad (4)$$

where  $Emp_{it}$  is employment in localities of type  $i$  in sectors exposed to posting competition at calendar time  $t$ , expressed either in log-level or in share of province-level working age population, and where  $i = 0, 1$  is an indicator for being a top or bottom exposure locality. The interaction variable  $\zeta$  captures the difference in domestic employment trends between top and bottom exposure localities after the supply shock of 2004.

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<sup>43</sup>Formally, this alternative exposure measure is computed as  $e_{p \in r}^{pre} = \sum_s \frac{Emp_{p,s}^{2003}}{Emp_{r,s}^{2003}} \times (P_{r,s}^{2005} - P_{p,s}^{2005})$ . I use posting flows in 2005 because before, only region flows are observed, not province-level flows.

To obtain the dynamic effect of the liberalization on exposed employment, and to formally test for pre-trends, I also estimate the dynamic counterpart of the standard difference-in-differences specification at the province level:

$$Emp_{pt} = \alpha + \lambda_t + \lambda_p + \sum_{k=1993}^{2015} \zeta_k \mathbb{1}_{\{t=k\}} \times \mathbb{1}_{\{treated_p=1\}} + u_{pt} \quad (5)$$

Where  $Emp_{pt}$  is employment in sectors exposed to posting competition in province  $p$  in year  $t$ , either in log-level or in share of working age population,  $\lambda_t$  are calendar year fixed effects,  $\lambda_p$  are province fixed effects and  $\mathbb{1}_{\{t=k\}}$  is an indicator equal to one in year  $k$ . I cluster the standard errors at the province level and omit  $\zeta_{2003}$  such that the sequence of estimated  $\zeta_k$  captures the differential evolution of employment in exposed provinces as compared to provinces less exposed to the shock in year  $k$ . To leverage the continuous measure of exposure to the shock, rather than solely comparing provinces at the top and bottom of the exposure distribution, I finally estimate a dynamic difference-in-differences model where I interact my exposure index  $e_p^{pre}$  with year fixed effects:

$$Emp_{pt} = \alpha + \lambda_t + \lambda_p + \sum_{k=1993}^{2015} \zeta_k \mathbb{1}_{\{t=k\}} \times e_p^{pre} + \lambda X_{pt} + u_{pt} \quad (6)$$

Where  $X_{pt}$  includes controls that vary within provinces over time. To leverage actual variations in posting exposure across provinces, I finally estimate a first difference model that correlates 2003-2015 exposed employment changes with import of posting services after the reform:

$$\Delta(Emp_{pt}) = \alpha + \zeta \Delta P_{pt} + u_{pt}, \quad (7)$$

In the baseline specification,  $\Delta P_{pt}$  measures province inflows of posting services per worker.<sup>44</sup> To account for the endogeneity in imports of posting services after the reform, I use my measure of pre-reform exposure to an instrument for observed post-reform imports of posting services.

#### 4.1.2 Results

Figure 7, Panel A displays the results for the baseline difference-in-differences strategy, plotting raw means. Compared to localities that were less exposed to the shock, localities with the highest initial exposure to posting saw a decrease in the share of their population working in exposed sectors after 2004, while following remarkably similar evolution before the reform. The absence of pre-trends in the 10 years before the

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<sup>44</sup> Posting inflows are measured as the average of posting inflows over the post reform period, in pre-reform total number of workers in that province, a specification close to [Dustmann et al. \[2017\]](#). The exception is that my left hand side variable is not total employment, but employment in exposed sector, as in [Autor, Dorn, and Hanson \[2013\]](#). I also use alternative specifications normalizing post-reform inflows per 2003-2015 total employment or using the log levels of inflows instead.

liberalization confirms that differences in pre-reform exposure levels do not affect changes in employment through other channels than the reform. The estimated coefficient  $\zeta$  reported on the graph is negative and significant at the 1% level. The share of population working in postable employment decreased by 5.47% (1.3 percentage points) in high-exposure provinces after the posting shock compared to provinces not exposed to the posting supply shock. Repeating the difference-in-differences design using alternative thresholds for top and bottom exposure provinces yields similar changes in trends after 2004, while no pre-trends can be detected before the reform (Figure A.10).

Were these employment effects followed by reallocation of domestic workers in sheltered sectors within exposed local labor markets? If labor markets are geographically integrated and fully competitive, a shock to exposed sectors should affect the aggregate labor market through two channels: a change in employment in exposed sectors; and indirectly, through aggregate labor demand. Panel B of Figure 7 shows that the share of individuals working in sheltered sectors followed exactly similar trends in provinces with high and low exposure to posting before and after the posting shock. The absence of pre-trends is again reassuring, hinging on the comparability of provinces with low and high initial use of posting services. I find no statistically significant differential evolution of employment in sheltered industries following the liberalization. The large and permanent import shock in services was not followed by significant reallocation of workers to sheltered sectors within affected local labor markets.

To formally test for pre-trends and show the dynamic estimates of the average coefficient reported in Figure 7, Figure A.9 displays the estimated  $\zeta_k$  from Equation (5) estimated at the province-level, controlling for province and year fixed effects. No coefficient before 2004 is significant and all coefficients prior to the liberalization are close to 0 in magnitude. The F-statistic for the joint significance of pre-liberalization estimates is 1.44, with a p-value of 0.1986. Exposed employment starts to differentially decrease following the liberalization, with the effects building over time. Figure A.9, Panel B, uses the dynamic approach to relate the magnitude of estimated employment effects to intensity of exposure to the supply-driven component of posting flows. The measure of pre-reform exposure to the liberalization is remarkably related to estimated differential evolution of exposed employment after the reform. Local labor markets with the highest initial exposure to the shock face the largest employment adjustments after the reform. These effects are larger when using the bottom 20% as a control group (pink line) compared to the bottom 40% that is more exposed to posting flows (orange line). In contrast, lowering the treatment threshold to the top 20% of pre-reform exposure gives lower average employment effects.

Table 2, column (1), summarizes the baseline estimates of the difference-in-differences model. Each coefficient is from a separate regression. The share of working age population employed in exposed sectors decreases differentially by 1.2(177) percentage points after 2004 in local labor markets more exposed to the

shock. As employment in sheltered in sectors does not experience a change in trends after the reform, unemployment increases differentially by 5.2% in exposed provinces, emphasizing the long-lasting effects of the trade liberalization in services. Other columns of Table 2, Panel A, repeats the baseline estimates with alternative specifications and selection of treatment and control groups. That the estimated coefficient is similar in magnitude across different specifications underscores the stability of the statistical relationships. The results are robust to using alternative pre-reform exposure measures, such as 1990 or 2000 employment shares (column (2) and (3)), geographic distance to NMS (column (4)), region-level exposure (column (5)), or applying the leave-out correction to the baseline pre-reform exposure measure (column (6)).

To exploit all variations in provinces' pre-existing exposure to the reform, Figure 8, Panel A, plots the estimates from Equation (6) where the coefficient of interest is the exposure index interacted with a year dummy and the dependent variable is log employment in exposed sectors. The baseline specification only includes province and year fixed effects. The coefficients before the liberalization shock are all indistinguishable from zero and show no negative pre-trends. Starting in 2004, there is a steady decline in the event-study coefficient values, with an estimated effect of roughly -0.11 by 2015. Multiplying this coefficient by 0.51 (the average difference in exposure between the bottom 40 and top 10 decile) gives a relative decrease of 5.6 log point which is similar to the results obtained when only comparing those two groups of provinces earlier. To account for potential trends in exposed employment driven by other factors than the posting liberalization, the rest of the series flexibly control for provinces' demographics and time trends. The second serie adds the 2003 manufacturing share of province employment interacted with year fixed effects, which leaves the coefficients unchanged. The third serie adds the interaction of year fixed effects with the share of exposed sectors in total employment of a province in 2003. The fourth and fifth series respectively control for the 2003 share of blue collar workers in a province employment interacted with year fixed effects, and the 2003 share of foreign born in a province population interacted with year dummies. Even after allowing pre-reform characteristics to flexibly affect local labor market outcomes after 2004, the effects of the posting liberalization on exposed employment remains negative and highly significant.

The bottom panel of Equation (6) turns to overall local labor market responses to the liberalization shock. I begin by asking whether service import shocks of the liberalization to local exposed employment cause reallocation of workers across French provinces. If the mobility response to the liberalization shock is large, it suggests that initial local impacts will rapidly spur across provinces, meaning that the indirect effects of posting on local labor markets are unlikely to be detected. The specification is analogous to the earlier model for exposed employment except that the dependent variable is the log working-age population in the province. The estimated coefficients plotted in the red series show no break in trends in 2004 and are all indistinguishable from zero. The absence of significant responses of local population size to the

service liberalization shock suggests limited mobility responses of workers' to on-site offshoring exposure. One hypothesis rationalizing the absence of effects is that population adjustments to local economic shocks are sluggish because mobility is costly.

If workers do not substantially reallocate across provinces more or less exposed to the shock, indirect effects may however occur within affected local labor markets. I then investigate the effects of the liberalization shock on employment in sectors sheltered from posting competition. The estimated coefficients show no evidence that higher exposure to the posting supply shock was associated with higher employment growth in sheltered sectors between 2004 and 2015. The absence of spillovers through higher labor demand in sheltered sectors suggests that reallocation of workers across sectors may be costly, and result in permanent employment effects in local labor markets exposed to trade in services liberalization.

I then turn to the estimation of Equation (7), leveraging all variations in province's actual exposure to the trade liberalization in services. The top panel of Table 3 confirms that higher exposure to the liberalization shock is systematically associated with a differential decrease in the share of adults working in jobs exposed to posting competition. The OLS estimated coefficient from equation (7) is -0.638(0.231), while instrumented coefficients range from -.871(.283) to -1.604(.338). Column (2) shows the results from the reduced form specification regressing the change in exposed employment on the pre-reform exposure to the shock, which yields a negative and statistically significant estimate of -.462(.118). Across all specifications, and consistent with the difference-in-differences results, higher exposure to the supply-driven component of posting inflows after 2004 is associated with a decrease in the share of working age population employed in exposed services sectors. The baseline employment elasticity in Column (3) is -1.604(.338). Column (4) adds a control for the share of postable employment in a province's pre-reform employment, addressing the concern that measured posting imports per worker after 2004 is picking up overall declining trends in sectors exposed to posting competition. The relationship between posting exposure and domestic employment remains economically large and statistically significant. The baseline employment effect means that moving from the 25th to the 75th percentile of exposure to the supply-driven component of posting flows is associated with a 1.5 percentage point decrease in the share of working age population employed in sectors exposed to posting competition.<sup>45</sup> The effect is very close in magnitude to the comparable coefficients from the difference-in-differences design, reported in Table 2, line 2, emphasizing the robustness of the estimates to various identification strategies.

To check that my results capture the effects of exposure to the posting shock after 2004, rather than long-run common causal factor behind both the fall in domestic employment in manual services and increasing inflows of posted workers, I conduct a falsification exercise. I regress pre-reform changes in ex-

<sup>45</sup> And that a 10% higher exposure to the supply-component of import of posting services after the reform is associated with a decrease in the share of working age population employed in exposed sectors of roughly 0.15 percentage points.

posed domestic employment on post-reform changes in posting inflows. Detecting a non-zero statistically significant relationship between post-reform posting inflows and lagged employment growth would raise worries that increasing service imports after 2004 is a symptom, rather than a cause, of declining domestic employment in service sectors exposed to posting competition. Column (6) shows the correlation between changes in domestic employment in the ten years preceding the liberalization and the change in service import exposure after 2004, while column (7) and (8) show the corresponding correlation for the 1993-2000 and 2000-2003 growth. The point estimates are non-statistically significant. I cannot reject that there is no relationship between post-liberalization posting imports (instrumented with pre-reform shares) and lagged employment growth in sectors exposed to the posting competition. The estimated correlations thus provide no evidence of reverse causality, consistent with the absence of pre-trends in the difference-in-differences analysis.

In Table A.7, I augment the IV model with a set of demographic measures and alternative instrumental strategies which test robustness and potentially eliminate confounds. Column (1) repeats the baseline specification weighting the model with pre-reform employment rather than working age population, and yield a point estimate of -1.560(.299). Clustering the standard errors at the region-level to account for spatial correlations across provinces in column (2) leaves the interpretation of the estimates unchanged.<sup>46</sup> The effects of increased posting competition on domestic employment are still negative and statistically significant when excluding industrial services potentially affected by other trade shocks (column (3)). Estimating the model with the import variable in percentage points instead of log (column (4)), or controlling for the share of foreign born in the population (column (5)) also leaves the baseline result unchanged. Column (6) tests that the effects are not driven by the normalization of the regressor by instrumenting posting inflows in levels by pre-reform posting flows, following the test suggested by Clemens and Hunt [2019].<sup>47</sup> Figure A.11 tests the robustness of the baseline estimate to outliers, deleting one province at a time from the regression. The estimated employment responses to posting exposure are remarkably stable to this test. Recently, Adao et al. [2019b] have also emphasized that exposure designs may suffer from cross-sectional correlations of standard errors across regions. I implement their inference procedure in table A.8 and show that the significance of the estimates is unchanged. Panel B of Table A.7 finally tests the robustness of the baseline estimate reported in column 3, Table 3, to alternative instruments for province's exposure to the liberalization shock. Column (7) uses the geographic distance to NMS countries that gain access to posting in 2004 as an instrument for a province imports of posting services after the liberalization. The effect of higher exposure to the supply-driven component of posting flows after the reform is sensibly higher than

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<sup>46</sup>There are however only 21 regions in France, which leads to a very small number of clusters.

<sup>47</sup>Formally, this implies to control separately for log of gross posting flows and log of initial total employment, allowing to predict only post-reform inflows of posting services by pre-reform inflows of posting services (Clemens and Hunt [2019]).

with the baseline instrument, with a point estimate of -2.192(.710). Column (8), (9) and (10) use alternative definition of pre-reform exposure to the liberalization, based on lagged industry shares or implementing the leave-out approach. The estimated coefficients are remarkably similar in magnitude, emphasizing that the baseline estimates are not explained by pre-reform differences in exposed employment shares nor by capturing demand specific shocks in the baseline pre-reform exposure measure. Column (11) finally uses predicted imports as an alternative instrument that exploits both cross-sectionnal variation in initial shares and sectoral shocks after the reform, and yields an estimated effect of -1.650(.351), again very close to the baseline estimate.

In the bottom panel of Table 3, I finally turn to the overall local labor market effects of the service import shocks. The regression specification is analogous to the earlier model for exposed employment share except that the dependent variable is the log change of the working-age population in the province (multiplied by 100). Column (9)-(10) show no evidence that the posting liberalization shock led to significant changes in population growth between 2003 and 2015.

The decrease in domestic employment in sectors exposed to posting competition should lead to an increase in non-exposed employment, unemployment, or labor force participation. Column (12) and (13) of Table 3 repeat the baseline specification with the log change of employment in sheltered sectors between 2003 and 2015 as the dependent variable. As in the difference-in-differences design, I find no evidence that higher exposure to the supply-driven component of posting inflows after 2004 is associated with higher employment growth in sheltered sectors between 2003 and 2015. The absence of spillovers through higher labor demand in sheltered sectors suggests that reallocation of workers across sectors is costly. That is consistent with [Saint-Paul \[2007\]](#) who theoretically shows that when labor markets are rigid, the backlash against trade liberalization in services will be large. The net decrease in exposed employment, and the null effect on sheltered service employment, lead to a sharp increase in the number of unemployed in affected provinces.

To summarize the results of that section, both the difference-in-differences design and the IV approach show that the trade liberalization in services led to (i) a persistent decline in the share of population working in sectors exposed to posting competition (ii) a non-significant adjustment through geographic mobility across provinces (iii) a non-significant reallocation of domestic workers from exposed to sheltered service sectors. Those results are remarkably close to the local labor market effects of standard manufacturing import shocks ([Autor et al. \[2013\]](#), [Choi et al. \[2021\]](#)), suggesting that the adverse effects of trade on workers have also been noticeable through the novel trade-migration channel.

## 4.2 Receiving-Firm Level Mechanisms Driving Market-Level Employment Effects

I explain the market-level displacement effects generated by the posting policy by two main mechanisms: posted workers are substitutes for domestic workers at receiving firms, and they are cheaper.

### 4.2.1 Receiving-Firm Technology: Substitutability Between Posted and Domestic Workers

Are posted workers substitutes or complements for domestic workers? Receiving firms could replace their own workers with posted workers, leading to negative employment effects at firms that purchase posting services. They could also simultaneously increase posted and domestic employment, for instance, if the novel source of labor allows them to be more competitive and gain market shares at the expense of their domestic competitors. In that case, one could observe a positive association between using posting services and employing domestic workers at the receiving firm, while aggregate employment could still decrease at the exposed industry level. I exploit the granularity of receiving firm data to explore potential substitution or complementarity between domestic and posted workers.

I use Belgium as the main laboratory for my analysis because Belgian granular data on received posting flows have the largest time span (nine years), allowing me to exploit a large set of receiving-firm-level variations in posting exposure. Belgium is one of the top importers of posting services (third country) and shares many characteristics with most of receiving countries: it is a high-wage country with relatively high labor market regulations and uses posting services to offshore mostly manual non-tradable services. I use the LIMOSA registry on the universe of posting missions purchased by Belgian firms from 2010 to 2019, which I merge with exhaustive administrative panel on Belgian firms' domestic employment. This unique dataset allows me to identify the 17,796 unique Belgian firms that used posted workers between 2010 and 2019 and to track their employment of domestic workers over the same period.

The main identification strategy asks what happens to domestic workers when their employer starts to offshore services "on site" through posting services. I thus leverage variations in posting exposure at the *extensive margin* by focusing on firms that start purchasing posting services. More specifically, I narrow down the analysis to the 11,796 firms that purchase posting services for the first time between 2014 and 2019. That sample restriction lets me select firms that never used posted workers from 2010 to 2014 so that I can precisely measure a shift from non-using to using status. I use an event study design to estimate the differential evolution of domestic employment at Belgian receiving firms before and after they first get connected to a foreign supplier of non-tradable services. More precisely, I estimate the following specification:

$$y_{it} = \alpha_i + \lambda_{st} + \sum_{k=\underline{T}}^{\bar{T}} D_{it}^k \gamma_k + \varepsilon_{it}, \quad (8)$$

where  $y_{it}$  is an outcome variable for firm  $i$  (in log) in calendar year  $t$  and  $\alpha_i$  is a firm fixed effect.  $\lambda_{sz}$  are three-digit sector  $\times$  calendar year fixed effects. The event time dummies  $D_{it}^k$  are defined as  $D_{it}^k = \mathbb{1}.[t = d_i + k] \forall k \in (\underline{T}, \bar{T})$ ,  $D_{it}^{\underline{T}} = \mathbb{1}.[t \leq d_i + \underline{T}]$ , and  $D_{it}^{\bar{T}} = \mathbb{1}.[t \geq d_i + \bar{T}]$ , where  $\mathbb{1}$  is the indicator function and  $d_i$  is the first year when firm  $i$  starts using posting workers. I normalize  $\theta_{-1} = 0$  and set  $\underline{T} = -5$  and  $\bar{T} = +5$ , and I cluster standard errors at the province  $\times$  event time level to account for spatial correlation in error terms, as in [Alfaro-Ureña, Manelici, and Vasquez \[2019\]](#). The binning of event time coefficients at the ends of the event window allows me to introduce both year and firm fixed effects to circumvent the issues related to event studies in the absence of a pure control group, following the recent econometric literature on event studies ([Borusyak and Jaravel \[2017\]](#), [Schmidheiny and Siegloch \[2019\]](#)).

The sequence of coefficients  $\gamma_k$  describes the dynamic of receiving firms' outcomes around the event of first services being offshored to posted workers. By exclusively comparing firms that will use posted workers at some point between 2014 and 2019, the event study design rules out any selection issue related to the "importer premium."<sup>48</sup> Estimated  $\gamma_k$  compare the outcomes of receiving firms in event year  $k$  to the outcomes of future receiving firms in the same narrowly defined sector in the year before their offshoring event. I estimate Equation (8) with both OLS two-way fixed effects and an alternative estimator that accounts for heterogeneous treatment effects and negative weighting in event-study designs developed by [Borusyak and Jaravel \[2017\]](#).

When estimating  $\gamma_k$ , my goal is to identify potential substitution or complementarity between posted workers and domestic workers in receiving firms' production function. A firm's decision to purchase posting services is endogenous and plausibly correlated with time-varying unobserved shocks that are likely to also affect its domestic employment. Demand shocks experienced by the Belgian firm are particularly likely to be correlated with both decisions to hire posted workers and domestic workers. In that case, the estimates of  $\gamma_k$  are biased upward and underestimate potential substitution between domestic and posted workers. The inspection of pre-trends will first allow me to check whether receiving firms self-select into purchasing posting services based on past domestic employment evolution. However, the absence of pre-trends does not rule-out firm-level shocks that are both correlated with the outsourcing of services to posted workers and firm-level employment of domestic workers. I then exploit additional variations in posting exposure within receiving firms to make progress on the causal interpretation of the estimates. Ultimately, the estimates of  $\gamma_k$  can be viewed as a way to identify how domestic and foreign employment co-move

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<sup>48</sup>Firms that use posting services tend to be larger and pay higher wages compared to firms that do not, as showed in the [Online Appendix](#).

at receiving firms after a given shock shedding-light on complementarity of substituability between these two sources of labour. Assuming that receiving firms face a given endogenous shock, such as a positive demand shock, the event-study estimates still reflect how receiving firms structure their employment responses to that shock when they can source services to foreign suppliers.

Figure 9, Panel A displays the estimates of  $\gamma_k$  and their 95% confidence intervals using log firm total domestic employment (blue line) as the main outcome. I find that employment of Belgian workers decreases at Belgian firms that start sourcing services to posted workers. Domestic employment decreases by 2% the year firms start subcontracting services to posted workers, compared to firms in the same three-digit sector that are yet to use posting services that same year. This negative employment effect corresponds, on average, to two less domestic jobs at receiving firms for an average subcontracting of six posted worker jobs at receiving firms that year. The response of employment is amplified over time, with a 17% decrease in domestic employment four years after the first on-site offshoring event. That result suggests domestic firms substitute domestic with posted workers once they get connected to a foreign services supplier. Domestic employment in firms that use and are yet to use posted workers appear to evolve similarly before the event, conditional on firm and three-digit sector  $\times$  year fixed effects. Posting use by receiving firms does not seem to be driven or caused by a differential evolution of domestic labor availability at receiving firms. The results are unchanged when estimating the event study model with the [Borusyak and Jaravel \[2017\]](#) estimator that corrects for negative weighting issues (Figure A.16).

Do receiving firms scale-up when starting to offshore services, or do they substitute domestic for posted workers, keeping their overall activity constant? I find that receiving firms grow in terms of *overall* size once they start using posted workers, relative to their employment level in pre-event year, but this effect gradually fades-away. Figure 9, Panel B shows that total employment at receiving firms, including posted workers, increases by almost 50% after the first on-site offshoring event. However, as domestic workers get progressively displaced, the overall size of receiving firms gradually gets closer to its pre-event level. Four years after first posting use, overall employment at receiving firms is only 7% higher relative to the pre-event level, while domestic employment has decreased by 17%. Employment responses at receiving firms seem to progressively converge to full displacement of employment from domestic to posted workers.

If Belgian firms decrease domestic employment when starting to rely on posted workers, how are the wages of remaining workers affected? Figure 9, Panel A orange line shows the event study estimates using log average wage paid at receiving firms. There is no evidence that firms that start purchasing posting services change their domestic pay policy, suggesting that when gaining access to alternative workers, receiving firms adjust their domestic payroll through employment rather than wages, which is consistent with the presence of downward rigidities on domestic workers wages.

While Figure 9 shows evidence of domestic employment losses simultaneous to a change in posting exposure at the extensive margin, the displacement effects could be caused by unobserved shocks affecting receiving firms the year they start posting workers abroad. To make progress on that issue, I start by leveraging additional variation in posting exposure within and across firms. I first investigate whether workers who are more or less substitutable with posted workers experience similar employment losses following a posting exposure event. Posted workers are mostly blue collar and are therefore more likely to be substitutes for domestic blue collar workers. While all workers at a receiving firm should be affected by firm-level shocks, only blue collar workers should be replaced by posted workers. If the overall employment responses displayed in Figure 9, Panel A reflect the effects of a firm-level shock rather than posting use, we should, however, detect strong employment responses of non-blue collar employment around the posting event.

Figure A.13 shows that the domestic employment responses to posting exposure are driven by a decrease in receiving firms' blue collar employment. In contrast, I do not find evidence of any statistically significant differential evolution of non-blue collar workers after their employer starts purchasing posting services. It suggests that the overall displacement effects experienced by domestic workers at receiving firms are driven by substitution between domestic and posted blue collar workers rather than by simultaneous firm-level shocks that would also affect white collar employment at these firms. As a result, aggregate domestic blue collar employment at Belgian firms offshoring services to posted workers has decreased substantially over the past 10 years. Figure A.14 shows that the share of blue collar workers at Belgian firms using posting services at least once between 2010 and 2019 started to decrease in 2010, decreasing from 58% to 54% between 2009 and 2019. At the same time, posting exposure increased dramatically: the share of posted workers in total workers hired at firms purchasing posting services once during the period increased from 5% to 16% between 2010 and 2019.

One other source of heterogeneity regarding the intensity of exposure to posting across workers lies in the proximity between the offshored service and the type of job performed by domestic workers. Two Belgian firms offshoring a construction service to a foreign firm may be affected by similar unobserved demand shocks or other factors correlated with the decision to use a foreign service. However, only receiving firms also operating in the construction industry should substitute their own workers with posted workers. I show in Figure A.15 that the domestic employment losses at receiving firms are driven by firms that offshore tasks close to their own activity. While construction firms decrease their domestic workforce once they start using construction work performed by posted workers, manufacturing firms do not significantly change their domestic employment after they start offshoring construction services to posting firms. It confirms that the estimated displacement effects at receiving are plausibly driven by substitution

between domestic and posted workers rather than other simultaneous shocks.

#### 4.2.2 Receiving-Firm Inputs Cost: Wages of Posted and Domestic Workers

Did the posting policy allow receiving firms to access cheaper inputs when substituting posted for domestic workers? While it is usually impossible to observe prices of domestic and foreign inputs at offshoring firms, my datasets allow me to compare posted and domestic workers' wages at the same workplace. I take advantage of unique matched employer-employee data on the universe of job spells in France for 2017-208 (DADS) that I match with the universe of posting contracts for the same period (DPD/SIPSI dataset).<sup>49</sup> I use the French-level data, rather than the Belgian receiving-firm-level data, because only the French data have information on wages paid to posted workers. I start from the universe of posting missions declared to the French authorities in 2017 and 2018 to track back the 19,138 French clients that have purchased a posting service at some point in that period and appear in the linked employer-employee dataset.<sup>50</sup>

Standard cost-saving theories would advocate that firms using posted workers are also firms that have higher domestic wage premia, as is the case for standard outsourcing ([Bilal and Lhuillier \[2020\]](#)). To test the hypothesis, I first estimate the importer wage premium: firms that offshore services "on site" pay domestic wages that are, on average, 20% higher than firms that do not use posting services in the same five-digit sector.<sup>51</sup> Such importer premium could, however, reflect firms' selection into on-site offshoring rather than true differences in pay policies at receiving firms. To better understand whether pay policies differ between firms that use or do not use posting services, I estimate the firm-level wage premium based on the workhorse [Abowd et al. \[1999\]](#) (henceforth AKM) model. Formally, I estimate the following specification on the universe of domestic job spells:

$$\ln w_{it} = \alpha_i + \psi_{J_i,t} + \beta X_{it} + \epsilon_{it}, \quad (9)$$

where  $\alpha_i$  are worker fixed effects,  $\psi_{J_i,t}$  are  $J$  workplace effects, and  $X_{it}$  are worker characteristics (cubic

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<sup>49</sup>The dataset is described in detail in [Online Appendix](#). I merge the DADS (matched employer-employee dataset on all job spells in France) with the SIPSI dataset that records all posting missions performed in France with information on the using French firm ID (SIREN). Since DADS allows me to follow individuals only from one year to the next, the analysis focuses on postings in 2017 and 2018.

<sup>50</sup>There are 23,332 unique French firms with a national identifier number (SIREN) that can be identified as purchasing posting services in 2017 and 2018. Of these firms, 19,138 have at least one employment spell in the linked employer-employee dataset DADS that records all job spells in France.

<sup>51</sup>Results are displayed in the [Online Appendix](#). Following [Bernard et al. \[2007\]](#) for importers, I regress firms' outcomes on a dummy equal to one if this firm is using a posting service that year, controlling for industry and province fixed effects. Compared to companies that do not use posted workers, firms sourcing their services on site through posting are larger in terms of sales and employment. They also exhibit more capital per worker and are more profitable. These findings are in line with [Bernard et al. \[2007\]](#), [Fort \[2017\]](#) or [Antras, Fort, and Tintelnot \[2017\]](#), who report that US importers exhibit a size premium. Reproducing their analyses for non-tradable imports in France, I show in [Online Appendix](#) that the size premium of receiving firms increases with the number of countries from which a firm sources its posting services. This suggests that as for standard importing, "on-site offshoring" is constrained by important country-level fixed costs of sourcing that limit the ability of small firms to source posting services from a large number of countries.

age and number of hours worked). I estimate Equation (9) using the methodology developed by [Correia \[2017\]](#) and cluster standard errors at the worker level.<sup>52</sup> The wage changes of domestic workers moving between different workplaces identify the fixed effects in a connected set. I plot in Figure 10, Panel A the distribution of firms fixed effects separately for receiving and never-receiving firms. Pay policies at receiving firms are shifted upward, indicating firms that pay high-wage premia to their domestic workers tend to use more “on-site” foreign services, consistent with the hypothesis that high-wage firms are more likely to use posting services to save on high-wage premia. The mean receiving firm wage premium is 0.18 relative to the mean wage premium of non-receiving firms normalized to zero.

If the use of posting services is explained by cost-saving motives, receiving firms may be able to pay these workers at lower wages than their in-house workers due to lower rent-sharing associated with alternative work arrangements ([Katz and Krueger \[2019\]](#)). I then turn to the second hypothesis: workers hired through posting arrangements are cheaper than domestic workers. I begin by estimating the raw wage penalty associated with posting arrangements in the sample of receiving firms based on the following specification:

$$\ln w_{it} = \rho \times \text{Posting}_{it} + \psi_{J_i,t} + \beta X_{it} + \epsilon_{it}. \quad (10)$$

Equation (10) allows me to compare wages of domestic and posted workers who perform work at the same firm. As posted workers do not transition from posting to regular work arrangements, it is not possible to separately identify the posting fixed effect when including a worker fixed effect. However, I control for work duration, age, and age squared to partially absorb potential differences in work arrangements. The results reported in Table 5 show that workers with similar age and work duration at the same workplace are paid 30% less when hired through a posting contract compared to a standard domestic contract. I take advantage of my unique dataset to further compare the wage penalty linked to foreign versus domestic alternative work arrangements. For this purpose, I augment Equation (10) with an additional indicator variable equal to one if the employee works at the receiving firm through a (domestic) temporary agency contract.<sup>53</sup> Estimates displayed in the last column of Table 5 show that both domestic and foreign outsourced workers face a significant wage penalty compared to incumbent domestic workers, but the wage penalty is *twice* larger for posted workers.<sup>54</sup> That suggests that foreign services suppliers are located even

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<sup>52</sup>Due to computational issues, I select a random sample of 20% of firms that are never observed as purchasing posting services between 2017 and 2020. I then run the AKM specification on the connected set of employees who worked at some point for a receiving firm or non-receiving firm included in the random sample.

<sup>53</sup>The DADS dataset allows me to link employees hired at temporary employment agencies to the firm where the work mission is effectively performed since 2018. I use this information to observe, for a given firm purchasing posting services: (i) wages of incumbent domestic employees, (ii) wages of domestic outsourced workers (whose permanent employer is the temporary employment agency), and (iii) wages of posted workers (whose permanent employers are the foreign services suppliers).

<sup>54</sup>Interestingly, the wage penalty estimated for domestic outsourced workers in my French dataset is very close to what has been

further at the bottom of the wage ladder compared to domestic contractors. To take into account permanent characteristics of workers, I follow [Drenik, Jäger, Plotkin, and Schoefer \[2020\]](#) and estimate a modified AKM model with separate workplace effects by work arrangements for the sample of receiving firms based on

$$\ln w_{it} = \alpha_i + \psi_{J_{i,t}}^{P_i} + \beta X_{it} + \epsilon_{it}, \quad (11)$$

where  $\psi_{J_{i,t}}^{P_i}$  are work arrangement-specific firm fixed effects with  $P_i$  equal  $P$  if worker  $i$  has a posting contract and equals  $R$  if worker  $i$  is a incumbent domestic worker, and  $J_{i,t}$  is the workplace. I control for age and age squared as well as the number of hours worked. The fixed effects are identified by worker wages changes when moving between different workplaces but are now allowed to differ across work arrangements.<sup>55</sup> I plot the distribution of workplace effects for posted and domestic workers in Panel B of Figure 10 in the sample of receiving firms. Workplace effects for posted workers are shifted downward compared to domestic workers. The mean wage premium for posted workers is -0.43 relative to the mean of workplace effects of workers normalized to zero.<sup>56</sup> Receiving firms thus pay lower wage premia (accounting for workers permanent characteristics) to posted workers.

The lower wage premia for posted workers compared to domestic workers is likely to reflect the degree of rent-sharing and pay differentiation for posted versus domestic workers. To finally shed light on rent-sharing between receiving firms and posted workers, I compare successively raw wages and wage premia for domestic and posted workers *at the same workplace*. The correlation between the two should mirror the amount of rent-sharing between receiving firms and posted workers: the lower that parameter, the less posted workers' pay premia are related to domestic pay policies. I start by plotting in Panel A of Figure 11 the binned scatter plot of the log average wage of posted versus incumbent domestic workers at the same workplace (red dots), absorbing five-digit sector fixed effects.<sup>57</sup> The figure shows a moderate and positive relationship between posted workers and incumbent domestic workers (log) wages at the same workplace, with an estimated slope of 0.21 (0.01). It means that firms that pay their domestic workers at higher wages also pay posted workers slightly higher wages, but the elasticity is small. To verify whether that effect is

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estimated by the literature relying on similar specifications: [Drenik, Jäger, Plotkin, and Schoefer \[2020\]](#) estimate a wage penalty of -0.140 for outsourced workers in Argentina.

<sup>55</sup> As there are no worker movement in and out of posting work arrangements, the fixed effects are therefore not identified through changes across the type of contracts for the same worker, but rather changes of workplace within the same type of work arrangement (posting or domestic employment). I estimate Equation (11) on the set of firms that are observed at least once as purchasing posting services between 2017 and 2019. Recall that posted workers cannot move across workplaces that are not using posting services, as posted workers are never observed as domestic workers.

<sup>56</sup> As what has been estimated for domestic outsourcing by [Drenik, Jäger, Plotkin, and Schoefer \[2020\]](#), the dispersion of wage premia is similar across work arrangements: I estimate a raw standard deviation of 0.37 for the posted worker wage premium and 0.32 for the domestic worker wage premium.

<sup>57</sup> In the [Online Appendix](#), I present the same correlational plot without adjusting for sectors effects.

driven by tenure differences between posted and incumbent workers, I repeat the analysis looking at the relationship between incumbent domestic workers and newly hired domestic workers at the receiving firm (blue dots). I find that there is a much stronger relationship between newly hired workers and incumbent workers when they are hired through regular rather than posting arrangements (0.65 versus 0.21 slope).<sup>58</sup> I confirm this finding by estimating the elasticity of estimated premia received by posted workers ( $\psi_J^P$ ) and domestic workers ( $\psi_J^R$ ), following [Card, Cardoso, and Kline \[2016\]](#) and [Drenik et al. \[2020\]](#):

$$\psi_J^P = \alpha + \rho\psi_J^R + u_J. \quad (12)$$

Panel B of Figure 11 shows the binned relationship between domestic and posted workers workplace effects.<sup>59</sup> The estimate of  $\rho$  is 0.11 (0.01), meaning that the pass-through of the firm-level wage premium to posted workers is essentially nil. Posted workers do not share firm's rent compared to domestic workers employed at the same workplace, suggesting receiving firms can cut labor costs by relying on on-site offshoring.<sup>60</sup>

## 5 Mobile Services Export Surplus in Sending Countries

The past section provided evidence that cross-border provision of services is associated with displacement of domestic workers in receiving labor markets. What are the counterparts of that redistribution of market shares in services for sending countries? In this section, I document the export-mobility gains created by the posting policy in sending (mostly low wage) countries. I first estimate the gains from the posting policy at the industry-level. I then focus on sending-firms scale-up once they access foreign markets through cross-border provision of services.

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<sup>58</sup>I further show in [Online Appendix](#) that the slope between the incumbent and domestic outsourced worker wage is higher than the one between incumbent and posted workers (0.27 versus 0.21).

<sup>59</sup>As noted by [Card et al. \[2016\]](#) and [Drenik et al. \[2020\]](#), a normalization of workplace effects is necessary to interpret the elasticity as the amount of workplace premia earned by domestic workers that posted workers receive at higher paying firms. I thus follow [Drenik et al. \[2020\]](#) and normalize workplace effects to zero in the lowest decile for each type of work contract. The normalization does not affect the estimate of  $\rho$ .

<sup>60</sup>Pay-premium sharing between receiving firms and posted workers appears to be very moderate, particularly in comparison with what has been found for domestic outsourced workers. For comparison, [Drenik, Jäger, Plotkin, and Schoefer \[2020\]](#) compare workplace effects of temporary agency workers and regular workers in Argentina and find a slope of 0.49(0.007) indicating rent-sharing between receiving firms and workers in alternative work arrangements is five times lower for posting than domestic outsourcing. Many qualitative studies have shown that posted workers tend to have very low bargaining power: they are not covered by most receiving firms' work agreements, do not benefit from union representation in the receiving country, have low level of information about domestic workers due to language barriers, and have few direct interactions with receiving firms and domestic workers.

## 5.1 Industry-Level Expansion After the Posting Policy Liberalization

To shed light on economic gains created by the posting policy for sending countries, I focus on the service trade liberalization in Poland, that provides the most striking example of the European “posting success story”. Poland became the first supplier of posting services in Europe in 2004. Postings from Poland increased rapidly right after the end of posting restrictions in 2004, to reach an average level of 250,000 postings per year, leading the country to account for 20% of overall posting outflows while accounting for 7% of the overall European active population (Figure A.17, Panel A).

To study the effects of the 2004 export opportunity shock, I compare employment in non-tradable sectors affected and unaffected by the liberalization, before and after the 2004 accession, in Poland versus a comparable neighboring country that did not benefit from the liberalization. I use health and public sectors as controls as these are covered by licensing regulations that limit posting services provision in these sectors. To avoid picking up effects driven by simultaneous standard trade openness, I focus on construction as the only “pure” non-tradable sector treated by the liberalization reform.<sup>61</sup> Panel B of Figure A.17 shows that 50% of postings from Poland occur in the construction sector, while postings in health or public administration are almost 0%.

I use Ukraine as an additional control group. Ukraine shares a border with Poland and is of similar size, but it was not included in the first and second European enlargements: unlike Poland, the country did not gain the right to supply mobile services in 2004. Geographical and economic factors that could affect sectoral employment besides EU accession should therefore be similar in the two countries.<sup>62</sup> Ultimately, using Ukraine as a placebo hinges on the assumption that determinants of EU accession are not correlated with the *differential* evolution of postable and non-postable sectors, which seems plausible.

Panel A of Figure A.25 shows the evolution of domestic employment in exposed and unexposed sectors, before and after suppliers in the treated sector gained the right to supply services abroad through posting. Before 2004, treated and control sectors experienced very similar employment trends. Domestic employment in the Polish construction sector started to boom right after the liberalization, with an increase of more than 600,000 workers between 2004 and 2007. Employment in the sector treated by the reform stayed permanently high relative to its pre-2004 level and relative to the evolution observed for control sectors in the same country. Panel B of Figure A.25 shows that in the placebo country, employment trends in exposed versus sheltered sectors did not diverge in 2004, suggesting the effect detected in Poland

<sup>61</sup>Trade tariffs were, however, abolished gradually between 1990 and 2004 in preparation of Poland accession in 2004. For instance, the trade of industrial goods with the EU-15 was almost completely liberalized in 1999 under the provisions of the Europe Agreements.

<sup>62</sup>Of course, differences in EU accession are partially determined by differences in countries’ development and openness, which may in turn affect employment dynamics. However, the level of development in Ukraine was sufficient over the period to lead to an EU association agreement, which was later unexpectedly canceled due to the election of a pro-Russian leader.

is caused by the liberalization shock rather than sectoral-specific trends common to Ukraine and Poland. The triple differences estimates suggest that non-tradable employment in the sending country increased by 17% in the exposed sector after on-site offshoring was liberalized.

## 5.2 Sending-Firm-Level Mobile Services Export Gains

Figure A.25 provides motivating evidence that the trade liberalization in services triggers substantial gains in sending countries' non-tradable sectors. To better characterize gains from trade in non-tradables, I leverage granular data on firms exporting posting services within the EU.

The main dataset for the analysis is an administrative tax dataset covering the universe of non-financial corporations established in Portugal merged with exhaustive information on provision of services abroad by Portuguese firms over the period 2006-2017. Portugal provides an ideal laboratory to study non-tradable service trade because it is a low-wage country, relatively well endowed in labor, and is the top exporter of posting services in main receiving countries such as France and Belgium. To identify posting flows, I use the methodology of central banks and identify five-digit sector codes where cross-border supply of services can only be provided through posting of workers abroad.<sup>63</sup>

I start from the universe of Portuguese firms in "non-tradable" sectors for which I can observe all services provided abroad reported by each firm to the tax administration for the period 2006-2017.<sup>64</sup> Of these firms, I use the exhaustive information on provision of services to an EU country to identify the 4,151 firms that started posting workers to another member state between 2010 and 2015.<sup>65</sup> The average (and median) posting firm is small, employing a mean of 16 (7) workers in 2009 and operating in the construction of residential buildings (39%), road transportation (19%), electrical installation (5.2%), temporary employment provision (2.5%), and plumbing installation (2.4%). The posting export represents an average (median) of 40% (22%) of the posting firms' turnover in the first year when they start posting abroad.

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<sup>63</sup>The analysis is thus restricted to non-tradable sectors that can only export their services through posting of workers following the MSITS 2010 classification, listed in the [Online Appendix](#). The dataset and methodology are further described in detail in the [Online Appendix](#).

<sup>64</sup>I focus on those who have at least a median of three workers across all years of activities. I also drop a minor number of firms that performed services in a country outside the EU, as these services provisions are not covered by the European posting regulation but by the restricted posting policy for non-EU member states.

<sup>65</sup>I restrict the treatment definition to firms that start providing services abroad for the first time in 2010 such that I can observe treated firms at least four years before the event and two years after. It allows me to define correctly their first "export event time" and to verify that firms that export services in 2010 were effectively not posting workers from 2006 to 2010. I further follow [Alfaro-Ureña et al. \[2019\]](#) by focusing only on firms with a median of three employees over the period. The [Online Appendix](#) provides descriptive statistics on all posting firms as well as an estimation sample coverage.

### 5.2.1 Identification Strategy

To uncover the effects triggered by posting in sending firms, I use an event study framework that investigates the effects for suppliers to provide their non-tradable services abroad for the first time.<sup>66</sup> Between 2010 and 2015, 4,151 events occur in Portugal among the 27 sectors in which non-tradable services exports can be identified in my administrative tax dataset. The empirical specification is

$$y_{it} = \alpha_i + \lambda_{spt} + \sum_{k=\underline{T}}^{\bar{T}} D_{it}^k \theta_k + \varepsilon_{it}, \quad (13)$$

where  $y_{it}$  is an outcome variable (in log) for firm  $i$  in calendar year  $t$  and  $\alpha_i$  is a firm fixed effect.  $\lambda_{sptz}$  are five-digit sector  $\times$  district  $\times$  calendar year fixed effects. The event time dummies  $D_{it}^k$  are defined as  $D_{it}^k = \mathbb{1}.[t = d_i + k] \forall k \in (\underline{T}, \bar{T})$ ,  $D_{it}^{\underline{T}} = \mathbb{1}.[t \leq d_i + \underline{T}]$ , and  $D_{it}^{\bar{T}} = \mathbb{1}.[t \geq d_i + \bar{T}]$ , where  $\mathbb{1}$  is the indicator function and  $d_i$  is the first year when firm  $i$  starts posting workers abroad. I normalize  $\theta_{-1} = 0$  and set  $\underline{T} = -5$  and  $\bar{T} = +5$ . I cluster standard errors at the province  $\times$  event time level to account for spatial correlation in error terms as in [Alfaro-Ureña et al. \[2019\]](#).

The sequence of coefficients  $\theta_k$  describes the dynamic of firms' outcomes around the event of the first service performed abroad. By comparing exclusively firms that export their services at some point between 2010 and 2015, the event study design conveniently rules out any selection issue related to the "exporter premium."<sup>67</sup> Formally, estimated  $\theta_k$  compare the outcomes of posting firms in event year  $k$  to the outcomes of future posting firms in the same narrowly defined sector and province in the year before their event. As in Equation (8), the binning of event time coefficients at the ends of the event window allows me to introduce both year and firm fixed effects ([Borusyak and Jaravel \[2017\]](#), [Schmidheiny and Siegloch \[2019\]](#)).

The main question addressed by my event study design is how services suppliers outcomes would evolve in the absence of the export opportunity opened by the posting policy. My identification strategy relies on the assumption that firms that will post workers in the future form a credible counterfactual for firms that start posting workers after accounting for time-invariant differences between firms and common sector-district-year shocks. Interpreting the sequence of estimated  $\theta_k$  as the causal effects of the mobility-related export opportunity requires that firms do not select into posting based on firm-specific shocks that would be correlated with firms' outcomes *in the absence of the posting policy*. What matters for identification

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<sup>66</sup>In spirit the exercise is similar to studies that investigate the effects of exporting or joining a global value chains on firms' performances such as [Alfaro-Ureña, Manelici, and Vasquez \[2019\]](#).

<sup>67</sup>Table A.12 shows the exporter premium and reports differences between firms that export or do not export non-tradable services. Following what has been found in the literature, exporting firms tend to be systematically different from non-exporting firms. The exporter premium is, however, lower in non-tradable services than in standard manufacturing, suggesting lower entry costs into exporting in service trade.

is not that the timing of posting is random but rather the observed changes in posting firms' outcomes after the event require that firms have the ability to use posting mobility to access foreign markets. The counterfactual I am interested in is not what would happen to exporters if they had not chosen to take up the posting opportunity but instead what would happen to exporters in a world where they are constrained to provide services solely in the domestic market (no posting mobility). The only threat to identification lies in firm-specific shocks that (i) affect the timing of posting of workers, (ii) affect firms' outcomes after the event of first services exports, (iii) do not affect firms' outcomes before the event, and (iv) would affect firms' outcomes after the event even in the absence of the service export opportunity.<sup>68</sup>

Ultimately, it is difficult to identify these unobserved factors without additional data on firm-specific shocks. The results from the event studies regressions will allow me to evaluate whether the timing of first posting is driven by the past differential evolution of outcomes between the treated and the control group. Focusing on non-tradable sectors further restricts potential unobserved shocks caused by automation or innovation events that could affect firms' performances in domestic markets even in the absence of exporting opportunities. To gauge whether firm-level shocks simultaneous to the posting event affect firms' activity at home, in Section 5.2.2 I investigate what happens to a firm's domestic sales when it starts providing services abroad. I then exploit differences in posting missions across treated firms to show that the posting export event is the prime driver of the estimated  $\theta_k$ . Finally, in Section 5.1.4 I compare posting firms' outcomes to those of similar firms operating in sectors shielded from posting opportunities.

### 5.2.2 Baseline Results on Sending-Firms Scale

In a world where companies are allowed to provide services abroad through posted workers, how much do they gain in doing so? Figure 12 plots the event study coefficients estimates for firms' total employment, turnover, assets, total hours worked, cash deposit, and wage bill, with corresponding estimates displayed in Table 6. The results show that providing non-tradable services abroad is associated with a large and permanent expansion of services supplier activity. The second year after the first posting export, total employment in sending firms increases by 30%, turnover and hours of work increase by 56%, and total wage bill increases by 72%, compared to firms that have not yet posted workers that year. The increase in sending firms' sales triggered by the mobile services export opportunity is not purely driven by a price effect, as services suppliers significantly scale up their use of labor inputs. In addition to increasing total hours

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<sup>68</sup>If a services supplier experiences a productivity shock in a given year, and if this productivity shock leads the firms to post workers this given year and this productivity shock would boost firms' activity even without the possibility of providing services abroad, then the interpretation of  $\theta_k$  as the effects of the posting opportunity are biased. If a services supplier starts posting workers abroad because of an information shock or a demand shock from a foreign customer, the identifying assumption is not violated. Similarly, if a services supplier innovates in a given year, and if this innovation allows this firm to provide services abroad but would not affect firms' sales at home in the absence of the posting opportunity, the estimated coefficients can still be interpreted as the gains created by the posting opportunity for firms.

of work, sending firms also grow at the extensive margin and hire significantly more employees. I find no evidence of selection into posting based on past firm growth in terms of economic activity, suggesting the timing of the first posting is not correlated with past differential evolution in outcomes across firms. It is only after sending firms start providing non-tradable services abroad that they experience strong growth.

To prove that posting is driving such gains, rather than unobserved firm-level shocks, I exploit heterogeneities in duration of posting missions across firms. I run Equation (13) separately for each of treatment duration groups in order to show heterogeneities in export gains depending on posting take-up duration.<sup>69</sup> Figure 13 shows that firm-level scale-up effects are simultaneous to the posting mission but do not last after the firm stops providing services abroad. For firms that post workers for three years consecutively, wage rates, profits, and employment start to significantly increase the year of the event relative to the pre-posting event but return to their pre-posting level in fourth year, e.g., when the posting mission ends. By contrast, the treatment effects are larger and last for firms that keep posting workers abroad permanently after their first non-tradable export. Figure 13 shows clear evidence that the posting opportunity is driving the large changes in firm-level outcomes, rather than other shocks.

### 5.2.3 Distribution of Posting Gains: Capitalists, Workers and Government

How is the increase in firms' activity triggered by the mobile services export opportunity shared between workers, firms and government in sending countries? I plot in Figure A.21 social security contributions and income taxes paid by sending firms around the event of the first services export. As sending firms' expand their wage bill after posting, social security contributions paid by sending companies start to increase right after they start supplying non-tradable services abroad. Sending firms also increase their corporate income tax payments once they start providing services abroad. Those results emphasize the radically different fiscal implications of trade-related mobility compared to standard migration: while emigration leads to tax losses, posted workers generate additional (substantial) tax revenues for sending governments.

I then investigate the effects of non-tradables exports on sending firms' profit and wages. Panel A of Figure 14 plots the event study coefficients with 95% confidence intervals for firms' hourly wage rates estimated from Equation (13) on the restricted sample of treated firms, with corresponding estimates displayed in Table 7. Wages of workers in firms that have yet to post workers evolve similarly before the event. The wage rate in sending firms starts to increase the year of the first posting provision compared to firms that do not yet export non-tradables this year and are in the same five-digit sector and province. Wage rate increases by 14% in treated firms two years after they start providing services abroad relative to the pre-

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<sup>69</sup>I divide my baseline group of treated firms into five groups: firms that are only posting during one year, firms posting for two consecutive years, firms posting for three consecutive years, firms posting for four consecutive years, and firms that keep posting workers for the entire period of observation after their first posting. The distribution of first posting events and their duration over time is described in the [Online Appendix](#).

posting year and relative to wages in firms that do not post workers yet. The increase in posting firms' hourly wages is persistent, stable, and statistically significant at the 1% level for the five-plus years after the event. Panel B of Figure 14 shows similar estimates for sending firms' profits. Firms that post workers and firms that are yet to post workers thus face similar profits evolution before the event, while earnings of sending firms compared to control firms increase by 9% the year of the first posting. Profits then increase by 37% in treated firms two years after they start providing services abroad relative to the pre-posting year and to profits in firms that do not post workers yet. Those results outline that capital owners derive profit gains from non-tradable services exports that are twice larger than wage gains redistributed to employees. It is even clearer focusing on the sample of permanent exporters of posting services, limiting noise in the measure of sending firms' profits. Figure A.22 shows the large differences in wages and profits gains split at sending firms.

**The Role of the Posting Policy in Explaining Posted Workers' Wage Gains** Are posted workers' wage gains explained by the service trade policy? Posted workers cannot be paid under the destination-level minimum legal wage, forcing sending firms to pay an additional posting allowance to their workers in some cases. I provide suggestive evidence of this mechanism in two successive steps.

While the firm-level data do not contain information on destination countries linked to each posting mission, I observe the decomposition of aggregate exports of posting services from Portugal in the EU-wide dataset on bilateral posting flows. Figure A.34, panel A, shows that most of posting services supplied by Portuguese firms are performed in high-wage countries. The average destination minimum legal wage faced by Portuguese firms is much higher than the level of wages paid by these firms before the posting mission (Figure A.34, panel B). It suggests that sending firms may indeed be constrained to pay higher wages due to posting policy. To verify this assumption, I re-estimate my baseline specification separately on the sample of sending firms with pre-posting wages below or above the average destination-level minimum wage index. Figure A.35 confirms that only firms with wages below the destination-level minimum legal wage increase their workers' wages during the posting mission. That provides suggestive evidence that wage gains are driven by the trade policy, rather than surplus-sharing.

The ideal test for that assumption requires to access similar data in a country that is not constrained by destination-level minimum wage policies. I use an additional administrative dataset on postings with heterogeneities in prevailing wage bindingness across sending countries. Luxembourg has the highest minimum legal wage in the EU<sup>70</sup> and therefore posting firms in Luxembourg are not constrained by the prevailing wage policy, while Portuguese firms are.<sup>71</sup> I use administrative exhaustive data on posting firms

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<sup>70</sup>1,921 euros per month in 2015 versus 589 euros in Portugal

<sup>71</sup>This is exemplified in the [Online Appendix](#), which displays the distribution of wages paid to workers posted to France by

in Luxembourg to repeat my baseline analysis.<sup>72</sup> If wage gains are explained by the destination-specific minimum wage rules, workers posted from Luxembourg should not benefit from wage gains when posted abroad. To ensure posting wage gains in Portugal and Luxembourg are comparable, I first show that posting firms located in Luxembourg exhibit a remarkably similar scale-up in terms of labor inputs (employment, hours of work) when they start exporting non-tradable services abroad compared to similar firms in Portugal. More specifically, I re-estimate Equation (13) for sending firms located in Luxembourg to compare those estimates with the baseline results for Portugal displayed in Figure 14. Results are displayed in Figure A.23. Remarkably, I find a strikingly similar growth in firms' employment and hours of work after that they start posting workers abroad, despite the estimates being performed in two different datasets and two different countries. I then investigate how this similar scale-up in posting firms' activity translates into potentially different posted worker wage increases in Luxembourg and Portugal. Panel C compares the evolution of (log) wage in posting companies before and after they start providing services abroad, for firms located in Portugal (red line) or Luxembourg (black line). While Portuguese employees experience a substantial increase in wages after their employer starts to provide non-tradable services abroad, employees of services suppliers based in Luxembourg do not benefit from wages increases when the posting mission starts. A similar scale-up in posting firms' activity after they start providing services abroad thus translates into important wage gains in the sending country constrained to pay a minimum allowance to its workers and no wage gains in the sending country not constrained by the destination-level policy. That provides support for interpreting the 10%-15% posting gains in the worker wage rate in Portugal as the result of destination-specific regulation rather than bargaining over surplus sharing between firms and workers.

#### 5.2.4 Alternative Specifications and Robustness

I run several alternative specifications to check the robustness of the baseline estimates. The estimates are robust to using an additional control group of (i) firms shielded from the opportunity to provide services abroad even through mobile workers (Figure A.29) and (ii) never-posting firms matched with posting firms on pre-event variables (Figure A.33). I follow the rule-of-thumb tests suggested by [Borusyak and Jaravel \[2017\]](#) and [Schmidheiny and Siegloch \[2019\]](#) by showing that the estimates are not drastically changed when omitting unit fixed effects or estimating the model in semi-dynamic rather than fully dynamic form

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location of services suppliers. No workers posted from Luxembourg are paid at the French-level minimum wage, while almost 40% of Portuguese posted workers' exhibit a bunching at the minimum wage, suggesting that for these workers, the prevailing receiving country's minimum wage is binding.

<sup>72</sup>The dataset is described in the [Online Appendix](#) and consists of linked employer-employee data merged with information on E101/A1 form issued by all firms in Luxembourg.

(Figure A.30, Panel A).<sup>73</sup> Therefore, the estimates accounting for heterogeneous treatment effects and negative weighting using the estimator developed in De Chaisemartin and d'Haultfoeuille [2019] are similar (figure A.20, figure A.19). To prove my results are not driven by biases due to the composition of the estimation sample, I also show that the estimates are robust to balancing the panel around the event time (Figure A.32). Finally, I run a placebo analysis by estimating Equation (13) on event times randomly assigned to my baseline estimation sample of 4,151 treated firms. Reassuringly, the estimates displayed in Figure A.31 show that no significant treatment effect of the placebo export event times can be detected

### 5.2.5 Magnitude and Incidence of Posting Gains: Lessons for Posting Policies

Following these large estimated gains, what are the lessons for posting policies, and the current negotiations regarding liberalization of these policies in new generation trade agreements. To put the results in the perspective of the policy debate, two questions remain to be answered: how large are these gains as compared to more standard trade policies, and who do they benefit to?

To gauge the size of the gains from non-tradable trade compared to more standard globalization channel, I benchmark the posting gains with comparable estimates for manufacturing trade, repeating the baseline event study of Equation (13) on the sample of manufacturing exporters.<sup>74</sup> Figure A.24 shows that manufacturing exporters experience a similar dynamic scale-up in their activity after they start exporting goods in foreign markets.<sup>75</sup> Figure 15, Panel A, summarizes the average gains from trade, measured by  $\theta_k$ , from usually studied international integration channel (standard manufacturing exports, blue bars) and the novel integration channel (pink bars). Exporters of “non-tradable” services experience a similar growth (relative to their own pre-event size) in terms of sales and employment. The posting policy generates gains in sending countries of similar magnitude than standard exports, or standard FDI, the usual focus of industrial policies in low-wage countries. Given the size of the export-mobility opportunities opened by the posting policy, countries with competitive advantage in services have large incentives to lift barriers to cross-border provision of services.

The incidence of the gains, however, appears to be different. Figure 15, Panel B, describes the average differences between usual exporters, and firms that export manual services. Companies that benefit from the alternative trade instruments are significantly smaller, less capital intensive and less profitable than standard exporters. In addition of being smaller compared to usual exporters, firms that access foreign markets through posting are also younger and face lower barriers to exports, as compared to what

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<sup>73</sup>When the estimates are largely affected by the omission of unit fixed effects, this could also indicate that negative weighting across treatment groups can represent a significant bias.

<sup>74</sup>Table A.12 provides descriptive statistics on manufacturing exporters and compares them to posting firms.

<sup>75</sup>The estimated gains from non-tradable services’ exports are also close in magnitude to those of Alfaro-Ureña et al. [2019] that focus on the effects for firms to start supplying to multinationals in Costa-Rica.

is observed in manufacturing. Table A.12, column (1) and (2), show that the *exporter premium*, defined as the average difference between exporters and non-exporters outcomes within a given sector (Bernard et al. [2007]), is smaller in posting services than in manufacturing. Exporters are bigger than non-exporters in both sectors, but the selection into exporting based on firms' size and profitability is twice smaller in exports through posting policies. Consistent with this finding, Figure A.27, Panel A, shows that manufacturing exporters must pre-invest in machines before being able to reach foreign clients, while services suppliers can sell abroad without differential pre-investments compared to non-exporters. This is also consistent with the share of newly created firms among exporters being twice lower in manufacturing than in services supply (Table A.13).<sup>76</sup> The redistributive implications of liberalizing cross-border provision of services may thus be different compared to standard trade policies focused on manufacturing.

If firms benefitting from the novel integration channel are different than usual exporters, the long-term implications of these novel micro gains from trade seem to have different long-run implications. While firms (mechanically) increase their sales abroad when they start supplying services in another EU member state, they simultaneously *decrease* their domestic sales. In contrast, manufacturing exporters sell more at home after their first export. A possible rationale for this result is that services suppliers are constrained in their ability to serve both markets once they obtain a service contract abroad, while manufacturing firms can smoothly scale up their supplies once they increased their stock of assets. Services trade liberalization may thus generate different spillovers for domestic customers compared to standard trade openness.<sup>77</sup> Increases of tangible assets are also noticeably larger at manufacturing exporters. While sending firms exhibit a larger stock of assets after exporting non-tradable services, the effect is driven by cash holdings rather than tangible assets due to low capital intensity of services supply (Figure 12, Figure E). Figure 13 showed that firms do not grow permanently after the posting mission ends, suggesting that firms operating in non-tradable sectors exhibit little learning by exporting, which is consistent with manual services being characterized by weaker scope for productivity gains.<sup>78</sup> The (large) estimated export surplus opened by the posting policy thus appears to be driven by increased market shares abroad rather than structural changes at the sending company.

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<sup>76</sup>This is consistent with Ariu [2016] that finds that exporters of services (all services, not specifically non tradable services) tend to have higher entry rates than manufacturing firms.

<sup>77</sup>A second rationale could be that manufacturing firms are more likely to start exporting once they experience an unobserved firm-level shock, such as innovation or automation, that simultaneously affects their ability to sell goods in foreign and domestic markets.

<sup>78</sup>I also test how TFP evolved in sending firms after they start posting workers abroad. I measure TFP assuming a standard Cobb-Douglas technology, using a simple OLS framework where sales are the dependent variable and where employment, net assets and material costs, are used as time-varying controls. To take into account potential endogeneity in input choices at the services supplier level, I also use methods proposed by Ackerberg, Caves, and Frazer [2015]. The results in Figure A.26 show that sending firms exhibit limited TFP changes after they start posting workers abroad. These TFP changes could be further driven by changes in margins or prices when providing services abroad.

## 6 Consumer Gains From Liberalizing “Non-Tradable” Service Trade

The liberalization of cross-border provision of services displaced low-paid workers in receiving countries, while allowing sending-firms in low wage countries to experience substantial growth. What is the magnitude of the efficiency gains from such reallocation of market shares in services? I close the paper by turning to the consumer gains created by the liberalization in Europe, building on a standard conceptual framework for the cross-border sourcing of services.

### 6.1 A Model of Cross-Border Provision of Services

I use a model of service trade drawing on standard [Eaton and Kortum \[2002\]](#). I consider a world with a finite number of countries  $i \in S$  and a continuum of services  $\Omega_n$  that every country can produce. In this world, services can be supplied by foreign countries through the geographical mobility of workers.

#### 6.1.1 Demand of Services

A representative consumer in country  $j$  with CES preferences consumes services:

$$U_j = \left( \int_{\Omega_n} S_j(n) dn \right)^{\frac{\sigma}{\sigma-1}},$$

where  $\Omega_n$  is the set of non-tradable services and  $S_j(n)$  is the quantity of services  $n$  consumed by country  $j$ . The CES preference yields a Dixit-Stiglitz price index:

$$P_j = \left( \int_{\Omega_n} p_j(n)^{1-\sigma} dn \right)^{\frac{1}{1-\sigma}}. \quad (14)$$

#### 6.1.2 Supply of Services

Services are produced by combining hours of labor with country  $i$ 's efficiency in producing services  $n z_i(n)$ . Unit labor costs in sending countries are wages paid to workers divided by productivity  $w_i/z_i$ . Services suppliers must pay payroll taxes  $\tau_i$ . To supply services from one country  $i$  to another country  $j$ , there are mobility costs and frictions  $m_{ij}$  that resemble the standard iceberg trade cost.

Foreign services suppliers may be subject to additional destination-level rules. Prevailing wage and tax policies imply that suppliers located in some countries must top up their sending country's wage level with an additional posting allowance to post workers to country  $j$ , which is captured by the general term  $a_{ij}$ . In the current posting policy, a posting allowance tops up the sending country's wage level to reach the minimum legal wage of the receiving country. This term is zero if the receiving country does not have

a minimum legal wage, if the sending country's wage level is higher than the prevailing wage, or if the service is produced at home.<sup>79</sup> The unit labor cost for services performed by workers posted from  $i$  to  $j$  is

$$C_{ij}(n) = \frac{w_i}{z_i(n)} (1 + \tau_i + a_{ij}) (m_{ij}) = \frac{c_{ij}}{z_i(n)}. \quad (15)$$

There is perfect competition across service suppliers. Each service is purchased from the country that offers the service at the lowest unit labor cost, including posting bilateral cost. Using the assumption of Fréchet distributed productivity such as  $F_i(a) = \exp\left\{-\left(T_i z\right)^{-\theta}\right\}$ , I can derive for each service  $n$  the probability that  $i$  provides the lowest price service in country  $j$ . The share of services in country  $j$  performed by workers posted from country  $i$  is given by

$$\lambda_{ij} = \frac{T_i(c_{ij})^{-\theta}}{\sum_{k \in S} T_k(c_{kj})^{-\theta}} = T_i(w_i(1 + \tau_i + a_{ij})(m_{ij}))^{-\theta} \Phi_j^{-1}, \quad (16)$$

where  $\Phi_j = \left[\sum_{k \in S} T_k(w_k(1 + \tau_k + a_{kj})(m_{kj}))^{-\theta}\right]$ . Denoting  $S_j$  the number of services demanded in country  $j$ , the number of services performed in  $j$  by workers posted from  $i$  is

$$S_{ij} = \lambda_{ij} S_j = S_j T_i(c_{ij})^{-\theta} \Phi_j^{-1}. \quad (17)$$

### 6.1.3 Equilibrium, Welfare and Counterfactual Analysis

I use market clearing conditions to close the model. I denote  $X_{ij}$  the expenditure of country  $j$  on services produced by workers posted from country  $i$  and  $X_j = \sum_i X_{ij}$  is country  $j$ 's total spending in services, and  $X_{ij} = \lambda_{ij} X_j$ .<sup>80</sup> From Equation (16) we can write  $X_{ij} = T_i(c_{ij})^{-\theta} \Phi_j^{-1} X_j$ . In equilibrium, total income in country  $i$  must be equal to total spending on services from country  $i$  such that

$$Y_i = \sum_j \frac{T_i w_i^{-\theta} (1 + \tau_i + a_{ij})^{-\theta} (m_{ij})^{-\theta}}{\sum_k T_k w_k^{-\theta} (1 + \tau_k + m_{kj})^{-\theta} (m_{kj})^{-\theta}} Y_j. \quad (18)$$

From the CES preferences of the final consumer, the welfare of individuals is given by a combination of their income and the price index they face. One question when thinking about consumer welfare in this paper's context is whether the price index is one of receiving or sending countries. Most of the time, the posting of workers describes a temporary work mission abroad where most of the workers' consumption is

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<sup>79</sup>Formally, to post a worker from  $i$  to country  $j$  where the destination-level minimum legal wage applicable to posted workers is  $\bar{w}_j$ , the supplier pays  $w_i + w_i \tau_i + \mathbb{1}_{w_i < \bar{w}_j} (\bar{w}_j - w_i)$ , which I write as  $w_i(1 + \tau_i + a_{ij})$ .

<sup>80</sup>It follows from the Fréchet assumption that the fraction of services purchased from a particular sending country  $\lambda_{ij}$  is equal to the fraction of country  $j$ 's income spent on services produced by country  $i$ , which I denote  $\Pi_{ij}$ . Closing the model with equilibrium conditions follows standard derivations.

paid off by employers.<sup>81</sup> I thus use the simplifying assumption that a representative consumer of country  $i$  earns consumes in his sending country. Welfare of the representative consumer in country  $i$  is:

$$W_i = \frac{w_i(1 + \tau_i + a_{ij})}{P_i}. \quad (19)$$

From Equation (16) and the price equilibrium, we have  $\lambda_{ij} = T_i C^{-\theta} w_i^{-\theta} (1 + \tau_i + a_{ij})^{-\theta} (m_{ij})^{-\theta} P_j^\theta$ .<sup>82</sup> As in [Arkolakis, Costinot, and Rodríguez-Clare \[2012\]](#), using the fact that  $m_{ii} = 1$ , welfare can be expressed as a function of domestic non-tradable services share  $\lambda_{ii}$  and the structural posting elasticity parameter:

$$W_i = \lambda_{ii}^{-\frac{1}{\theta}} C^{-1} T_i^{\frac{1}{\theta}}, \quad \hat{W}_i = \lambda_{ii}^{-\frac{1}{\theta}} \quad (20)$$

A change in the representative consumer welfare of country  $i$  after a given posting policy shock can be inferred from changes in equilibrium changes in posting shares ( $\hat{\lambda}_{ii}$ ) and the posting elasticity ( $\theta$ ). In the range class of trade models resembling Equation (16), one can rely on “exact hat algebra” ([Dekle et al. \[2008\]](#)) to express the counterfactual trade flows after a policy shock. Denoting the ratio of the variables in the new and old equilibrium following a change in posting frictions as  $\hat{x} = x' / x$ , the consumption shares (in services) after the policy change are given by

$$\hat{\lambda}_{ij} = \frac{\hat{T}_i (\hat{w}_i (1 + \hat{\tau}_i + \hat{a}_{ij}) (\hat{m}_{ij}))^{-\theta}}{\sum_k \lambda_{kj} \hat{T}_k (\hat{w}_k (1 + \hat{\tau}_k + \hat{a}_{kj}) (\hat{m}_{kj}))^{-\theta}}. \quad (21)$$

On the other hand, using Equation (18) and Equation (22),

$$\hat{Y}_i Y_i = \sum_j \frac{\lambda_{ij} \hat{T}_i (\hat{w}_i (1 + \hat{\tau}_i + \hat{a}_{ij}) (\hat{m}_{ij}))^{-\theta}}{\sum_k \lambda_{kj} \hat{T}_k (\hat{w}_k (1 + \hat{\tau}_k + \hat{a}_{ik}) (\hat{m}_{kj}))^{-\theta}} \hat{Y}_j Y_j. \quad (22)$$

I obtain a system of equations from which I can get  $\hat{Y}_i$  as a function of policy shocks and initial observables. To simulate the effects of a policy shock  $\hat{m}_{ij}$  accounting for general equilibrium changes, Equation (21) allows me to combine observed  $\lambda_{kj}$  with estimates of  $\theta$ .

Importantly, the model focuses on the service sector only, which has two main implications for the interpretation of the results. First, the overall welfare effects of posting policy shocks will capture real wages changes in the service sector and need to be scaled-down by the share of services in overall consumption. Second, one assumption required to close the model is that trade is balanced in the equilibrium. Such assumption may however be restrictive when focusing on services only e.g countries exporting more services abroad may consume more goods than services from abroad.

<sup>81</sup>For instance, micro administrative data from France show that for 80% of posting missions, workers’ housing, food, and trip were paid by firms and not by the workers themselves.

<sup>82</sup>With  $C = \Gamma(\frac{\theta+1-\sigma}{\theta})$  and  $\Gamma(t) = \int_0^\infty x^{t-1} e^{-x} dx$  the Gamma function.

## 6.2 Theory-Consistent Estimates of the Posting Elasticity

A central parameter to quantify the welfare effects of the posting policy is the structural elasticity  $\theta$ . To shed light on cross-border services responsiveness, I start by documenting the empirical relationship between posting flows and labor cost at the aggregate level. The “origin-based” tax treatment of posted workers generates origin-specific labor cost variations within a receiving country: workers posted from low-tax countries are cheaper to hire than domestic workers at the same workplace. Figure 16 shows that a tight aggregate relationship holds between posting flows and labor cost differentials: workers tend to be posted from low to high labor cost countries, with a cross-sectional correlation between (log) posting flows and (log) destination-origin payroll tax ratios of 0.52. If the cross-sectional relationship is informative of the steady-state impact of payroll taxes on posting flows, many factors could be simultaneously correlated with employers’ labor costs and the magnitude of mobility-dependent trade. To properly estimate the causal effect of labor cost policies on posting flows, it is crucial to exploit exogenous variations in labor costs while controlling for these simultaneous factors. I thus estimate the model-based Equation (17), using as a dependent variable  $S_{ijt}$  the number of postings from country  $i$  to  $j$  at time  $t$  and controlling for all structural determinants of supply and demand of services’ flows

$$S_{ijt} = \exp \{ -\theta \ln(w_{it}(1 + \tau_{it} + a_{ijt})) - \theta \ln(m_{ij}) - \ln(\Phi_{jt} S_{jt}) + \theta \ln T_i \}. \quad (23)$$

The main challenge in recovering the posting elasticity  $\theta$  is to exploit exogenous variations in the posting cost, accounting for simultaneous shocks that affect demand and supply of cross-border services within a given country pair. I use payroll tax and minimum wage reforms in place of standard “trade tariffs” to identify the posting elasticity. I follow the best-practice methods for theory-consistent structural gravity estimations that are summarized in [Head and Mayer \[2014\]](#).

The results of the estimation of Equation (23) are displayed in Panel A of Table 8, using alternatively variations in payroll tax employers’ labor cost alone (top panel) and total wage cost (middle panel) to identify the posting elasticity parameter  $\theta$ . All specifications include destination-origin fixed effects (filtering-out  $m_{ij}$ ), destination-year fixed effects (filtering-out  $\Phi_{jt} S_{jt}$ ), and a free posting agreement dummy (filtering-out  $m_{ijt}$ ) and cluster standard errors at the destination-year level. The structural parameter  $\theta$  is identified by *origin-specific* payroll tax variations *within* receiving countries (workers posted from different countries pay different taxes in the same receiving country) as well as *origin-destination* minimum wage variations (workers posted from different countries are affected differentially by destination-level changes in minimum wage).

I find evidence of large and significant responses of bilateral posting flows to changes in labor costs.

Across all specifications, I find that the coefficient estimate of  $\theta$  is significant at the 1% level, with a median point estimate that lies above one. The lower bound 0.66 (0.21) is close to the steady-state correlation between labor cost differentials and posting flows observed in Figure 16, while the upper bound of 2.4 (0.28) is closer to the posting elasticities estimated in quasi-natural experiments. The median elasticity estimate based on the theory-consistent gravity equation is 1.1 and is reassuringly close to the reduced-form estimates displayed in Panel B of Table 8.

It has been well documented that the log-linearization of the multiplicative gravity equation can be biased by zero flows and heteroskedastic error terms ([Silva and Tenreyro \[2006\]](#)).<sup>83</sup> Following the rule of thumb in the literature, I estimate Equation (23) with both log-linear OLS and Poisson pseudo-maximum likelihood (PPML) estimators: estimates from OLS (Columns (2), (5), (9), and (12)) and PPML (Columns (3), (6), (10), and (13)) are reassuringly close. I also repeat the estimation with a Poisson regression using posting shares  $\lambda_{ijt}$  as the dependent variable, as suggested by [Eaton, Kortum, and Sotelo \[2012\]](#). Estimated elasticities displayed in Columns (7) and (14) show very similar effects when using that estimator.

As in standard trade models, my theoretical framework features a world where producers choose among and consume services supplied by domestic and foreign suppliers. To be fully consistent with theory, Equation (23) should therefore also reflect the differential use of domestic versus posted services. Columns (1), (4), (8), and (11) in Table 8 show the estimates of  $\theta$  including the domestic services  $S_{j,jt}$  in the estimation.<sup>84</sup> The magnitude and statistical significance of the estimates is unchanged when including domestic services supply in the structural gravity estimation. Columns (4)-(7) and (11)-(14) of Table 8 further present estimates of  $\theta$  from regressions weighted by the sending country's population to adjust for countries' size heterogeneities. The point estimates are slightly larger when using weights but lie in the same ballpark as estimates from unweighted regressions.

All specifications include a destination-year fixed effect absorbing all time-varying shocks from receiving countries that could affect demand for posting services in that country. The only source of confounding factors remains in origin-specific shocks that would be correlated with changes in labor cost and posting flows. I control for origin-year fixed effects in Column (15), thus filtering out all origin-year and destination-year shifters of posting flows demand and supply. With such controls, the identification rests on bilateral variations driven by origin-specific exposure to changes in the destination-level minimum wage implementation. I find that the posting elasticity is again remarkably stable, with a point estimate of 1.1 (0.3).

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<sup>83</sup>Data on bilateral posting flows are, however, less likely to be affected by zero flows compared to standard goods and services export flows, as there is no minimum reporting threshold for postings.

<sup>84</sup>To measure  $S_{j,jt}$ , the yearly number of domestic workers performing work for domestic producers established in  $j$ , I use total domestic employment in country  $j$  at time  $t$  minus the total number of workers posted from  $j$  at time  $t$  to work for other EU countries. This methodology is the counterpart for mobile services supply of the standard approach in the literature that uses domestic production minus total exports.

**Complementary Reduced Form Evidence** In Section C, I provide additional evidence of the causal effect of labor tax reforms on posting flows, focusing on the reduced form effects of country-level reforms. Exploiting three quasi-natural labor costs shocks induced by payroll tax reforms (in Belgium and Slovenia) and the introduction of a minimum wage (in Germany), and using a difference-in-differences approach, I find that posting flows significantly respond to policy-induced labor cost differentials. Remarkably, the three quasi-natural experiments, while affecting distinct components of posted labor costs in different countries and periods, yield close estimates of the posting elasticity, lying between 1.3 (0.27) and 1.6 (0.33). I finally show that 1) a reform limiting labor tax exemptions granted to workers posted from some countries and sectors significantly decreased treated flows (Figure A.39) and 2) the posting duration exhibits a substantial bunching at payroll tax exemption thresholds (Figure A.40). There is a striking similarity between the theory-consistent structural estimates and the three reduced-form estimates from quasi-experimental reforms, hinging on the credibility of these estimates.

Using alternative estimation methods and controlling for destination and origin shifters, estimates of the posting elasticity with respect to labor cost reforms  $\theta$  are extremely stable across all specifications, statistically significant at the 1% level with a median point estimate of 1.1, and an upper-bound of 2.4. Interestingly, the posting elasticity is lower than the standard “trade in goods” elasticity, which is around 4 ([Head and Mayer \[2014\]](#)), and closer to the international migration elasticity, which is usually closer to unity ([Caliendo, Oromolla, Parro, and Sforza \[2017\]](#); [Kleven, Landais, Munoz, and Stantcheva \[2020\]](#)). That is fully consistent with posting being simultaneously a trade and migration flow. Non-tradables trade is thus not only affected by different policies compared to standard trade but also characterized by different responsiveness to these different policies. Given the magnitude of these differences, Table 8 provides key and new parameters to inform discussions on the trade liberalization of services.

### 6.3 Model-Based Welfare Calibration

I use the model’s structure to assess the welfare effects of the service trade liberalization in Europe, accounting for general equilibrium changes in countries’ income. I consider the liberalization of the posting policy for NMS as my main experiment. I combine my estimated reduced-form coefficient  $\beta$  (1.8) on a dummy for the reform estimated from Equation (1) with the estimates of  $\theta$ . It allows me to measure  $\hat{m}_{ij}$  the structural change in service trade cost following the liberalization of the posting policy to NMS.

Using the initial value of service production of each member state ( $Y_i$ ) and the original posting shares ( $\lambda_{ij}$ ), I can plug the estimated change in posting cost  $\hat{m}_{ij}$  into Equation (22), which defines a system of equations determining  $\hat{Y}_i$  for each member state. Using my structural estimates of  $\theta$ , I can substitute the change in posting frictions  $\hat{m}_{ij}$  and in income  $\hat{Y}_i$  into Equation (21) to obtain the matrix of posting shares

change  $\hat{\lambda}_{ij}$ . I iterate this procedure using a dampening factor until  $\hat{\lambda}_{ij}$  stops changing, and can finally express the change in welfare induced by the liberalization by  $\hat{\lambda}_{ij}^{-\frac{1}{\theta}}$ .

Figure 17 shows the distribution of welfare gains derived from the lifting of mobility restrictions for NMS studied in Figure 4. The liberalization shock, or decrease in trade costs of services for NMS, acts as a positive productivity shock in the model, allowing all countries to source services from newly available suppliers. While the removing of posting barriers had large implications in terms of service trade flows, the overall welfare gains appear to be small. The liberalization of the posting policy to NMS countries has increased the average consumer gains in services by 0.3%. Small countries are more open and consume more services produced by foreign firms: they derive the largest relative gains from the liberalization. NMS gaining the right to supply services abroad see large welfare improvements, with top winners being Slovenia, Croatia, Slovakia, and Hungary. Portugal, Italy, and Spain derive smallest gains from the expansion of the posting policy to Eastern Europe, as they are the direct competitors of NMS for the cross-border provision of services. Large receiving countries, such as France and Belgium appear to derive moderate welfare gains from the increase in posting exposure, which are below 0.2%. Table 9, column 2, summarizes the changes in real consumption in services under the extreme case of *moving to autarky*. That policy shock considers closing all service trade, expressing the gains from the posting policy as  $1 - \lambda_{ii}^{1/\theta}$ . Under the restrictive scenario, welfare gains of the trade liberalization in services appear larger, increasing to up to 4% for small countries like Belgium or Luxembourg that consume a relative large share of their overall services through posting of workers. Overall, the changes in real consumption following the liberalization of trade in services remain modest, and tend to lie below what is usually quantified for overall trade.<sup>85</sup>

While the finding of small aggregate efficiency gains from “non-tradable” trade is close to what has been found for manufacturing, the underlying forces differ in some dimensions. The consumption shares of services performed by posted workers ( $\lambda_{ij}$ ) are small, and much smaller than the consumption shares of imported goods. This standard “small number effect” is however counterbalanced by much lower substitutability of foreign and domestic services as compared to standard traded goods. With elasticities four times smaller than standard trade elasticities, much smaller expenditure shares in manual services in fact lead to non-trivial gains from international integration.

## 7 Concluding Remarks

Exploiting novel administrative data on a continent-wide experiment of trade liberalization in services, I use the European example to illustrate the redistributive implications of exposing novel jobs to international competition through posting policies. My results can be interpreted as a toolkit for policy makers

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<sup>85</sup>For instance, Costinot and Rodríguez-Clare [2014] find that in the same class of model, gains from trade are 7.5% for Belgium.

discussing adopting these novel trade instruments, in the general context of declining share of manufacturing in advanced economies.

First, the definition of what jobs are tradable is a policy choice rather than a given parameter of the economy. Posting policies can expand the range of tradable activities and the magnitude of globalization. Those novel trade instruments open large market opportunities for low-wage countries, while high-wage countries are the net importers of those newly traded services.

Second, trade liberalization in services has long-lasting negative effects on labor markets in high-wage countries. Domestic employment in exposed sectors decreases following the liberalization, while receiving firms substantially lower their costs through posting. Workers do not significantly reallocate across labor markets or sectors, suggesting that adjustment of labor markets to trade shocks is also sluggish when focusing on trade in services.

Third, posting policies have positive effects on labor markets and tax revenues of low-wage countries. Firms usually insulated from international trade experience substantial economic growth and profit gains once accessing foreign markets through posting, leading to higher tax revenues for origin governments. Wages increase, but not as much as profits, and are driven by destination-level minimum wage rules. Compared to import tariffs, the novel class of trade instruments benefit novel firms, that are smaller, younger and less capital intensive.

Fourth, trade liberalization in services had small efficiency gains for European consumers. The effect is driven by two countervailing forces. On the one hand, the share of services supplied by posted workers in total consumption remains low on average, because these services are heavily concentrated in some specific sectors, and because the posting policy only started to boom 15 years ago. On the other hand, posting services are much less substitutable than traded goods. Whether the latter will end up outweighing the former, as posting flows keep rising dramatically, remains an open question.

New generation trade instruments, by expanding the scope of globalization, open novel questions related to labor regulations in exporting countries. Because cross-border services are performed in their territory, receiving countries have the right to impose part of their fiscal and social standards to workers performing the exported services. Could we extend this logic to other trade flows, for instance, by imposing a set of core labor rights to all imports? Such an “anti-dumping” clause has, for instance, been recently proposed in a report commanded by President Macron on the future of economic challenges ([Blanchard and Tirole \[2021\]](#)). While I leave the answer to that question for future research, I have shown that posting represents a unique experiment where such policies have already been tested continent-wide.

Finally, the novel and numerous datasets leveraged in my analysis could allow us to overcome two major measurement challenges faced by the trade and labor literature. First, the paucity of empirical stud-

ies on trade in services, its determinants, and its consequences can be traced to the lack of reliable micro data on those transactions, as services are intangible and therefore absent from usual customs-based measures of trade flows. Identifying service trade through payroll tax information on posted workers helps reconstruct administrative records of service trade and could provide a trove of information for future research on the topic. Second, it is often impossible to track workers before and after they immigrate since no administrative data from any one country jointly observe individual labor market situations before and after a move. Following posted workers across borders could allow researchers to recover such usually truncated information around the mobility event and could thus provide novel answers on the dynamic path of earnings and employment for international migrants.

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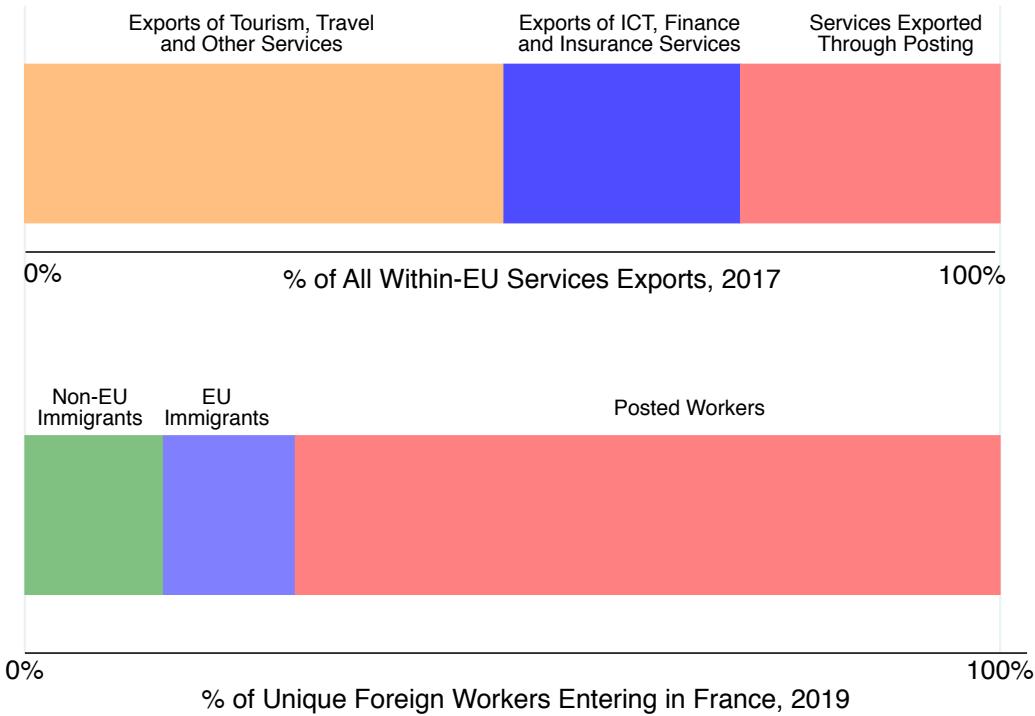
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## 8 Figures And Tables

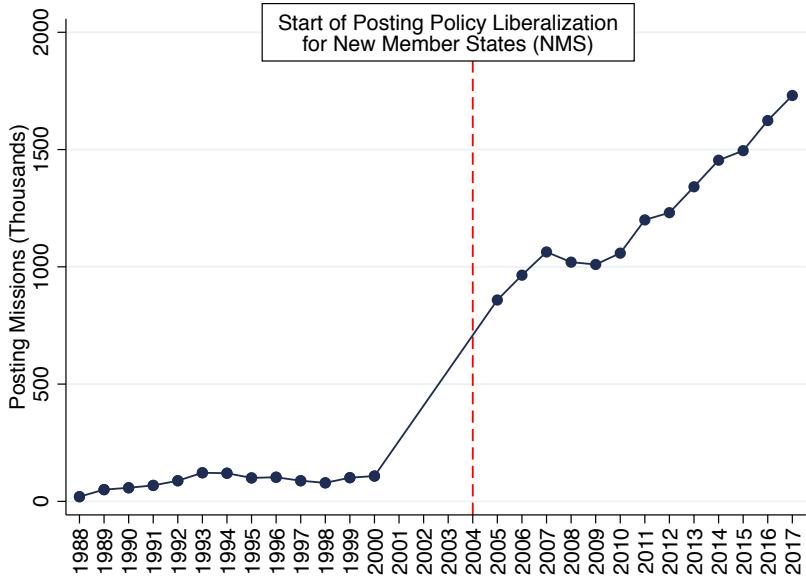
Figure 1: Posting Flows and Globalization in the European Union



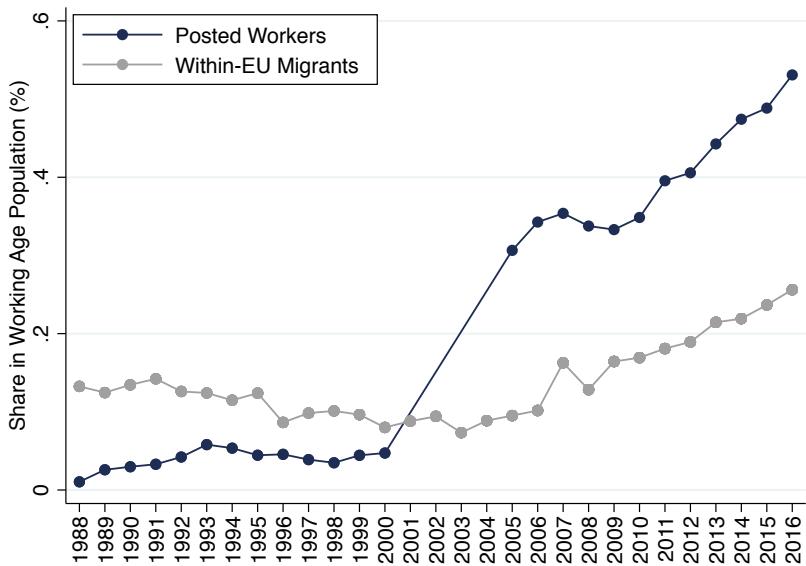
Notes: This figure benchmarks the size of trade-migration posting flows in EU to standard measure of trade in services and trade in factors. The top panel of the graph decomposes within-EU trade in service flows by type of transactions, using data on services' trade by mode of supply computed from Eurostat in 2017. Services exported through posting are services that are performed by workers posted abroad (mode 4 services supply of WTO). The bottom panel decomposes the incoming flows of foreign workers in France in 2019. Posted workers are sent temporarily by a foreign firm to perform a service in France, but do not have an employment contract in France and do not appear in standard French migration statistics. Data on workers posted to France come from administrative registries of all workers posted to France each year described in the [Online Appendix](#). Data on standard immigrants entering in France come from the 2019 census (INSEE).

Figure 2: Within-EU Services Offshoring Through Posted Workers

**A. Cross-Border Provision of Services Within-EU**



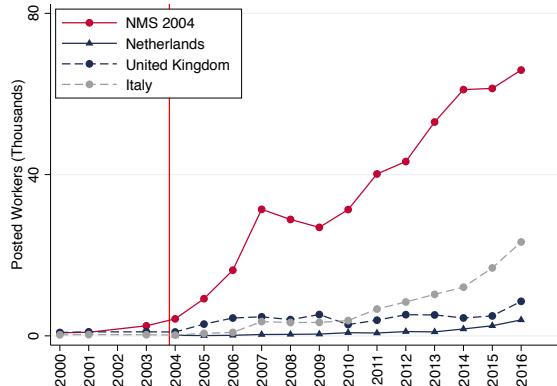
**B. Trade-Related Mobility Is Larger Than Migration**



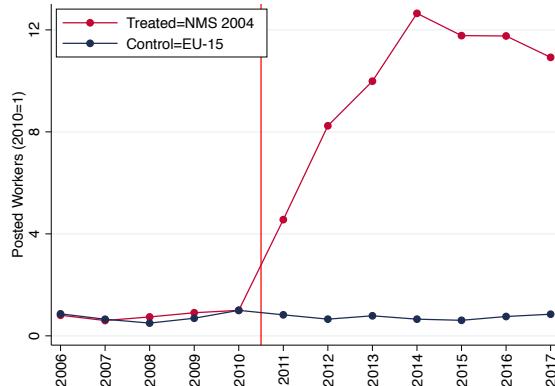
Notes: This figure describes the evolution of posting flows within the EU since 1988. From 2004 onwards, the posting policy was expanded to low-wage countries located in Eastern Europe (New Member States, henceforth NMS). Within the EU, posted workers must hold a E101/A1 mandatory certificate while performing a service mission in another member state. The yearly number of issued posting forms has been collected each year by the European Commission, with a break in data collection between 2000 and 2005. The top panel shows the yearly number of posting missions between EU member states based on the universe of E101/A1 social security posting forms issued each year in the EU. A worker may be posted several times during the year: posting forms relate to posting missions rather than unique workers. Panel B compares trade-related mobility flows (posting missions/population) to standard migration flows (migrants/population) within the EU. Migration flows are computed from the EU-LFS survey and measure the number of individuals who change, for at least 12 months, their residence country each year within the EU. Data on posting forms are described in detail in the [Online Appendix](#).

Figure 3: Lifting Entry Restrictions for Posted Workers: Raw Events

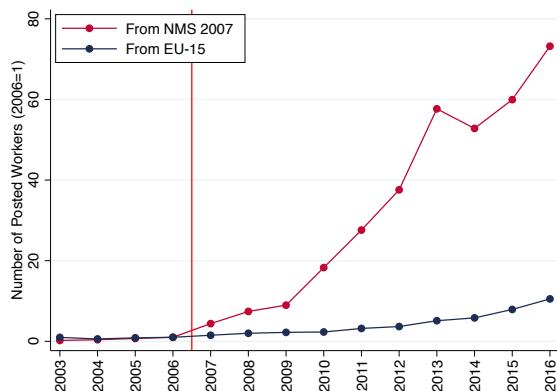
**A. New Member States 2004 to France**



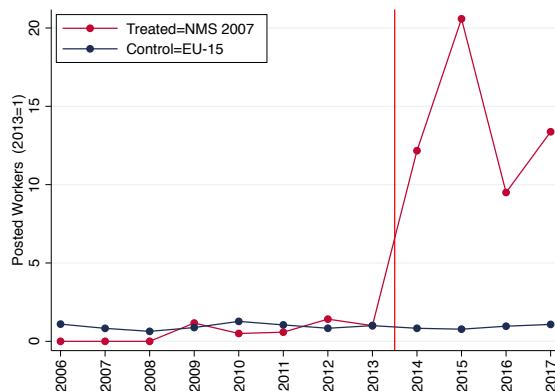
**B. New Member States 2004 to Austria**



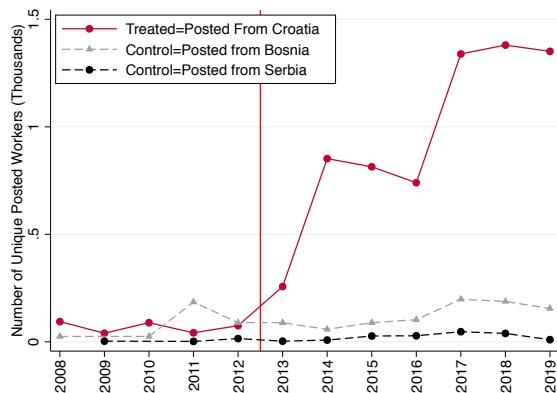
**C. New Member States 2007 to France**



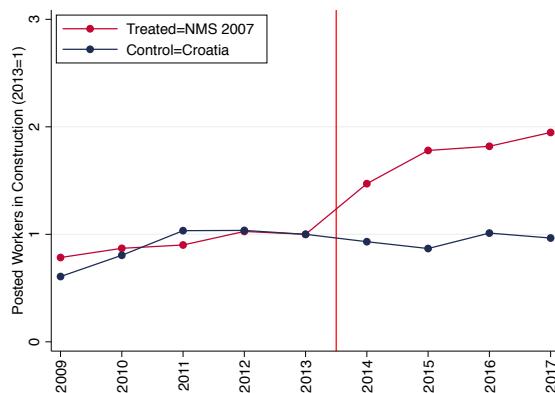
**D. New Member States 2007 to Austria**



**E. New Member States 2013 to Belgium**

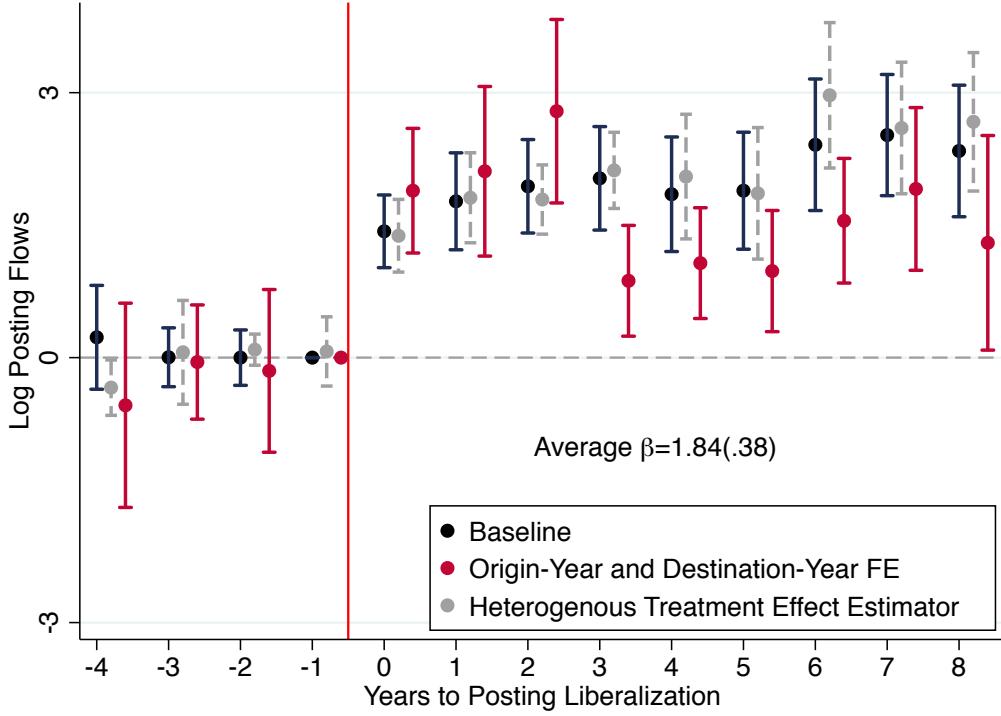


**F. New Member States 2007 to Germany**



Notes: This figure plots raw series of posting inflows around the end of mobility restrictions in receiving countries. The liberalization events are defined as a receiving country lifting all entry restrictions for workers posted from a given sending country. Panels A and C are based on exhaustive administrative declarations of posting missions performed by foreign suppliers to France for 2000-2016 recorded in the DPD/SIPSI dataset. Panels B and D are based on exhaustive administrative declarations of posting missions performed by foreign services suppliers to Austria between 2006 and 2017 recorded by the BUAK dataset. Panel E is based on exhaustive administrative declarations on postings to Belgium from 2008 to 2019 recorded in the LIMOSA dataset. Panel F is based on exhaustive administrative posting declarations on postings to Germany from 2000 to 2017 recorded by SOKA-BAU. Each figure compares postings from treated (red series) to control (dark series) sending countries to a given receiving country, before and after this receiving country lifted entry restrictions for treated countries (event depicted by vertical red line). The timing of these events is described in Figure A.2, Panel B.

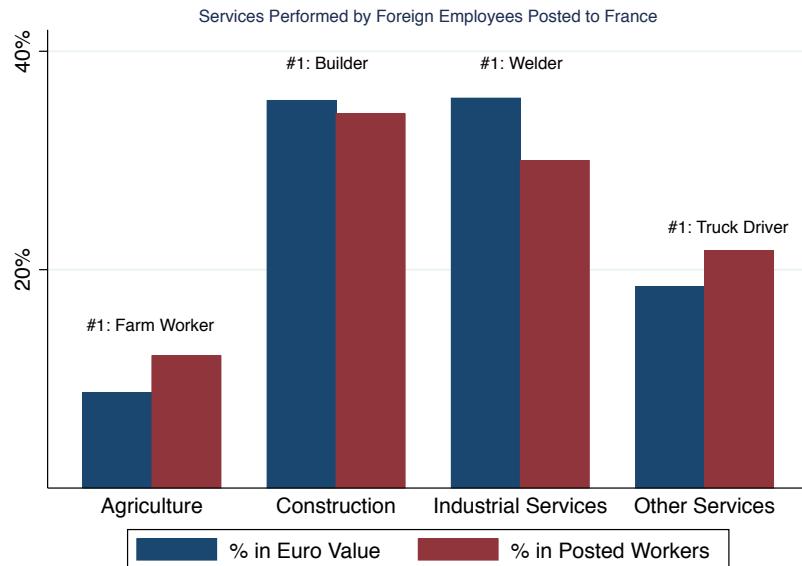
Figure 4: Effect of Posting Liberalization on Cross-Border Supply of Services



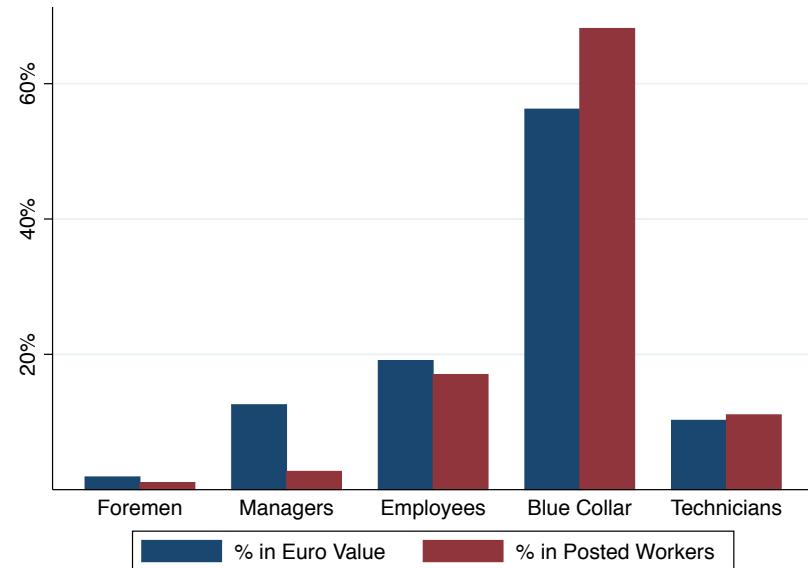
Notes: This figure reports the causal dynamic effects of posting liberalization in receiving countries on the volume of services performed by foreign suppliers' employees in that country. The event study is restricted to the four main receiving countries for which flows of posted workers can be observed before liberalization in country-level posting registries: Germany, France, Belgium, and Austria, and account for 60% of all received posting flows in Europe each year. The datasets pooled for the estimation are exhaustive administrative declarations of postings performed in (i) France (DPD/SIPSI dataset), (ii) Belgium (LIMOSA dataset), (iii) Austria (BUAK dataset), and (iv) Germany (SOKA-BAU dataset). The graph plots  $\beta_k$  coefficients and their 95% confidence interval from the dynamic staggered difference-in-differences Equation (1) that pools events and raw variations presented in Figure 3. The dependent variable is log posting flows from country  $i$  to  $j$  at time  $t$ . The treatment is defined as country  $i$  gaining the right to post workers without restrictions in country  $j$  at time  $t$ . The identifying variation is the liberalization from low- to high-wage countries within the EU, with staggered timing across origin-destination country pairs as described in Figure A.3. The coefficient of the year before liberalization  $\beta_{-1}$  is normalized to zero, and standard errors are clustered at the origin-destination level. A control country  $i$  is such that posting regulations from  $i$  to  $j$  never changes over the estimation period, e.g., is never or yet to be treated by the end of posting restrictions event. Heterogenous treatment effects are computed using the [De Chaisemartin and d'Haultfoeuille \[2019\]](#) estimator correcting for negative weighting. Origin-year and destination-year fixed effects capture shifters of demand and supply of services. The reported coefficient is the average treatment effect of the posting liberalization over the post-reform period. Table 1 reports displayed estimates and standard errors, and shows similar estimation using a PPML estimator instead of the log transformation ([Silva and Tenreyro \[2006\]](#)).

Figure 5: “Non-Tradable” Jobs Are Offshored On-Site Through Posting of Workers

### A. Sectors of Work Mission Performed by Posted Workers



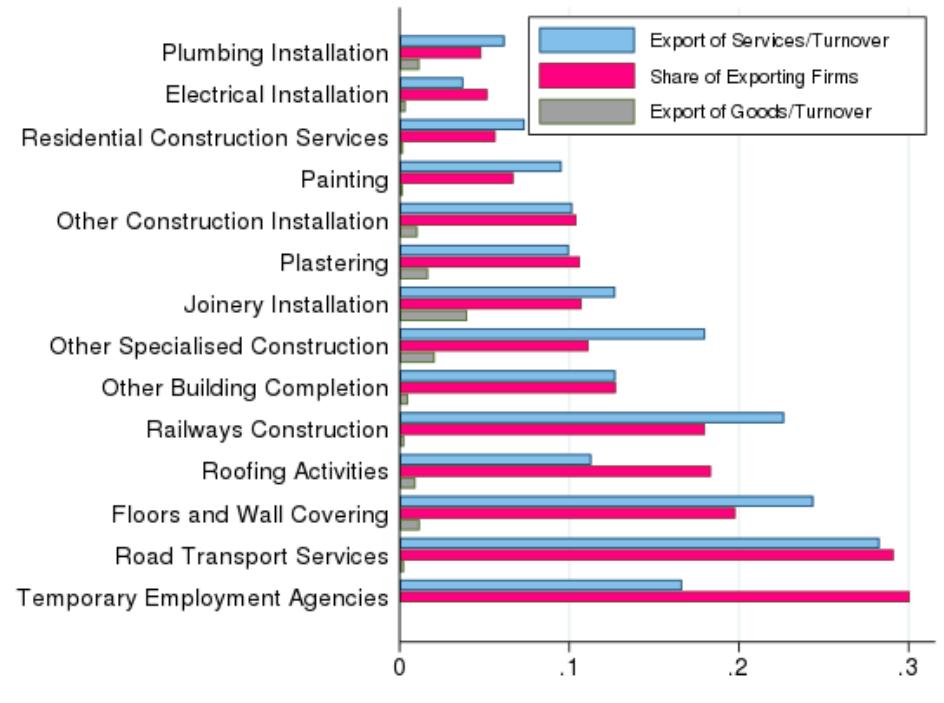
### B. Qualification of Posted Workers



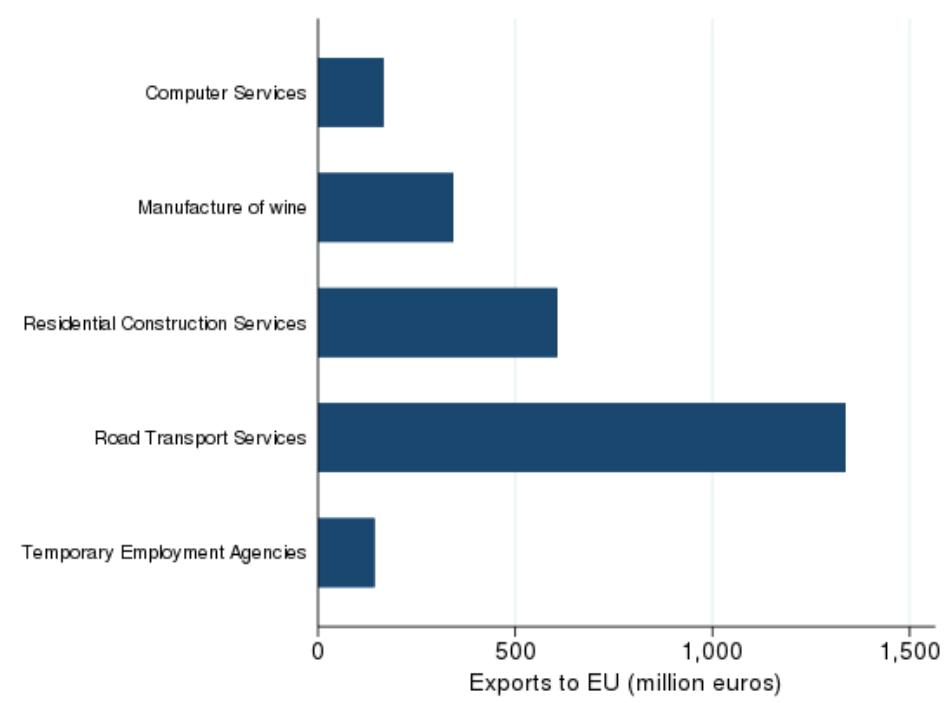
Notes: This figure shows the decomposition of posting missions performed by mobile (foreign) employees in 2019 in France, the second importing country of posting services in Europe. It is based on the DPD/SIPSI dataset that records all posting missions performed by foreign services suppliers in France’s territory, with detailed information on posted workers’ wage, posting mission duration, and type of job performed in France. In 2019, 657,216 posting missions performed by 227,991 unique posted workers were declared in the country. To compute the euro value of posting contracts, each posting mission is weighted by its duration and the wage paid to the foreign suppliers’ employee. Panel A shows the decomposition of posting missions performed in France in 2019 by sector of that mission. The decomposition is computed with respect to the total number of posting missions (red bar) or total amount of posting missions (blue bar). Panel B shows the decomposition of posting missions by qualification level of the foreign employee performing that mission. Top jobs performed by posted workers are builder, welder, mechanic, cleaner, driver, and farm worker. The sector of the posting mission offshored “on-site” through posted workers is not necessarily the same as the sector of the receiving firm. The equivalent of Panel A for all European countries is available in Figure A.43. Data are described in [Online Appendix](#). Top occupations of posted workers are listed in Table A.3.

Figure 6: Exports in “Non-Tradable” Sectors Are in Fact Substantial in Sending Countries

**A. Exposure to Exports Opportunities in “Non-Tradable” Sectors**



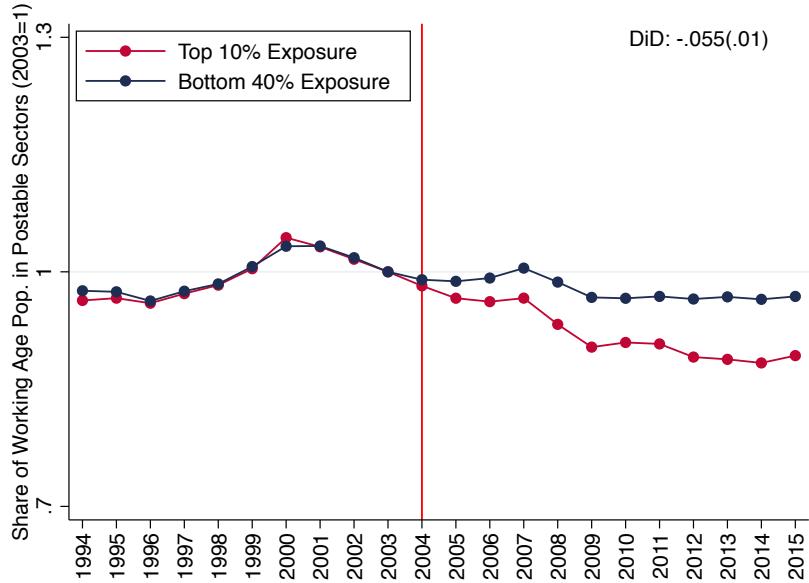
**B. Portuguese Exports by Sectors**



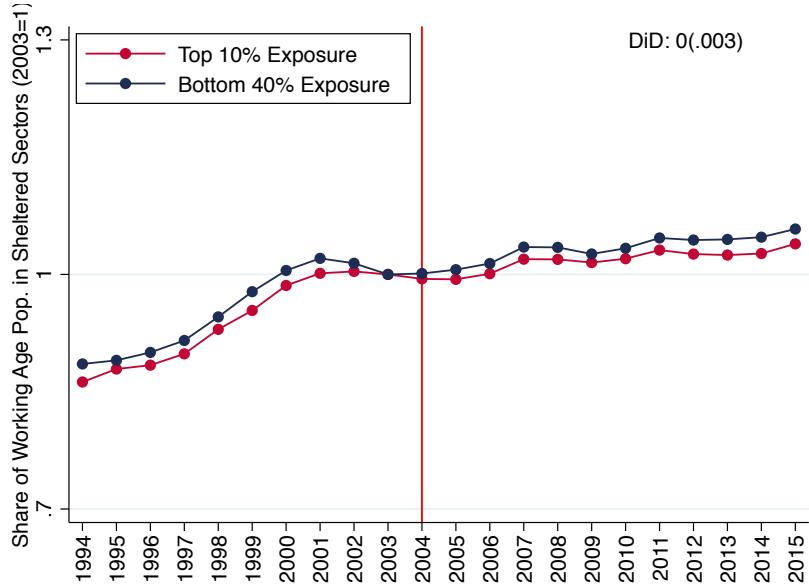
Notes: The Figure shows the amount of services and goods exports in non-tradable sectors in one of the main sending country: Portugal. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country, as well as exported goods and materials, from 2006 to 2017, described in [Online Appendix](#). The histogram shows for non-tradable sectors where trade in mobility-dependent, the total amount of services provided in EU (red) and total amount of goods exported to EU (blue) divided by total sales in that sector.

Figure 7: Effect of the Posting Liberalization on Domestic Employment: Raw Series

### A. Domestic Employment in Exposed Sectors and Provinces



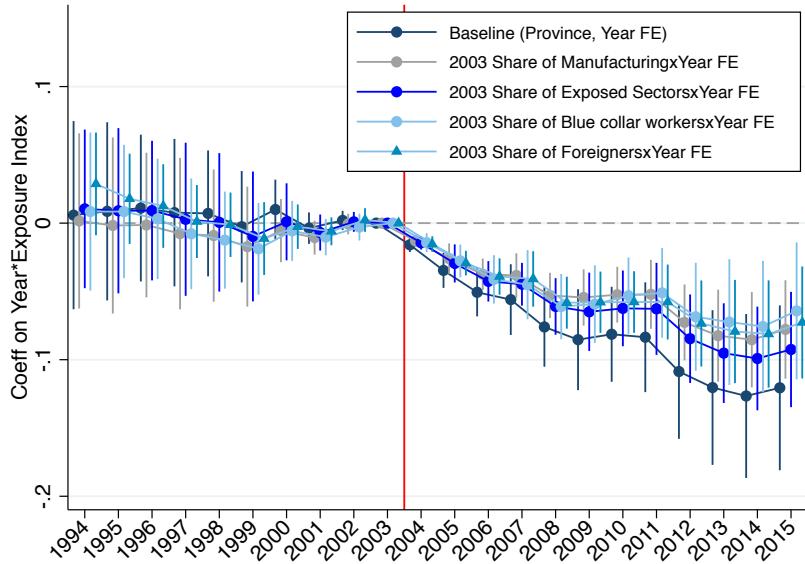
### B. Domestic Employment in Sheltered Sectors



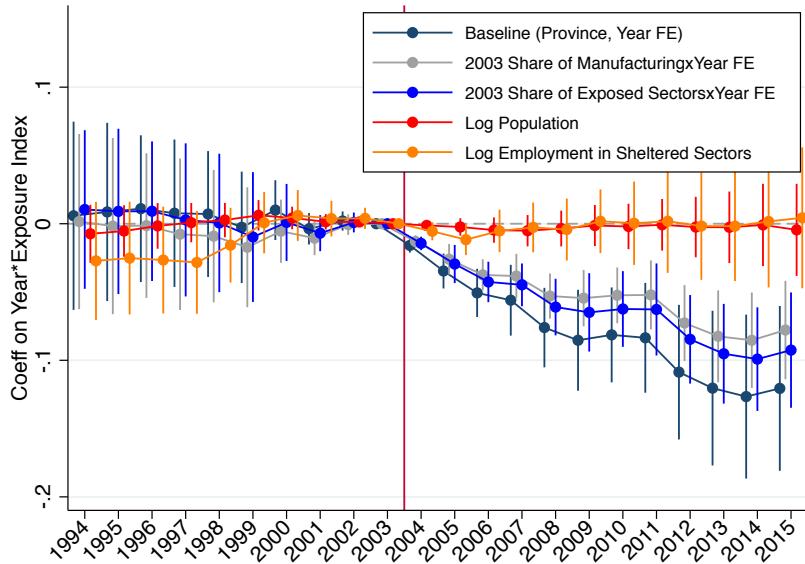
Notes: The figure studies the effect of a posting supply shock on domestic employment in the second largest importer of posting services: France. In mid-2004, France lifted entry restrictions for workers posted from 10 Eastern European countries, leading to permanent increased imports of posting services (see Panel A, Figure 3 and Table A.4). Province-level exposure to the supply shock is defined by a province imports of posting services per worker before the reform as described in the text and in Equation (2). The prediction power of pre-reform exposure (first stage) is showed in Table A.6, column (1). Exposed sectors are those for which posting inflows is non-zero (such as construction, agriculture, hotels and restaurants, temporary employment agencies, entertainment services and other manufacturing services, see top occupations in Table A.3). Panel A shows the evolution of the share of domestic workers in exposed sectors, before and after 2004, in provinces with low and high exposure to the shock. All series are normalized to one in 2003, the year before the reform. Panel B shows the counterparts for the share of domestic workers in sheltered sectors, such as retail or skilled and licensed services that exhibit zero posting imports. The coefficient reported in the graph is based on Equation (4) using log share of population employed in exposed sectors as the outcome variable. The corresponding estimate for the top figure using the share of population employed in exposed sectors in percentage points as the outcome variable is -1.25(.17). All coefficient are reported in Table 2.

Figure 8: Effect of the Posting Liberalization on Local Labor Markets

### A. Log Exposed Employment by Exposure to Posting



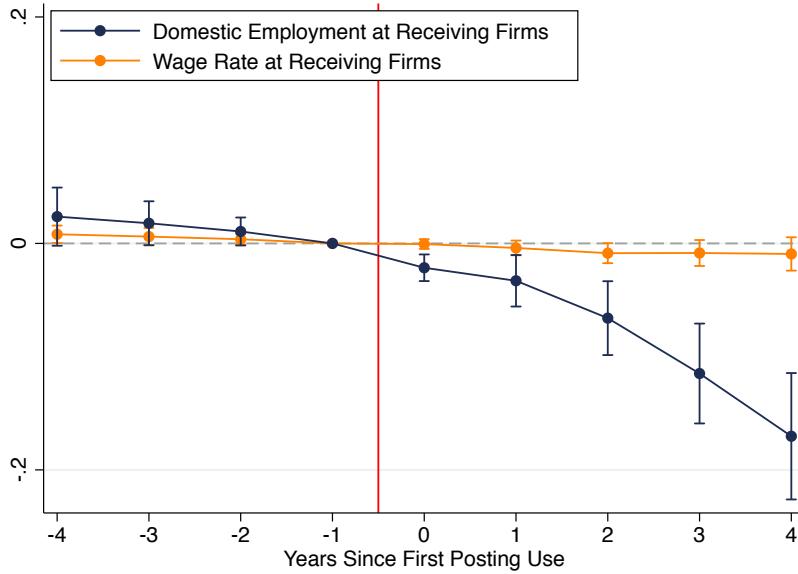
### B. Sectoral and Migration Responses to the Shock



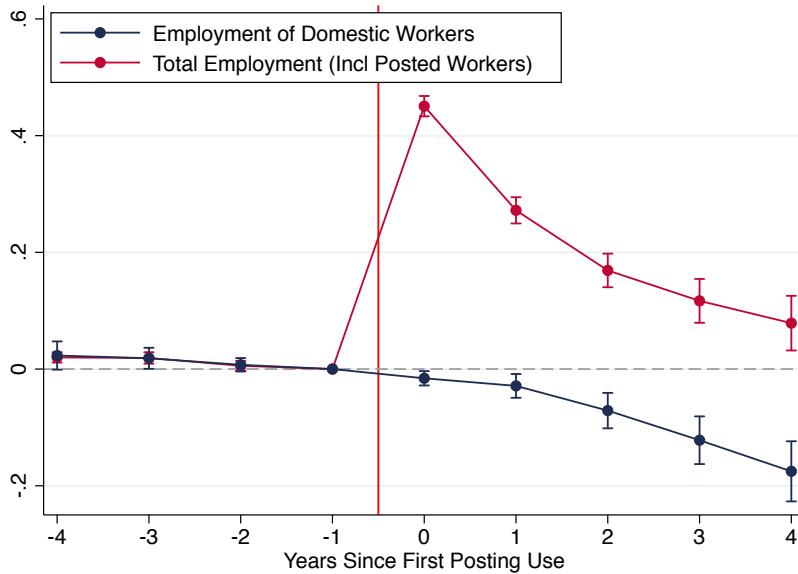
Notes: The figure displays the estimates from Equation (6) that capture the differential evolution of domestic employment in French provinces initially exposed to the liberalization of the posting policy. Panel A compares the evolution of domestic employment in provinces with more or less pre-reform exposure to posting. Initial exposure to the policy is measured by pre-reform imports of posting services per worker in a province. The dependent variable is the log employment in exposed sectors. The event is the lifting of posting restrictions for services supplied by low-cost countries in 2004-2005. The coefficient of the year before the reform  $\zeta_{2003}$  is normalized to zero. All regressions include calendar year and province fixed effects. The average difference in the exposure index between the least and more exposed province is 0.9. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the province level. Panel B repeats the estimation using as dependent variable the log of working age population in a province (red serie) and the log of employment in sectors not exposed to posting competition (orange serie).

Figure 9: Employment and Wages At Receiving Firms After Using Posted Workers

**A. Domestic Employment Decreases and Wages Are Unchanged**



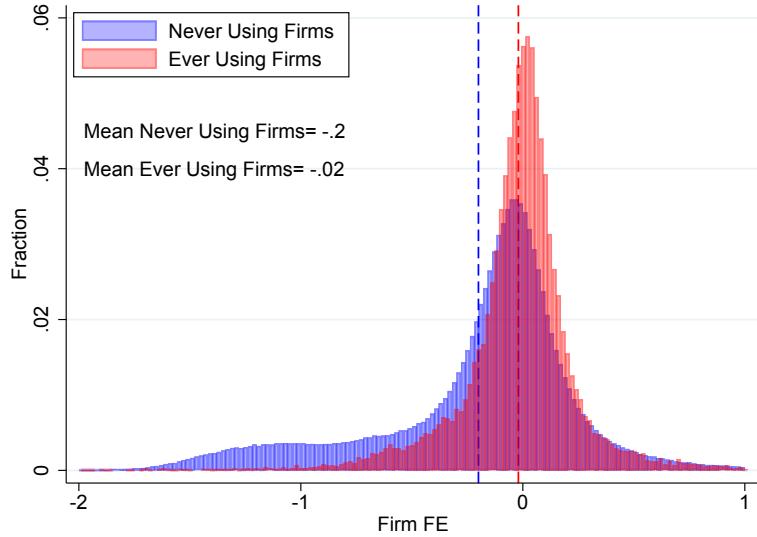
**B. Evolution of Employment Including Posted Workers**



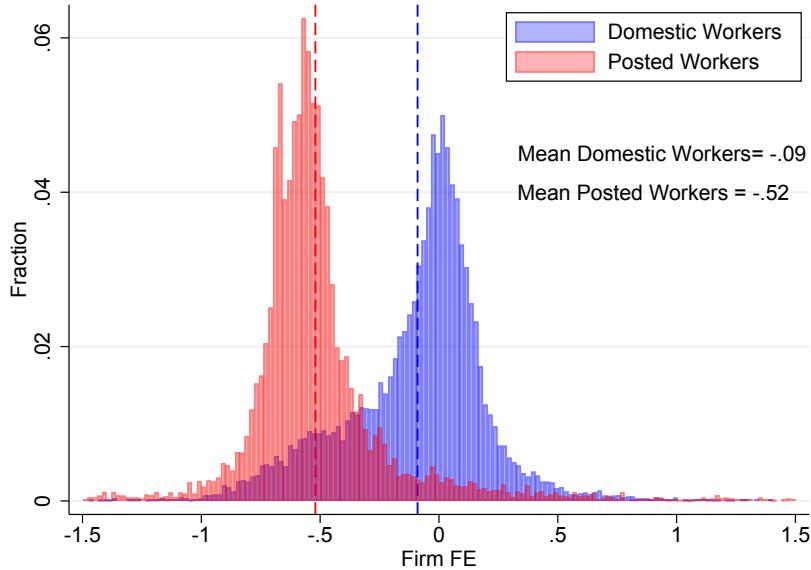
Notes: This figure studies how posting affects receiving firms and domestic workers in Belgium, one of the main receiving countries for posted workers. I use exhaustive administrative posting records of Belgian firms merged with administrative employment data to select the 11,796 firms that started using posted workers for the first time between 2014 and 2019. The figure plots the estimated event study coefficients  $\gamma_k$  from Equation (8) for the period 2008-2019, where the dependent variable is log employment and log wage rate (Panel A). Panel B compares the evolution of log overall employment (domestic and posted workers, red series) and log domestic employment (blue series) at receiving firms before and after the event. The event is defined as the first time a Belgian firm sources services to foreign posted employees. The coefficient of the year before the first posting use  $\gamma_{-1}$  is normalized to zero. The regressions include firm and three-digit sector  $\times$  calendar year.  $\gamma_k$  compares the outcomes of receiving firms in event year  $k$  to the outcomes of future posting firms in the same narrowly defined sector in the year before their event. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the calendar year  $\times$  province level. The estimates of  $\gamma_k$  using an alternative estimator for heterogenous treatment effects are reported in Figure A.16.

Figure 10: Are Posted Workers Cheaper Than Domestic Workers?

**A. Firms Purchasing Posting Services Face Higher Domestic Labor Cost**



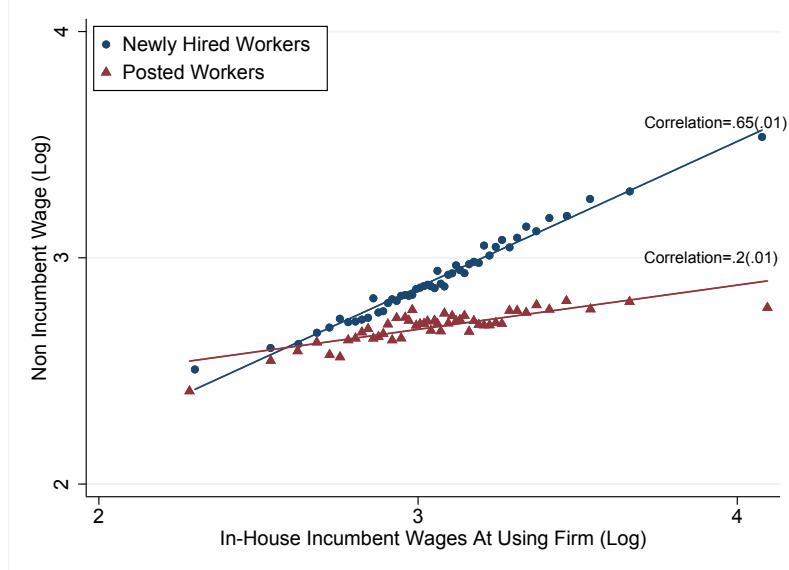
**B. Posted Workers Receive Lower Workplace Wage Premia at Receiving Firms**



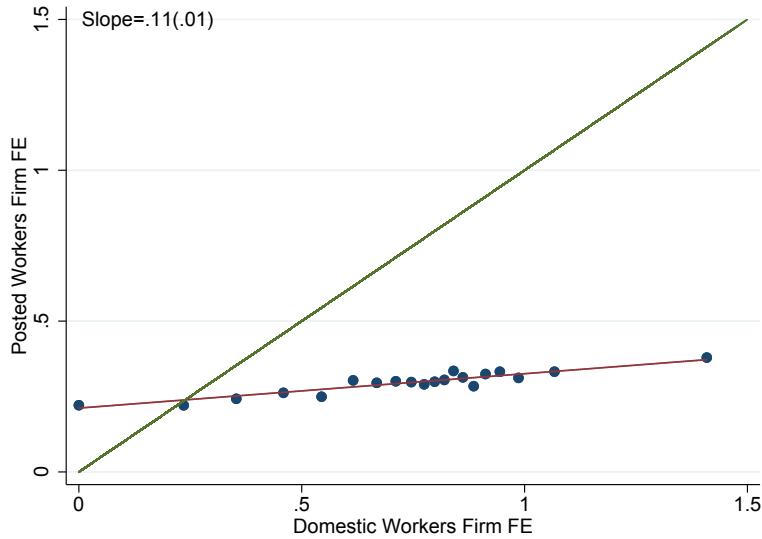
Notes: This figure compares posted workers' and domestic workers' wages in the second largest importer of posting services: France. I use the universe of mandatory posting declarations filed by foreign suppliers that send posted workers in the French territory (DPD/SIPSI dataset) to identify all posting contracts that started in 2017 and 2018, and to track the 23,332 French companies that have purchased a posting service in those years. For each posting contract, I observe, among other rich characteristics, the wage paid to the posted worker by their foreign employer, the hours of work linked to the posting mission, and the identifier of the French firm that purchased that mission. To obtain employment information on domestic workers, I use the linked employer-employee administrative dataset "DADS postes 2018" that covers all job spells of French employees in 2017 and 2018. I use the unique receiving firm identifier (SIREN) to link posted workers to French employees and end up with 19,138 French firms that purchased a posting contract at some point in 2017-2018 and for which at least one domestic job record exists in the 2017-2018 DADS postes. Panel A plots the histogram of workplace AKM effects for domestic workers, separately for firms that use or never use posting, based on Equation (9). Panel B plots workplace pay premia for domestic and posted workers estimated *within the sample of receiving firms only*, based on Equation (10). The mean wage premium for posted workers is -0.43 compared to the mean wage premium of domestic workers normalized to zero, suggesting a substantial wage penalty borne by posted workers.

Figure 11: Surplus-Sharing Between Posted Workers and Receiving Firms

### A. Relationship Between Domestic Workers' and Posted Workers' Wages

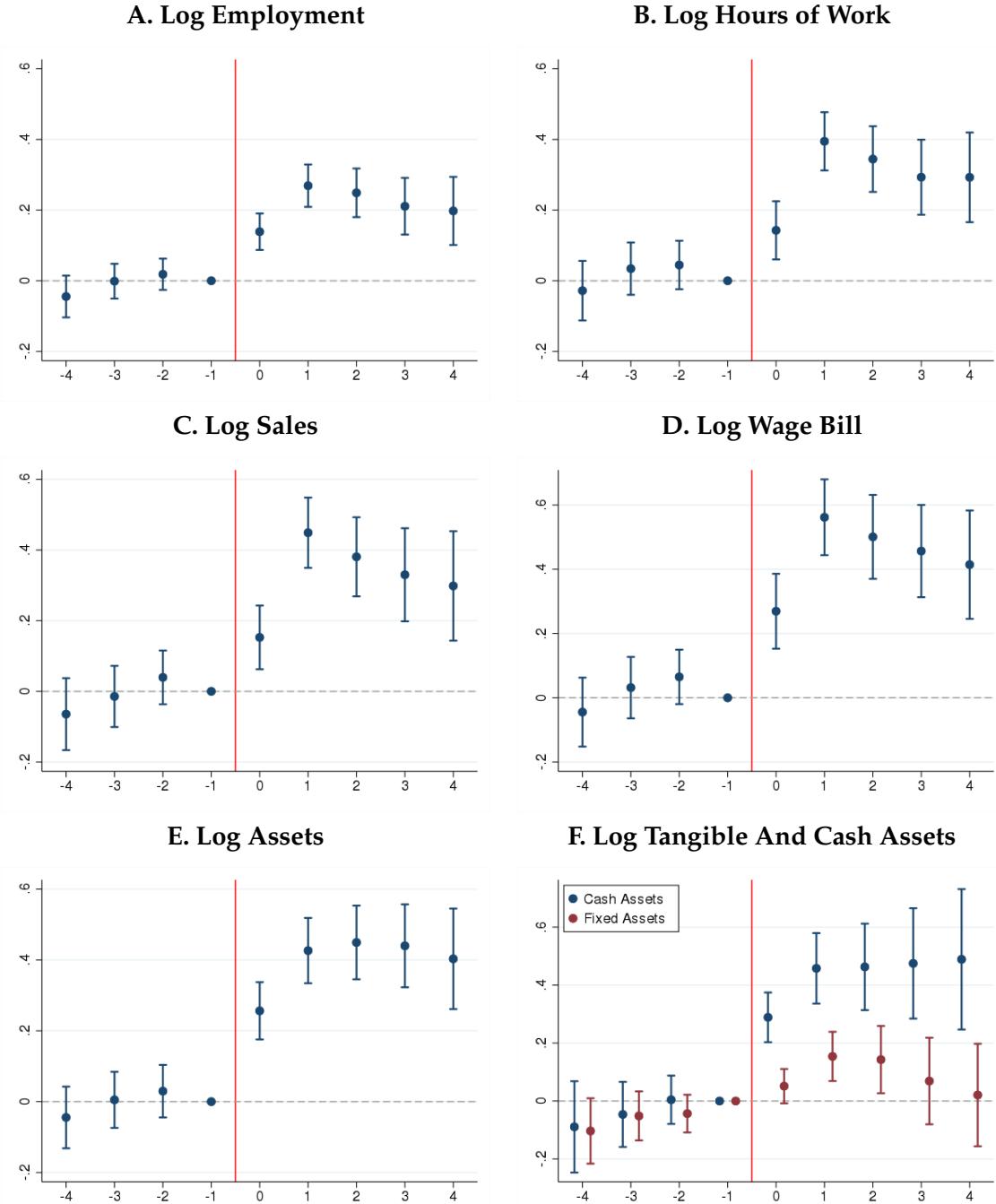


### B. Firm-Level Pay Premia Sharing with Posted Workers



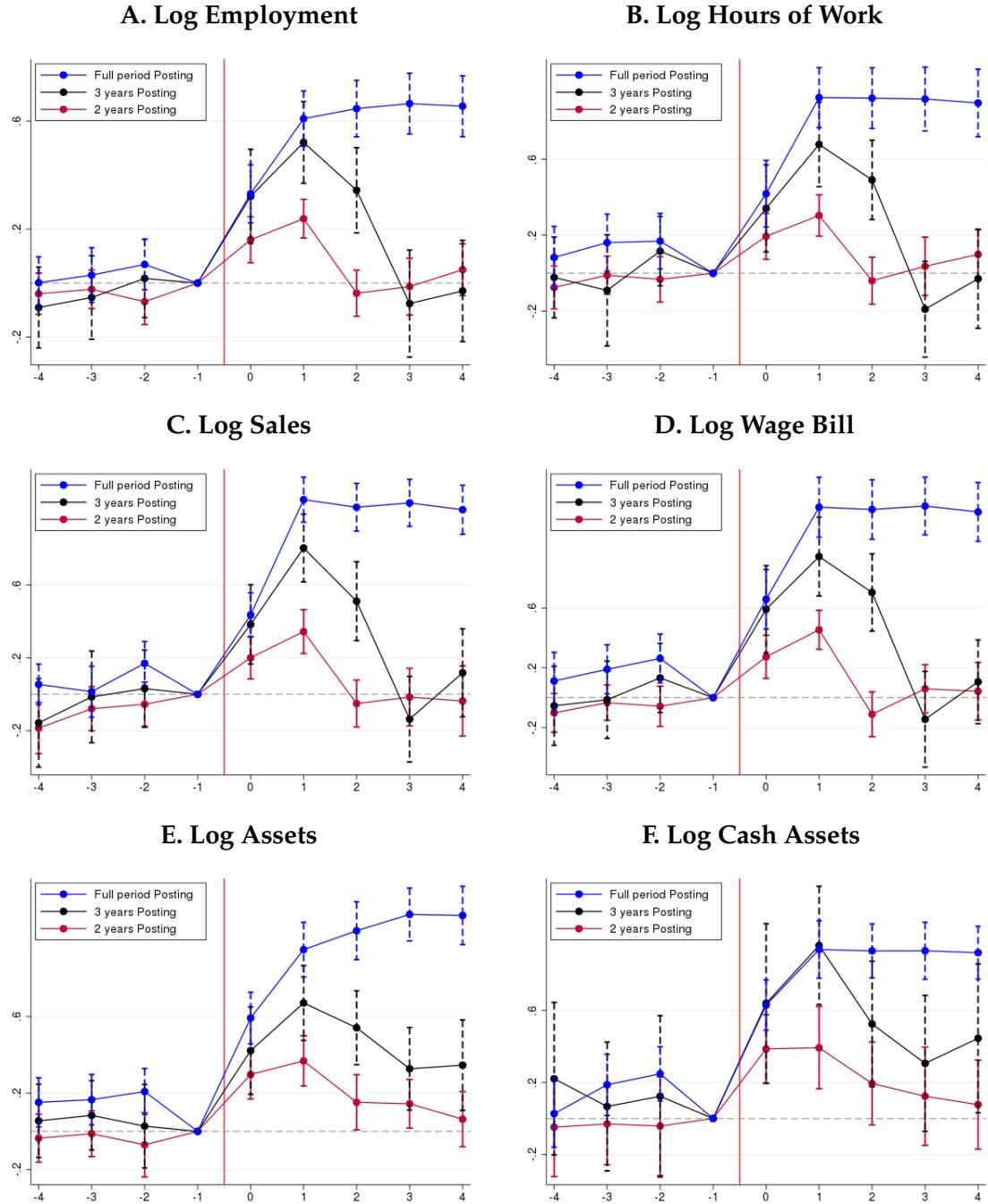
Notes: This figure compares posted and domestic workers' wage within a workplace in the second largest importer of posting services: France. I use the universe of mandatory posting declarations filed by foreign suppliers that send posted workers in the French territory (DPD/SIPSI dataset) to identify the 19,138 French firms that purchased a posting contract in 2017-2018 and for which at least one domestic job record exist in the 2017-2018 DADS postes dataset, a linked employer-employee dataset covering all job spells in France during that period. I can observe wages paid to French workers and posted workers at the same workplace in France. Panel A shows the relationship between incumbent, newly hired domestic, and posted workers' wages at the same workplace in 2018. It shows the binned scatterplot of log domestic incumbent workers' wage (x axis) against log domestic newly hired workers' wage (blue dots) and posted workers' wage (red dots) for receiving firms, residualized on five-digit sector fixed effects. [Online Appendix](#) shows similar pattern adding domestic temporary agency workers' wage in the comparison. Table 5 reports estimates of the raw wage penalty within a workplace borne by posted workers. Panel B shows the binned scatter plot of estimated AKM workplace effects for posted workers against estimated AKM workplace effects for incumbent domestic workers. For visualization, the fixed effects are normalized to zero in the lowest respective deciles, but the normalization does not affect the estimates of the slope. The red line in bottom panel corresponds to the regression described in Equation (11), while the green line depicts the 45-degree line.

Figure 12: Sending Firms Expand When Starting to Provide Services Abroad



Notes: This figure studies how posting affects sending firms located in Portugal, one of the main suppliers of posting services in Europe. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country from 2006 to 2017 to select the 4,151 firms (with a median of more than three employees over the period) that start posting workers abroad for the first time between 2010 and 2015. The figure plots the estimated event study coefficients  $\theta_k$  from Equation (13) for the period 2006-2017 where the dependent variable is log number of paid employees (Panel A), log total hours worked by employees (Panel B), log total sales (Panel C), log domestic sales (Panel D), log total assets (Panel E), and log wage bill (Panel F). The event is defined as the first time a Portuguese firm provides non-tradable services in another EU country. The coefficient of the year before the first posting  $\theta_{-1}$  is normalized to zero. The regressions include firm and five-digit sector  $\times$  calendar year  $\times$  province fixed effects.  $\theta_k$  compares the outcomes of posting firms in event year  $k$  to the outcomes of future posting firms in the same narrowly defined sector and province in the year before their event. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the calendar year  $\times$  province level. The event study coefficients are reported in Table 6. The dataset and estimation sample are described in [Online Appendix](#). The estimates of  $\theta_k$  using [de Chaisemartin and d'Haultfoeuille \[2019\]](#) estimator for heterogeneous treatment effects and reporting pre-event median outcome levels are presented in Figure A.19.

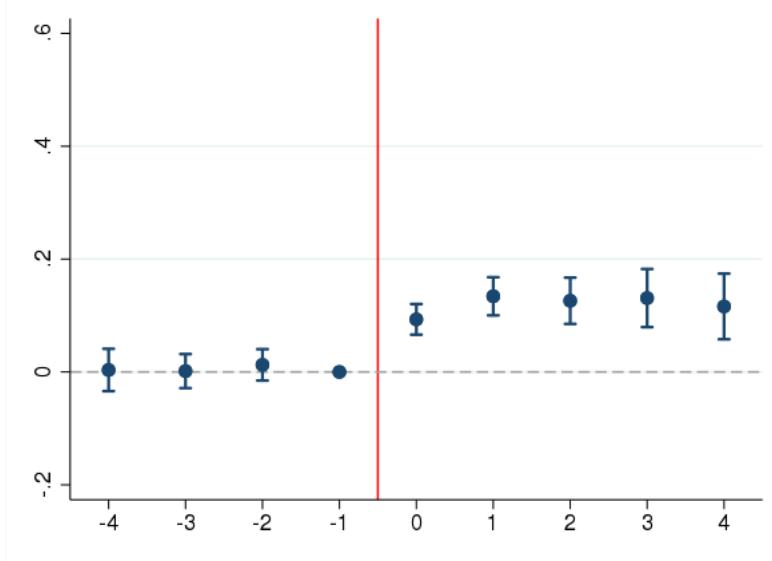
Figure 13: Export-Mobility Gains Start and End With the Posting Mission



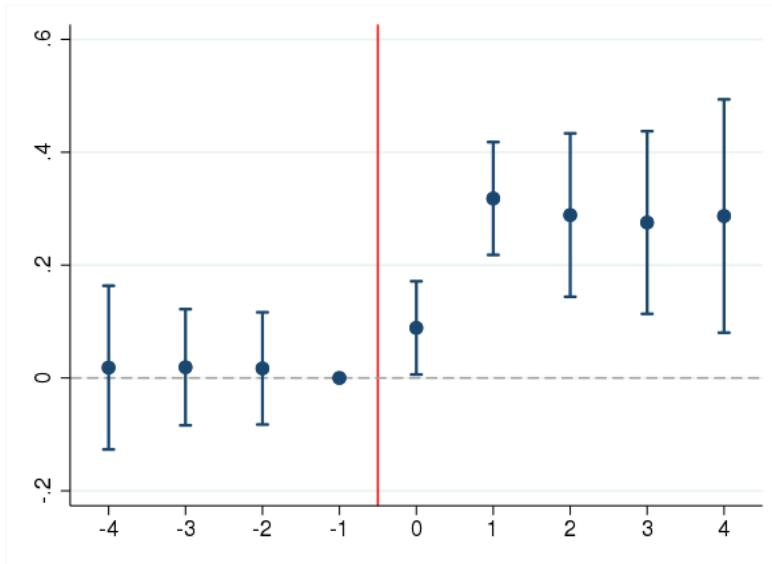
Notes: This figure studies how posting affects sending firms located in Portugal, one of the main suppliers of posting services in Europe. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country from 2006 to 2017 to select the 4,151 firms (with a median of more than three employees over the period) that start posting workers abroad for the first time between 2010 and 2015. The figure plots the estimated event study coefficients  $\theta_k$  from Equation (13) for the period 2006-2017 where the dependent variable is log number of paid employees (Panel A), log total hours worked by employees (Panel B), log total sales (Panel C), log domestic sales (Panel D), log total assets (Panel E), and log wage bill (Panel F). The event is defined as the first time a Portuguese firm provides non-tradable services in another EU country. The coefficient of the year before the first posting  $\theta_{-1}$  is normalized to zero. The regressions include firm and five-digit sector  $\times$  calendar year  $\times$  province fixed effects.  $\theta_k$  compares the outcomes of posting firms in event year  $k$  to the outcomes of future posting firms in the same narrowly defined sector and province in the year before their event. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the calendar year  $\times$  province level. The event study coefficients are reported in Table 6. The dataset and estimation sample are described in [Online Appendix](#).

Figure 14: Surplus-Sharing Between Sending Firms and Posted Workers

**A. Wage Rate After Provision of Services Abroad**



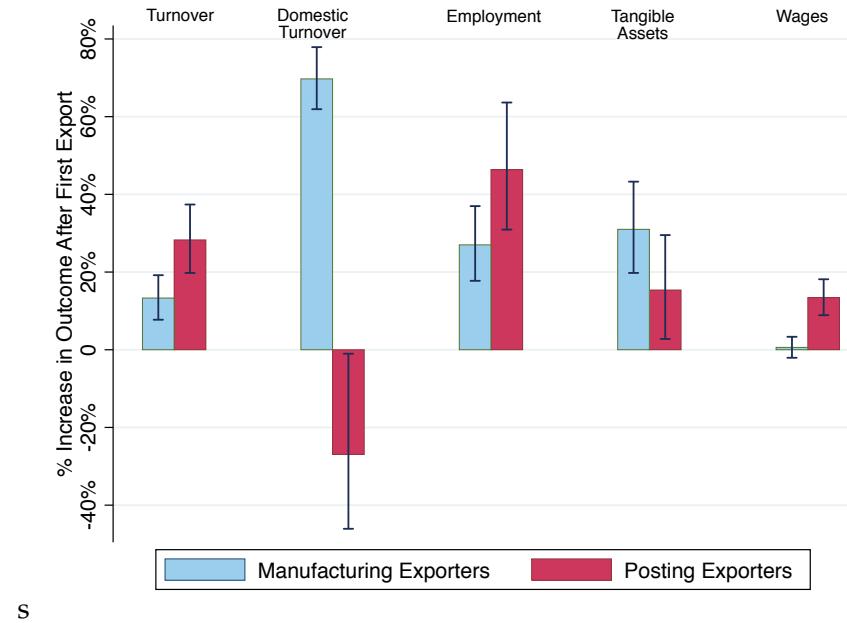
**B. Profits After Provision of Services Abroad**



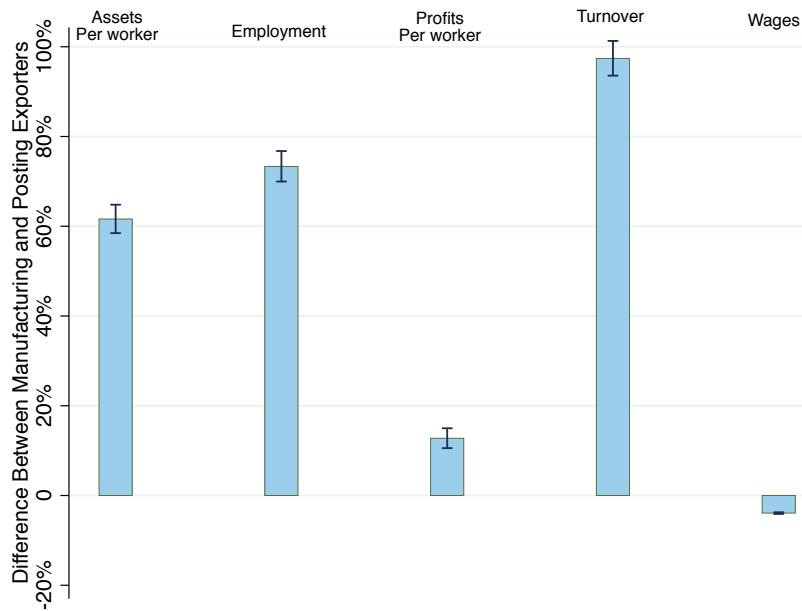
Notes: This figure studies how posting affects sending firms located in Portugal, one of the main suppliers of posting services in Europe. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country from 2006 to 2017 to select the 4,151 firms (with a median of more than three employees over the period) that start posting workers abroad for the first time between 2010 and 2015. The figure plots the estimated event study coefficients  $\theta_k$  from Equation (13) for the period 2006-2017 where the dependent variable is log wage rate (Panel A) and log earnings before taxes (Panel B). The event is defined as the first time a Portuguese firm provides non-tradable services in another EU country. The coefficient of the year before the first posting  $\theta_{-1}$  is normalized to zero. The regressions include firm and five-digit sector  $\times$  calendar year  $\times$  province fixed effects.  $\theta_k$  compares the outcomes of posting firms in event year  $k$  to the outcomes of future posting firms in the same narrowly defined sector and province in the year before their event. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the calendar year  $\times$  province level. The event study coefficients plotted in the figure are reported in Columns (1)-(2) of Table 7. The dataset and estimation sample are described in [Online Appendix](#). Estimates accounting for heterogeneous treatment effects are presented in Figure A.30.

Figure 15: Magnitude and Incidence of Firm-Level Export Gains in Posting Services and Manufacturing

### A. Firm-Level Export Gains in Posting Services Versus Manufacturing



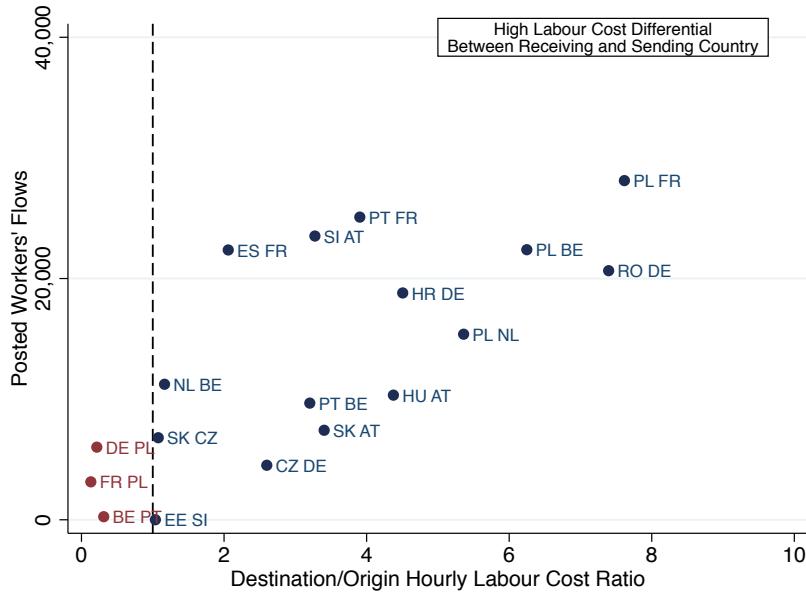
### B. Differences Between Exporters of Manufacturing Goods and Posting Services



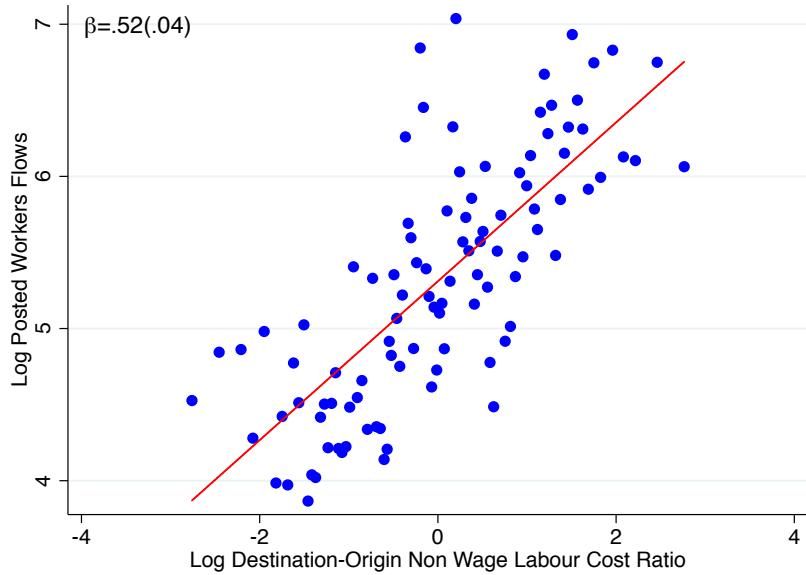
Notes: This figure summarizes the estimated firm-level gains from export events for firms located in Portugal, one of the main supplier of posting services in Europe. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country, as well as goods exported abroad, from 2006 to 2017 to identify (i) the group of firms that start posting workers abroad for the first time between 2010 and 2015. (ii) the group of manufacturing firms that start exporting manufactured goods abroad for the first time during the same period. The top figure shows the average treatment effect  $100(e^\theta - 1)$  from Equation (13) estimated separately on these two samples. The treatment effect can be interpreted as the average percent increase in a firm outcome 2 years after that the firm starts exporting manufactured goods (or posting services abroad), compared to its pre-event level. The comparison of the entire dynamic path of effects between manfuacturing and posting exporters is displayed in Figure A.24. The bottom figure shows the average differences in firm-level outcomes between standard manufacturing exporters and posting firms, estimated from a regression described in the footnote of Table A.10. The coefficient can be interpreted as the percent difference for a given outcome for manufacturing exporters, as compared to firms exporting services through posted workers abroad.

Figure 16: Postings Flows and Labor Tax Differentials

### A. Bilateral Flows and Labor Cost Ratio

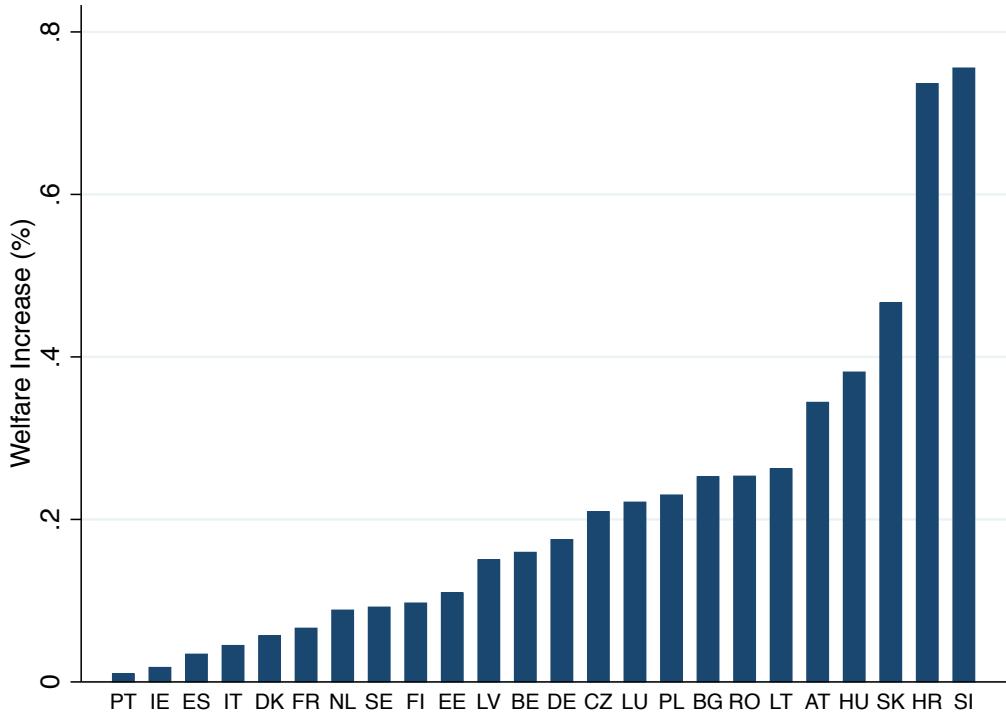


### B. Steady-State Correlation



Notes: Posted workers pay origin-level labor taxes and are exempted from destination-level payroll taxes. The figure depicts the steady-state correlation between bilateral posting flows and destination-origin payroll taxes differentials for the period 2009-2017. The figure is based on the full matrix of bilateral posting flows within the EU merged with data on employers' payroll tax cost for 2009-2017. Posting flows are measured by mandatory E1/A101 social security forms that posted workers must hold when providing a service abroad, available at the origin-destination level each year for 2005-2017. Data on employers' non-wage labor cost (social security contributions and other labor taxes) are from annual Eurostat Labor Cost Indexes and are available for 2009-2017. The top panel plots, for some destination-origin pairs, the average raw level of posting flows against the average destination-origin payroll tax ratio over the period. A large destination-origin non-wage labor cost ratio means the sending country is characterized by much lower level of payroll taxes than the receiving country. The black dotted line depicts country pairs with similar levels of payroll taxes. The bottom panel generalizes this relationship by plotting the binned scatter plot of log bilateral posting flows against the log of the destination-origin non-wage labor cost ratio for all country pairs and all years. The reported coefficient is the cross-sectional correlation between log posting flows and log labor cost ratio for the period 2009-2017.

Figure 17: Model-Based Consumer Gains from Posting Liberalization after 2004



Notes: This figure plots the distribution of aggregate consumer welfare gains following the lifting of mobility restrictions for employees posted for firms located in new member states, for each country in the European Union. The welfare effects of the change in posting policy accounts for general equilibrium effects and are based on Equation (21) and Equation (22). The model and calibrations use the [Arkolakis et al. \[2012\]](#) approach and the [Dekle et al. \[2008\]](#) exact hat algebra methodology. The model and calibrations only focus on sectors where trade in services through posting of workers occur. The structural theory-based policy shock  $\hat{m}_{ij}$  is calibrated combining the reduced form effect of the liberalization estimated in Figure 4 (Table 1) with the structural posting elasticity  $\theta$  in Table 8. Using the estimates of the policy shock, the measure of current bilateral posting flows, and the measure of the structural posting elasticity, I numerically solve the system for changes in equilibrium wages and posting trade flows.

Table 1: Causal Effect of the Liberalization on Posting service flows

	(1)	(2)	(3)
4 years before liberalization	-.53 (.58)		
3 years before liberalization	-.05 (.31)		
2 years before liberalization	-.15 (.47)		
Year of liberalization	1.89*** (.35)		
1 year after liberalization	2.11*** (.49)		
2 years after liberalization	2.79*** (.53)		
3 years after liberalization	.88*** (.32)		
4 years after liberalization	1.08*** (.32)		
5 years after liberalization	.99*** (.35)		
6 years after liberalization	1.55*** (.37)		
7 years after liberalization	1.91*** (.47)		
8 years after liberalization	1.3*** (.63)		
<b>Average Effect (<math>\beta</math>)</b>		1.83*** (.37)	.75*** (.13)
Observations	853	853	953
Origin-Destination FE	Yes	Yes	Yes
Destination $\times$ Year FE, Origin $\times$ Year FE	Yes	Yes	Yes
Estimation	Log	Log	PPML

Notes: \* $p<0.10$ , \*\* $p<0.05$ , \*\*\* $p<0.01$ . The table summarizes the effects of lifting entry barriers for foreign suppliers' employees on within-EU posting flows. The dependent variable is the number of posting services from country  $i$  to country  $j$  at time  $t$  in log (Log) or levels (PPML). The identification strategy exploits the staggered timing of the exogenous liberalization reform across sending and receiving countries within the EU. The treatment is defined as country  $i$  gaining the right to post workers without reentry restrictions in country  $j$  at time  $t$ . The event study is restricted to receiving countries for which flows of posted workers can be observed before the liberalization in country-level datasets (Austria, Belgium, Germany, and France). Column (1) shows the dynamic effects following Equation (1) and shown in Figure 4. Columns (2) and (3) estimate average effects of liberalizing services exports mobility. In parentheses are robust standard errors clustered at the origin-destination level.

Table 2: Causal Effect of Posting Exposure on Receiving Country Employment: Difference-in-Differences

Dependent Variable	Baseline (1)	Difference-in-Differences: Estimates of $\zeta$ Top 10 vs Bottom 40 Exposure, Before and After 2004						
		1990 Shares (2)	2000 Shares (3)	Distance NMS (4)	Regional Exposure (5)	Exposure Leave-Out (6)	Top20 Bottom40 (7)	
Exposed Emp/pop (log)		-.0547*** (.007)	-.0412*** (.007)	-.0547*** (.007)	-.0961*** (.010)	-.0561*** (.007)	-.755*** (.009)	-.0401*** (.007)
Observations		44	44	44	44	44	44	44
Exposed Emp/pop (% ppts)		-1.251*** (.177)	-.65*** (.163)	-1.251*** (.177)	-.864*** (.168)	-1.847*** (.617)	-1.81*** (.227)	-.872*** (.149)
Observations		44	44	44	44	44	44	44
Total unemp (log)		.0520*** (.0138)	.039** (.0140)	.0520*** (.0138)	.165*** (.0113)	.0628*** (.0160)	.105*** (.0142)	.0497*** (.0117)
Observations		44	44	44	44	44	44	44
Unemp rate (% ppts)		.575*** (.155)	.298** (.110)	.575*** (.155)	1.51*** (.129)	.653*** (.118)	1.057*** (.016)	.495*** (.014)
Observations		44	44	44	44	44	44	44

Notes: \* $p<0.10$ , \*\* $p<0.05$ , \*\*\* $p<0.01$ . Robust standard errors in parentheses. This table summarizes the effects of the 2004 posting liberalization shock on domestic employment in France. Employment of French workers does not include employment of workers posted in France, as these workers are employed by foreign firms. Estimates are based on the difference-in-differences model described by Equation (4). Each reported coefficient is from a separate regression, and captures the differential evolution of domestic employment in French provinces with high and low exposure to posting, before and after the exogenous supply shock of 2004. One observation is at the year-exposure level, from 1994 to 2015. To measure pre-reform exposure to imports of posting services, column (1) uses the baseline pre-reform spatial-industrial exposure per worker (Equation (2)). Column (3) uses 1990 industry shares, column (3) uses 2000 industry shares, column (4) uses geographic distance to NMS countries that gain access to the French market in 2004, column (4) uses region-level exposure per worker and column (5) implements a “leave-out” correction as described in the text. Each coefficient can be interpreted as the differential evolution of the dependent variable in provinces with top versus bottom exposure to the liberalization, after the liberalization as compared to before.

Table 3: Causal Effect of Posting Exposure on Receiving Country Employment: 2SLS Model

	Post-reform (2003-2015)					Pre-reform, Falsification Test		
	OLS (1)	RF (2)	IV (3)	IV (4)	IV (5)	1993-2003 (6)	2000-2003 (7)	1993-2000 (8)
$\Delta \log$ Posting Imports/worker	-.638*** (.231)	-.462*** (.117)	-1.604*** (.338)	-.871*** (.283)	-1.523*** (.555)	1.044 (0.782)	-.184 (.208)	1.21 (0.806)
Observations	94	94	94	94	94	94	94	94
Fstat			19.49	11.5	23.56	19.37	19.47	19.37

Panel B. Dependent Variable:  $100 \times \log$  change in population counts, 2003-2015

	Exposed Emp (8)	Adult Pop (10)	Sheltered Emp (12)	Unemployment (14)	Unemployment (15)			
	(9)	(11)	(13)					
$\Delta \log$ Posting Imports/worker	-9.152*** (2.462)	-7.109*** (3.319)	-1.973 (1.496)	-0.494 (1.860)	-2.844 (2.450)	-1.539 (2.306)	9.168** (4.654)	8.242*** (3.399)
Observations	94	94	94	94	94	94	94	94
Fstat	19.49	23.56	19.49	23.56	19.49	23.56	19.49	23.56

Notes: \* $p<0.10$ , \*\* $p<0.05$ , \*\*\* $p<0.01$ . Robust standard errors in parentheses. The table shows the estimates of the IV model relating local domestic employment changes from 2003 to 2015 with changes in posting exposure after the liberalization of 2004, which is measured as imports of posting services per pre-reform total number of worker, in log. To account for endogeneity in posting inflows after the liberalization, imports of posting services over 2005-2015 is instrumented by the 2003 province exposure to posting. The top panel uses the 2003-2015 change in the share of French working age population employed in exposed sector as a dependent variable, and is measured in percentage points. The regressor is the log of a province posting imports after the reform in total pre-reform employment. Column (2) shows the reduced form relationship between the dependent variable and the instrument. Column (4) controls for the initial share of a province employment in exposed sectors. Column (5), (6) and (7) show placebo estimates of 2003-2015 local import exposure on lagged employment growth in exposed sectors. The bottom panel uses log points (100 times log changes) as the dependent variable, for exposed sectors, sheltered service sectors (no posting imports), total unemployment, and working age population. All columns except column (5), (9), (11) and (13) are weighted by the the province adult population at the beginning of the period. More details are provided in the text. Robustness to the specification column (3) are displayed in Table A.7 and Table A.9. Figure A.11 repeats the specification in column (3) deleting one observation at a time. The first stage relationship between pre-liberalization exposure and posting imports after the reform is detailed in Table A.6. More details are provided in the text of Section 3.

**Table 4: Dynamic of Receiving Firms Employment and Wages After First Posting Use Event**

Dependent Variable (in log)	(1) Total Employment	(2) Wage Rate	(3) Blue Collar Workers	(4) Other Workers
4 years before event	.02326* (.0123)	.0080** (.0039)	.0268 (.01475)	-.0257 (.2080)
3 years before event	.0184** (.0091)	.0060** (.0030)	.0162 (.0112)	-.0697 (.1941)
2 years before event	.0073 (.0058)	.0037 (.0024)	.0154 (.0073)	.2889 (.4657)
Year of event	-.0158** (.0062)	-.0005 (.0022)	-.0219*** (.0075)	-.2210 (.3087)
1 year after event	-.0288*** (.0103)	-.0040 (.0033)	-.0423*** (.0128)	-.5621 (.5307)
2 years after event	-.0711*** (.0104)	-.0086* (.0045)	-.0596*** (.0180)	-.7750 (.7603)
3 years after event	-.1219*** (.0154)	-.0084 (.0058)	-.1031*** (.0242)	-1.362 (1.012)
4 years after event	-.1752*** (.0262)	-.0093 (.0075)	-.1336*** (.0310)	-.9746 (1.291)
Firm FE	Yes	Yes	Yes	Yes
Year×3DSect	Yes	Yes	Yes	Yes
Never Using Firms	No	No	No	No
# of Observations	108,386	107,973	68,718	90,146

Notes: \*p<0.10, \*\*p<0.05, \*\*\*p<0.01. This table reports the estimates of domestic employment responses to the use of posting services by Belgian firms. The estimates are based on Equation (8).

**Table 5: Posting Employment Pay Penalty**

	Outcome: Log Wage			
	(1)	(2)	(3)	(4)
Posting Arrangement	-.32*** (.002)	-.30*** (.004)	-.30*** (.004)	-.34*** (.003)
Temp Employment Arrangement				-.12*** (.001)
Firm FE	Yes	Yes	Yes	Yes
Polynomial Age	No	Yes	Yes	Yes
Log Hours of Work	No	Yes	Yes	Yes
Year Fe	Yes	Yes	No	Yes
Observations	13,144,061	13,144,045	13,144,045	13,144,045

Notes: The table compares posted and domestic workers' wage *within a workplace* in the second largest importer of posting services: France. I use the universe of mandatory posting declarations filed by foreign suppliers that send posted workers in the French territory (DPD/SIPSI dataset) to identify the 19,138 French firms that purchased a posting contract at some point in 2017-2018 and for which at least one domestic job record exist in the 2017-2018 DADS postes dataset, a linked employer-employee dataset covering all job spells in France during that period. Merging the DADS with the posting registry, I can observe wages paid to French workers (reported in DADS by French employer) and posted workers (reported in DPD/SIPSI by foreign supplier) at the same workplace in France. For the sample of receiving firms in 2017-2018, I regress workers' log wage on an indicator equal to one if the workers is in a posting arrangement, controlling for firm fix effects, cubic age, and number of hours worked.

Table 6: **Sending Firms' Expansion Around the First Posting Event**

Dependent Variable (in log)	(1) Turnover	(2) Wage Bill	(3) Hours Worked	(4) Employees	(5) Total Assets
4 years before event	-0.0644 (.0518)	-0.0446 (.0546)	-0.0280 (.0428)	-0.0446 (.0301)	-0.0446 (.0442)
3 years before event	-0.0144 (.0440)	.0316 (.0486)	.0343 (.0376)	-0.00121 (.0250)	.00508 (.0402)
2 years before event	.0395 (.0387)	.0649 (.0431)	.0447 (.0349)	.0184 (.0225)	.0296 (.0377)
Year of event	.153*** (.0458)	.269*** (.0593)	.143*** (.0419)	.139*** (.0263)	.256*** (.0411)
1 year after event	.449*** (.0506)	.562*** (.0600)	.395*** (.0419)	.269*** (.0305)	.426*** (.0469)
2 years after event	.381*** (.0569)	.501*** (.0664)	.344*** (.0473)	.249*** (.0350)	.449*** (.0529)
3 years after event	.330*** (.0670)	.457*** (.0730)	.293*** (.0540)	.211*** (.0408)	.440*** (.0595)
4 years after event	0.298*** (.0787)	0.414*** (.0858)	.293*** (.0645)	.198*** (.0490)	.403*** (.0722)
Firm FE	Yes	Yes	Yes	Yes	Yes
Year×5DSect×Prov FE	Yes	Yes	Yes	Yes	Yes
Never Posting Firms	No	No	No	No	No
# of Observations	29,754	29,971	29,880	29,972	30,851

Notes: \* $p<0.10$ , \*\* $p<0.05$ , \*\*\* $p<0.01$ . The table reports the event study estimates from the empirical specification described by Equation (13) for the period 2006-2017, focusing on the 4,151 firms that post workers for the first time between 2010 and 2015. The regressions include firms and five-digit industry  $\times$  province  $\times$  year fixed effects. Robust standard errors are clustered at the event year  $\times$  province level to account for spatial autocorrelation of errors terms. The estimation sample is described in detail in [Online Appendix](#).

Table 7: Dynamic Effects of First Posting on Firms' Wages and Profits

Dependent Variable (in log)	(1) Wage Rate	(2) Profits	(3) Wage Rate	(4) Profit
4 years before event	.00996 (.0161)	-0.0183 (.0545)	.00354 (.0191)	.0184 (.0737)
3 years before event	.00455 (.0154)	.0231 (.0411)	.00154 (.0153)	.0190 (.0523)
2 years before event	.0129 (.0156)	.0284 (.0379)	.0126 (.0141)	.0169 (.0506)
Year of event	.0834*** (.0200)	.0932** (.0429)	.0932*** (.0138)	.0887** (.0420)
1 year after event	.119*** (.0213)	.304*** (.0478)	.134*** (.0172)	.318*** (.0508)
2 years after event	.102*** (.0201)	.266*** (.0438)	.126*** (.0208)	.289*** (.0736)
3 years after event	.106*** (.0198)	.256*** (.0479)	.131*** (.0262)	.275*** (.0823)
4 years after event	.0835*** (.0185)	.255*** (.0465)	.116*** (.0296)	.287*** (.105)
Firm FE	Yes	Yes	Yes	Yes
Year $\times$ 5DSect $\times$ Prov FE	Yes	Yes	Yes	Yes
Never Posting Firms	Yes	Yes	No	No
# of Observations	235,471	167,496	29,880	23,118

Notes: \* $p<0.10$ , \*\* $p<0.05$ , \*\*\* $p<0.01$ . The table reports the event study estimates from the empirical specification described by Equation (13) for the period 2006-2017. The estimation sample is restricted to the 4,151 firms that post workers for the first time between 2010 and 2015 in Columns (3)-(4), while Columns (1)-(2) use the 28,803 firms that never post workers over the period as an additional control group. The regressions include firms and five-digit industry  $\times$  province  $\times$  year fixed effects. Robust standard errors are clustered at the event-year  $\times$  province level to account for spatial autocorrelation of errors terms. The estimation sample is described in detail in [Online Appendix](#).

Table 8: Elasticity of Posting Flows to Policy-Induced Labor Cost Changes

<b>Panel A: Full Gravity Estimation</b>								
Regressor: Log Payroll Taxes	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
<b>Posting Elasticity (<math>-\theta</math>)</b>	-.71*** (.20)	-.75*** (.21)	-.66*** (.21)	-1.2*** (.20)	-1.2*** (.21)	-.75** (.33)	-1.1*** (.38)	
Regressor: Log Total Wage Cost	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
<b>Posting Elasticity (<math>-\theta</math>)</b>	-.78*** (.23)	-.82*** (.24)	-1.2*** (.15)	-1.4*** (.25)	-1.4*** (.27)	-.97*** (.27)	-2.4*** (.47)	-1.1*** (.19)
Observations	4,665	4,455	4,723	4,665	4,455	4,723	4,723	4,667
Origin-Destination FE	Yes							
Destination $\times$ Year FE	Yes							
Origin $\times$ Year FE	No	Yes						
Weighted	No	No	No	Yes	Yes	Yes	No	No
Estimator	OLS	OLS	PPML	OLS	OLS	PPML	MPPML	MPPML
Internal Flows	Yes	No	No	Yes	No	No	No	No

**Panel B: Quasi-Natural Experiment Estimates**

	Slovenian Posted Bonus ( $\Delta\tau_{it}$ )	Belgian Tax Shift ( $\Delta\Phi_{jt}$ )	German Min Wage ( $\Delta a_{ijt}$ )
<b>Posting Elasticity (<math>-\theta</math>)</b>	-1.6*** (.33)	-1.4*** (.42)	-1.3*** (.27)

Notes: \* $p<0.10$ , \*\* $p<0.05$ , \*\*\* $p<0.01$ . Posted workers are exempt from labor taxes in the receiving country: all payroll taxes during the posting mission are paid in the sending country. Posted workers cannot be paid less than destination-level minimum wage: they must receive an additional posting allowance to match that “prevailing regulatory wage.” I exploit within destination-year or within country-pair-year-level variation generated by payroll tax exemptions or differentially binding minimum wages to identify the elasticity of posting flows with respect to labor cost. Panel A estimates the structural gravity Equation (23) on the full matrix of bilateral posting flows within the EU merged with data on employers’ labor cost for each country pair (origin-specific wage and payroll taxes combined with destination-specific posting allowance) for 2009-2017. Each column is from a separate regression. The dependent variable is the number of postings from  $i$  to  $j$  at time  $t$  ( $S_{ijt}$ ); in log for specifications relying on a log-linear version of Equation (23) (OLS estimation); in levels for specifications relying on the multiplicative form of Equation (23) following Silva and Tenreyro [2006] (“PPML” Poisson pseudo maximum likelihood estimator); and in shares  $\lambda_{ijt}$  following Eaton et al. [2012] (“MPML” Poisson pseudo maximum likelihood estimator with trade shares as dependent variable). All specifications include destination-origin fixed effects, a dummy equal to one if mobility rules between country  $i$  and  $j$  changes at time  $t$ , and a destination-year fixed effect to control for the multilateral resistance structural term ( $\Phi_{ijt}$ ). Columns (1) to (7) exploit variations in (log) employers’ payroll taxes only, while Columns (8)-(14) exploit variations in (log) total employers’ labor cost. Weighted regressions use total population in sending countries to weight observations. Robust standard errors are clustered at destination-year level and are displayed in parentheses. Panel B displays the reduced-form posting elasticity estimates from difference-in-differences designs applied to three quasi-natural labor costs shocks induced by payroll tax reforms (in Belgium and Slovenia) and the introduction of minimum wage (Germany). Appendix C further documents bunching (Figure A.40) and difference-in-differences (Figure A.39) responses to two reforms in labor cost exemptions granted to posted workers in receiving countries.

Table 9: Model-Based Welfare Gains in the Service Sector

Member State	Consumer Gains in Services After Policy Shock (%)	
	NMS Liberalization	No Autarky
Austria	.35	1.9
Belgium	.16	4.3
Bulgaria	.26	.62
Czech Republic	.21	.75
Germany	.18	.81
Denmark	.05	.40
Estonia	.45	.90
Spain	.03	.42
Finland	.12	.52
France	.07	.85
Croatia	.76	1.3
Hungary	.39	.80
Ireland	.02	.15
Italy	.04	.30
Lithuania	.27	.42
Luxembourg	.22	6.8
Latvia	.15	.5
Netherlands	.09	1.1
Poland	.25	.42
Portugal	.01	.91
Romania	.27	.67
Sweden	.09	.52
Slovenia	.78	1.2
Slovakia	.48	.74

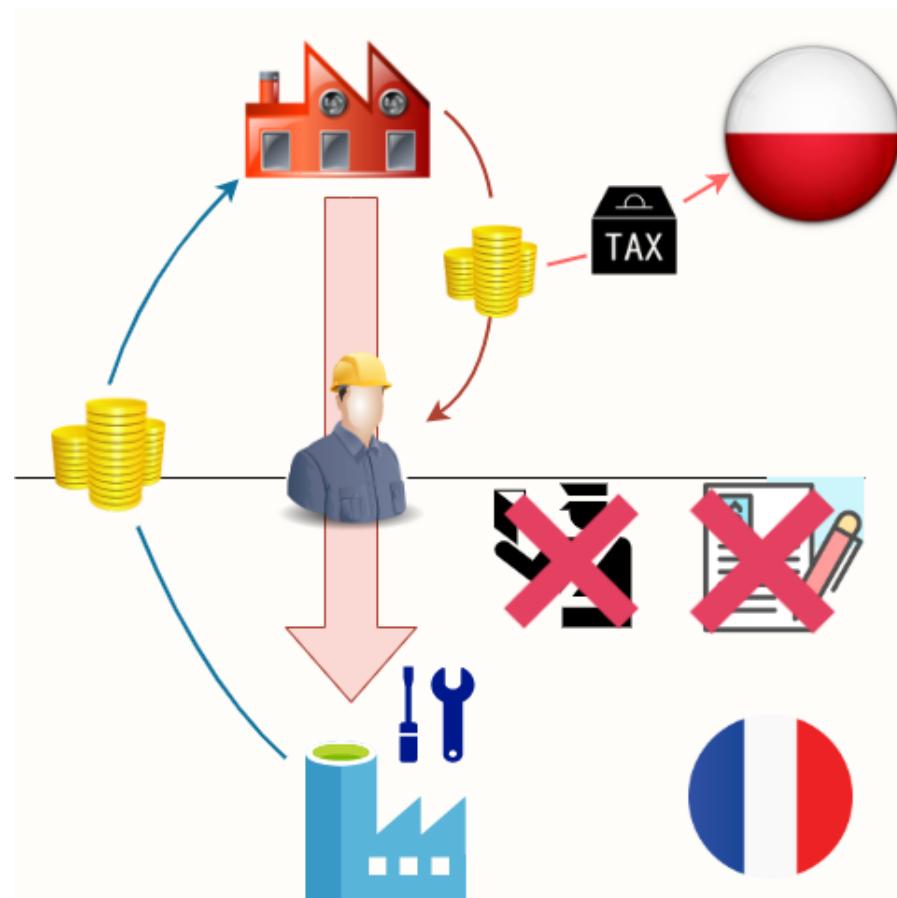
Notes: \* $p<0.10$ , \*\* $p<0.05$ , \*\*\* $p<0.01$ . This table summarizes the average and median welfare gains from lifting posting restrictions, as explained in the text. The calibration accounts for general equilibrium effects and is based on equation (21) and equation (22), and it uses estimates of the posting elasticity from theory-consistent estimations as presented in Table 8.

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## A Additional Figures and Tables

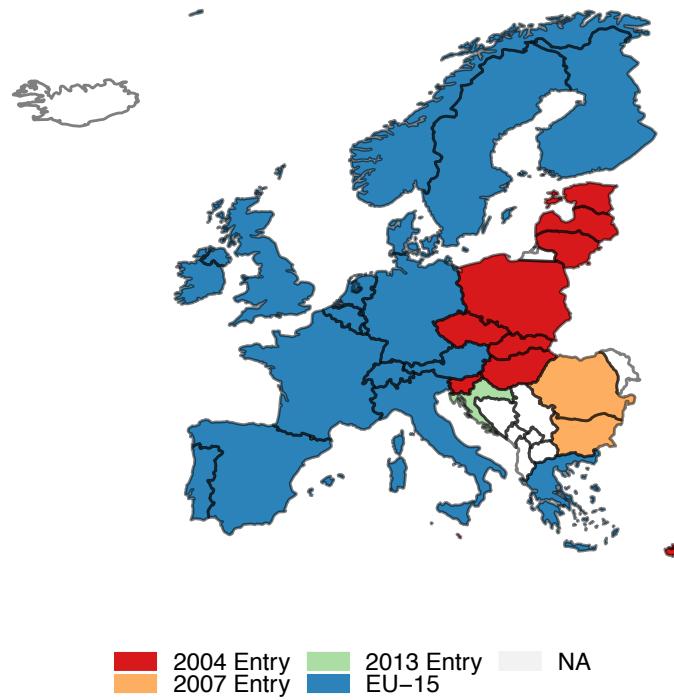
Figure A.1: Non-Tradable Services Export from Poland (PL) to Germany (DE)



Notes: This diagram summarizes the European posting policy that allows firms established in one member state to send their workers in another member state in order to perform a service. Sending firms do not need to request a work authorization in the receiving country. Employees sent abroad are hired in the sending country and never integrate the labor market where the service is provided while performing their activity in the receiving country. Posted workers are exempted from the receiving country's social security contributions and labor taxes, and they keep paying payroll taxes in the country where the sending firm is established. The exemption cannot exceed 12 or 24 months and can be repeated after a two-month break. Posted workers benefit from destination-level minimum wage. If their usual wage in the sending country is below the "prevailing wage," the sending firm must pay its workers an additional allowance to match the destination-level minimum legal wage. The posting policy only concerns the within-EU services provision. Firms located outside the EU must request a work and entry authorization in the receiving country.

Figure A.2: Timing of Posting Liberalization

**A. Three Waves of EU Accession Events**



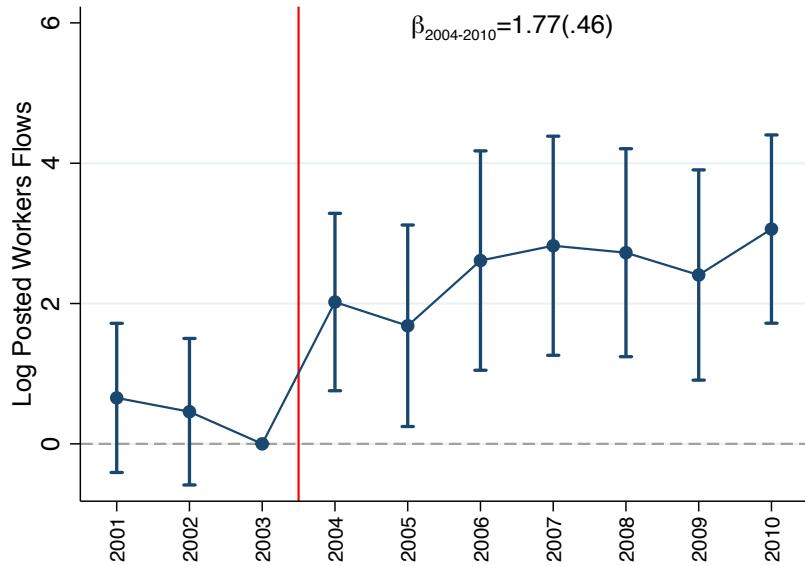
**B. Staggered Timing Across Origin-Destination Set by the EC**



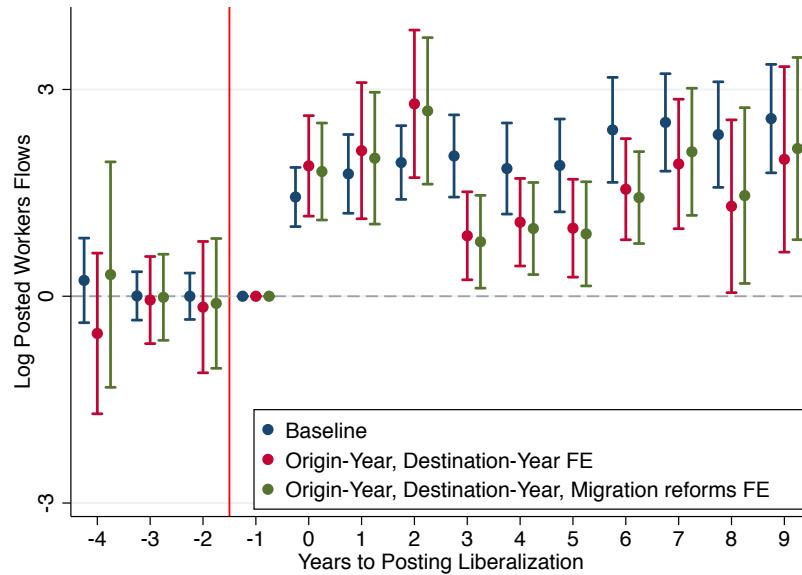
Notes: This Figure shows the timing of EU accession for new member states (NMS) located in Eastern European countries from 2004 to 2013. The EU enlargements of 2004, 2007 and 2013 triggered posting liberalization for successively 10 (Poland, Lithuania, Hungary, Estonia, Latvia, Slovakia, Slovenia, Czech Republic, Malta and Cyprus), 2 (Bulgaria and Romania) and 1 (Croatia) countries located in Eastern Europe. The bottom figure summarizes the differential timing posting mobility liberalization for some country pairs. Before EU accession, employees sent from these new member states to an EU member state had to request a work and entry authorization in the destination country. As detailed in the text, all destination countries lifted posting mobility restrictions at EU accession, while Germany and Austria were allowed by the European Commission to keep pre-existing entry barriers for 7 additional years following each EU accession events. After the lifting of mobility restrictions, destination countries have no right to refuse the foreign intervention performed by another EU member state in their territory.

Figure A.3: Robustness to Excluding Migration and Posting Reform Events

**A. Robustness to Excluding Simultaneous Migration and Posting Reform Events**



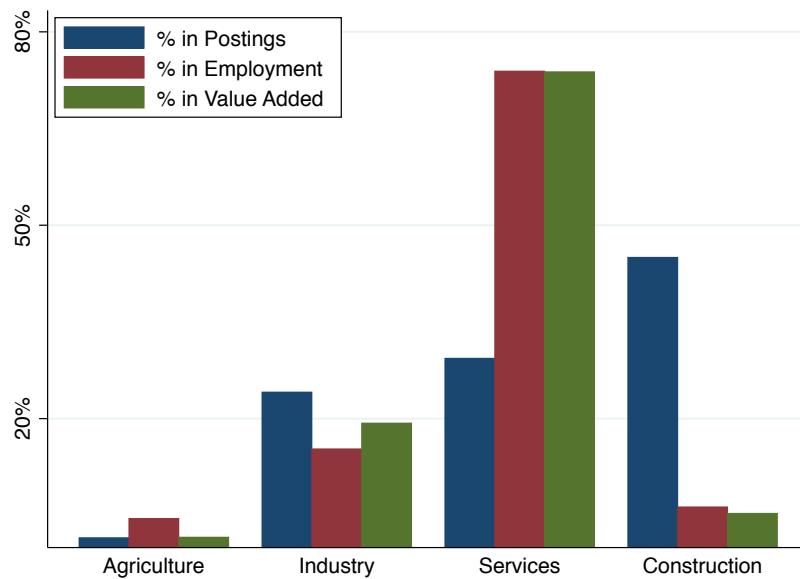
**B. Robustness to Controlling for Bilateral Migration Reforms**



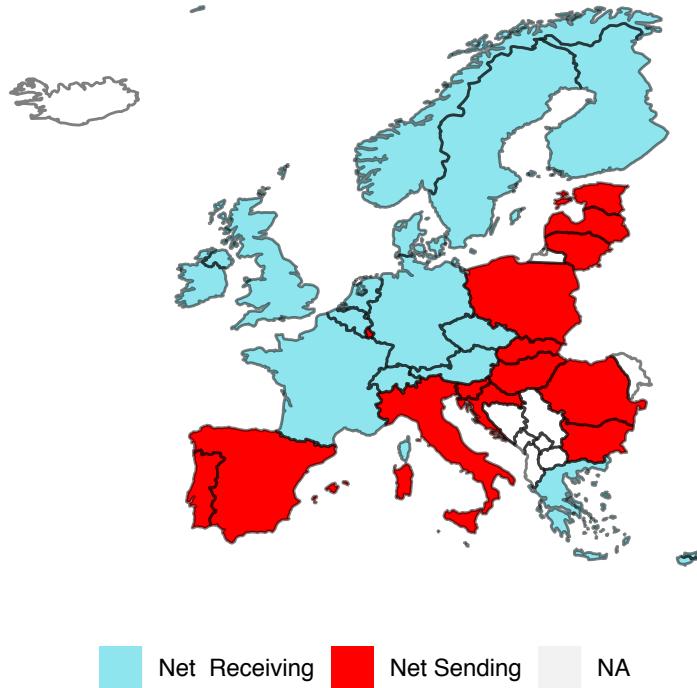
Notes: The Figure shows the effects of an origin-specific posting liberalization shocks on posted workers flows to France. In 2004, posting restrictions for countries that became EU members in 2004 (NMS 2004: Poland, Lithuania, Latvia, Estonia, Slovakia, Slovenia, Hungary, Czech Republic, Malta and Cyprus) were lifted. Posting restrictions for workers posted from NMS2004 were kept until 2011 in the German construction sector. In a triple differences design, Panel B compares the differential evolution of postings from countries treated and not treated by the 2004 enlargement, to France versus Germany where NMS 2004 were not granted the end of posting restrictions, controlling for destination and origin-year fixed effects. Figure B repeats the baseline estimation Equation (1) adding as a control a dummy for bilateral migration reforms occurring at different timings than posting liberalization reforms.

Figure A.4: Posting Flows in Europe: Geography and Sectors

**A. Overall Economic Activity and Postings Within EU**



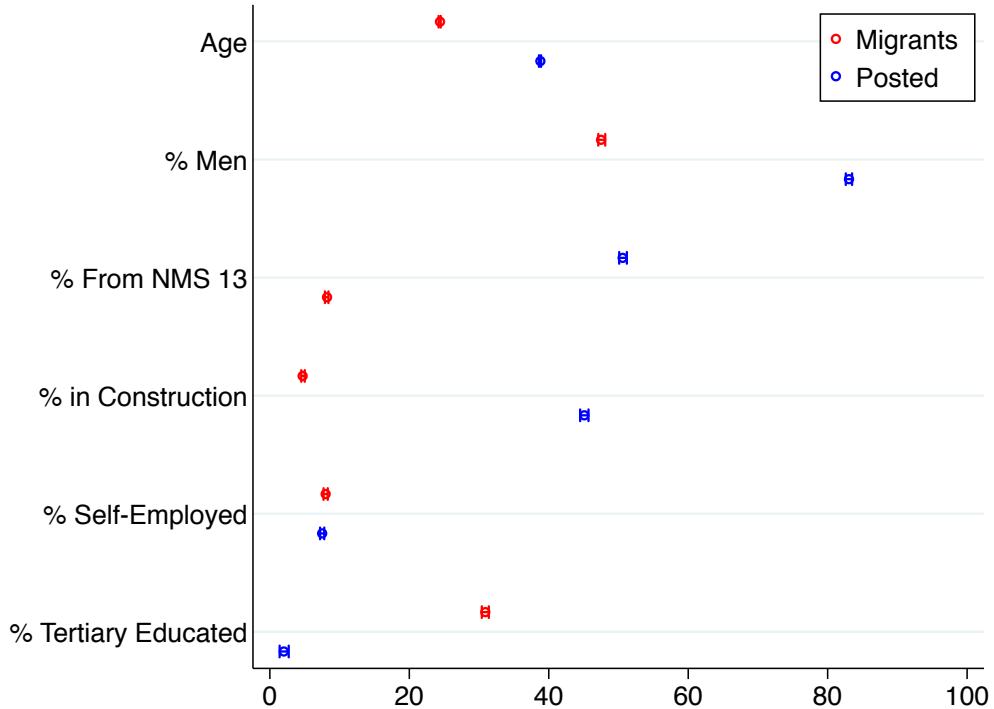
**B. Exporters and Importers of Posting Services**



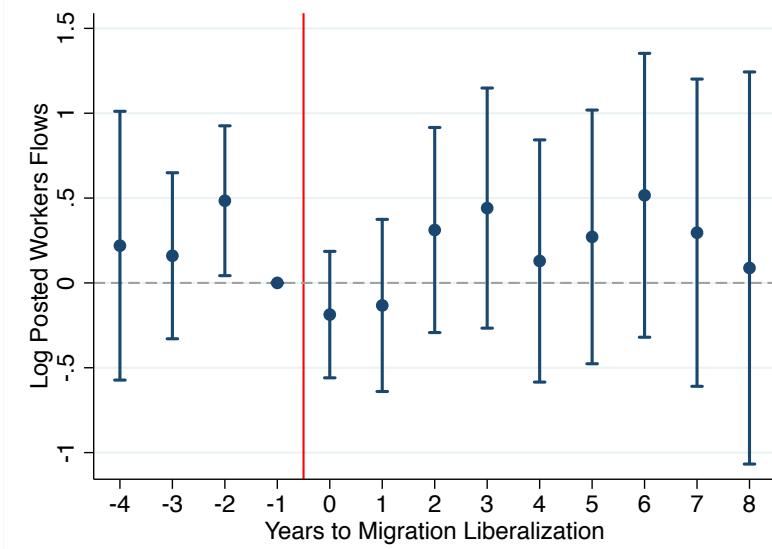
Notes: The Figure A shows the sectoral decomposition of posting missions within the EU as well as the share of European value added and employment of each of these sectors. The Figure is based on mandatory social security forms E101/A1 that foreign employees must hold when they provide a service in another EU member state, this dataset is described in [Online Appendix](#). Statistics from EU-level employment and value added are from Eurostat economic indicators. Figure B shows the location of consumers and providers of cross-border services performed through posting in Europe. Net sending countries (in red) are countries that performed more services in the EU by sending workers abroad compared to the number of services performed by workers posted to their territory. Net receiving countries (in blue) are countries that consumed more services performed by foreign workers posted to their territory compared to the number of services their domestic workers performed abroad.

Figure A.5: Complementarity of Migration and Posting

**A. Posted Workers Differ From Standard Migrants**



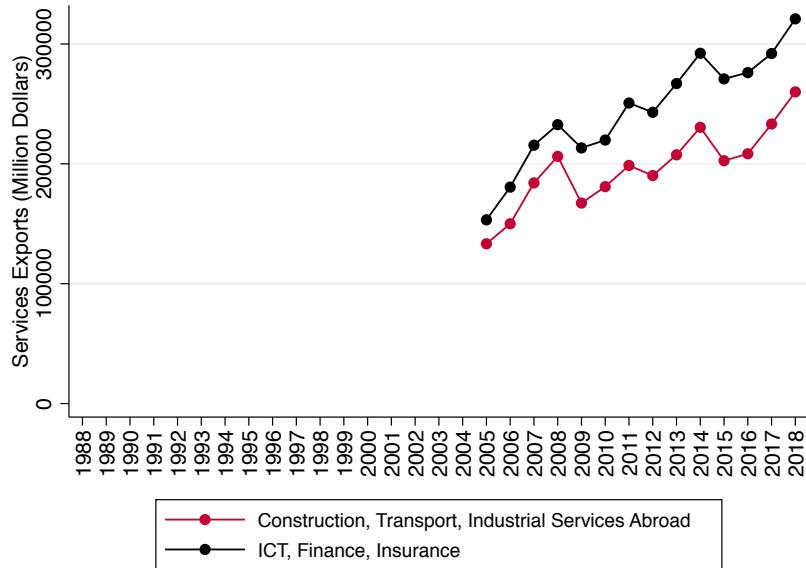
**B. Posting Flows Do Not React to Standard Migration Liberalization**



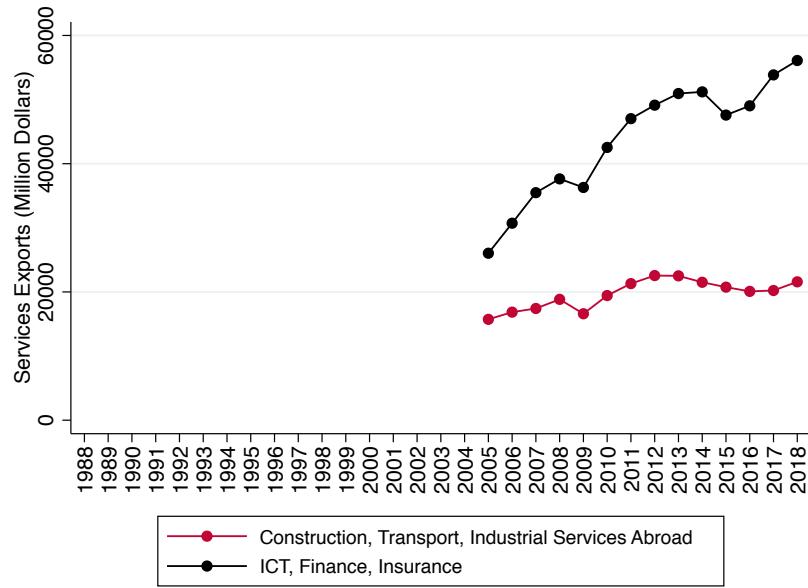
Notes: The figure illustrates potential complementarity or substitution between standard migration and posting. Figure A shows demographics of posted workers versus standard migrants for the second and third importer of posting services in Europe: France and Belgium. In 2019, 227,991 unique posted workers were in France and 269,235 to Belgium. For posted workers, being tertiary educated is proxied by having a managerial job, and this information is only available for workers posted to France. Self-employed posted workers are only recorded in Belgium. Demographics for migrants come from the EU-LFS dataset, a continent-wide European survey. Migrants are defined as working-age foreigners who live permanently in France or Belgium. For posted workers, all demographics are measured in the year of the posting mission. For migrants, all characteristics are measured at the time of the survey, but age is the age at which they arrived in the destination country. NMS 13 refers to the 13 new member states that entered in the EU since 2004 and are located in Eastern Europe (figure A.2). Figure B estimates posting flows responses to a change in standard migration reforms, when posting and standard migration are liberalized in different years.

Figure A.6: International Exposure of Non-Tradable Sectors: EU vs NAFTA

A. Within-EU service trade

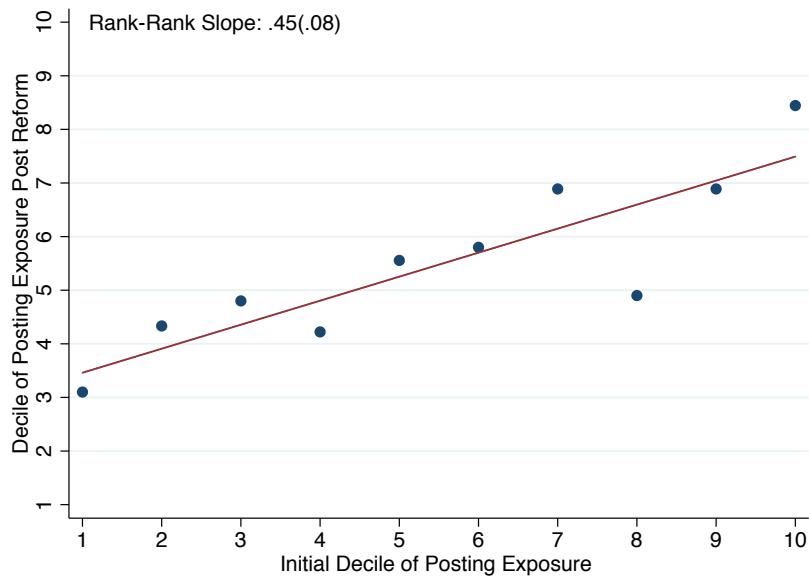


B. Within-NAFTA service trade



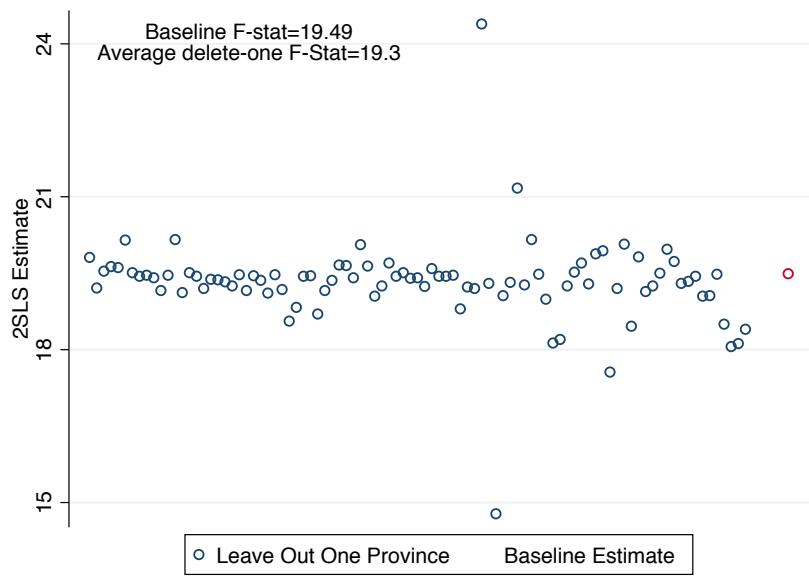
Notes: This figure compares non-tradable service trade within the EU and within the NAFTA since 2005. The figure is based on international data on service trade from the WTO for 12 sectors. I select sectors where trade is purely mobility dependent, e.g., services that must be produced locally: construction, transport, and manufacturing services performed on inputs owned by others. To measure trade in services in sectors that are less mobility dependent, I select sectors where services can be produced remotely and exchanged easily through electronic means: information and communications technology (ICT), finance, and insurance. This measure of provision of services through posted workers is a lower bound of mobility-dependent trade, as services in ICT, finance, and insurance can also be performed through posted workers.

Figure A.7: Relationship Between Pre-Existing and Future Exposure to Posting Imports



Notes: The Figure shows the correlation between the decile of exposure before the liberalization of posting services (x axis) and in years 2005-2015 following the reform. Posting exposure is defined as imported posting services per total worker in a province.

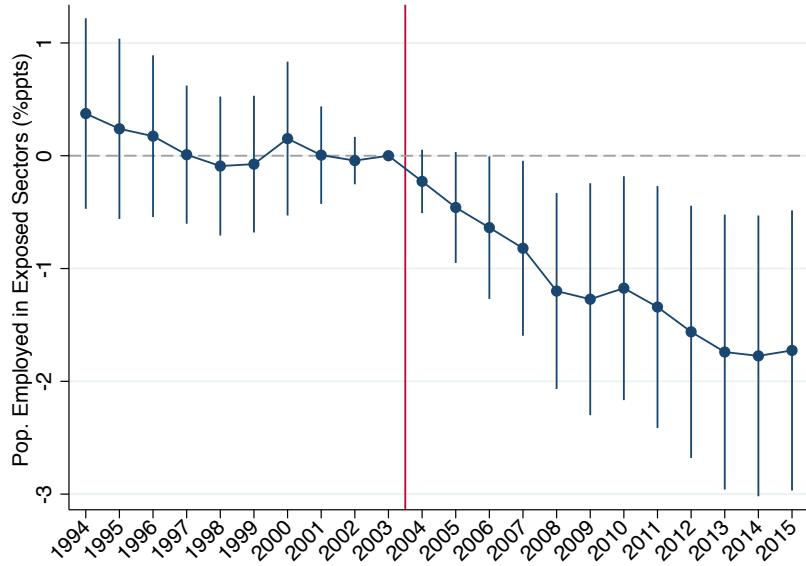
Figure A.8: 2SLS First Stage to “Delete-One” Test



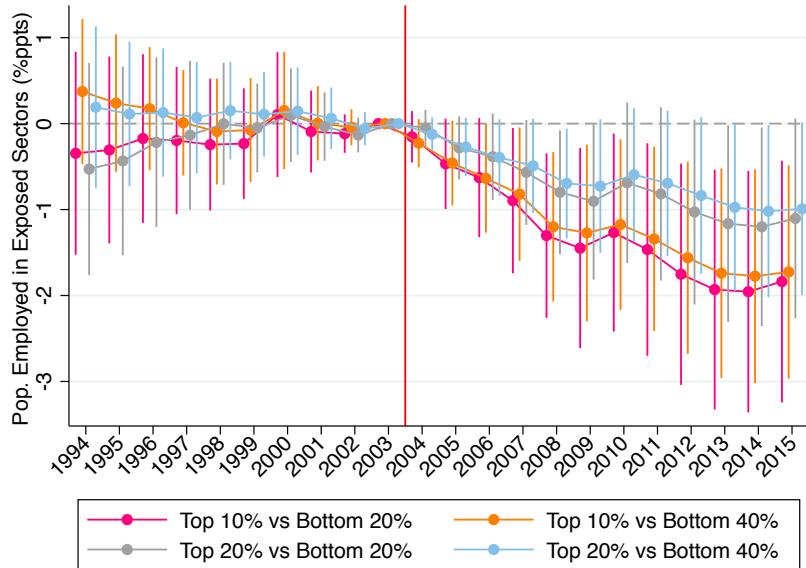
Notes: The Figure shows the robustness of the baseline first stage F statistics presented in Table A.6, column (1), to excluding each of the province (observation) from the baseline regression.

Figure A.9: Causal Effect of the Posting Liberalization on Domestic Employment

### A. Dynamic Difference-in-Differences

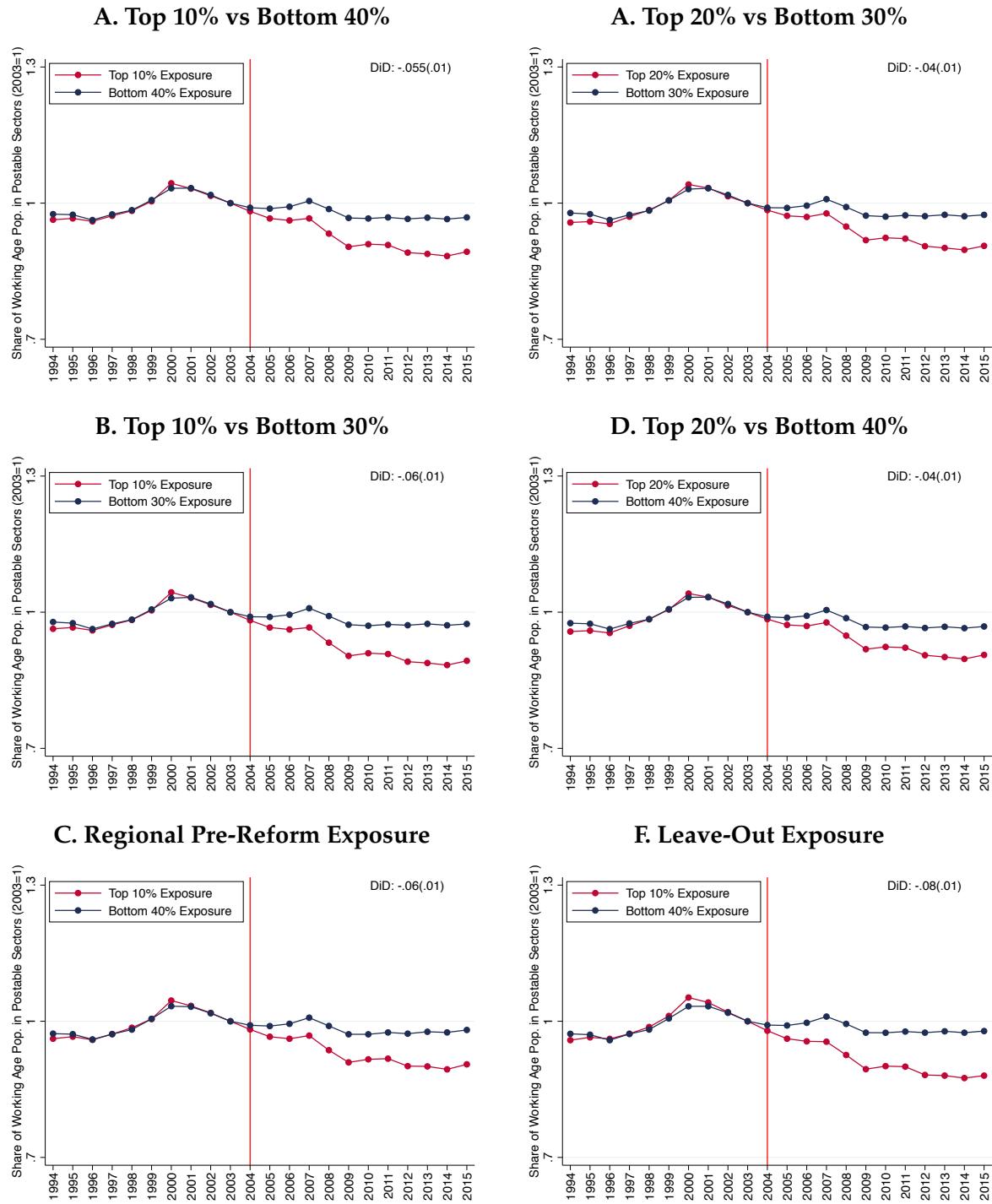


### B. Heterogeneity by Intensity of Local Labor Market Exposure



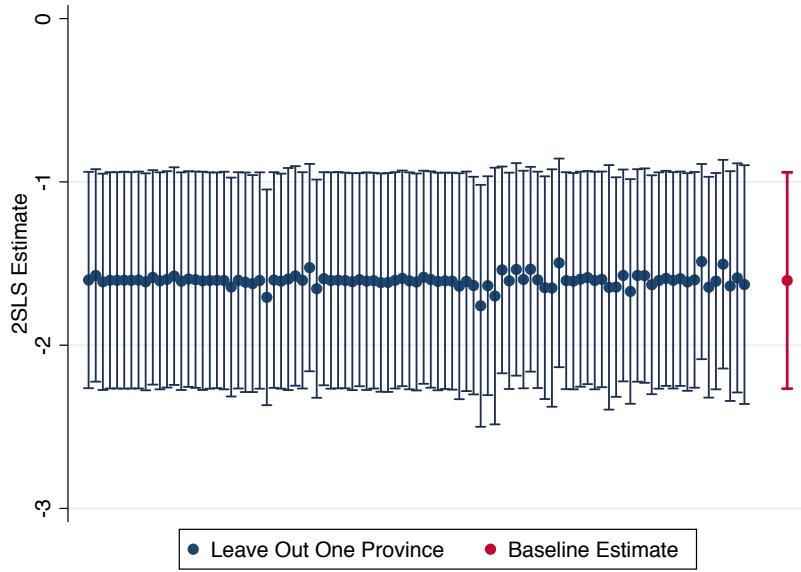
Notes: The figure displays the estimates from Equation (5) that capture the differential evolution of domestic employment in French provinces initially exposed to the liberalization of the posting policy. Panel A compares the evolution of domestic employment in provinces in the top 10% of pre-reform spatial exposure compared to provinces in the bottom 40% as control group, following the aggregate series displayed in Figure 7. The dependent variable is the share of a province working age population employed in exposed sectors, in percentage points. The event is the lifting of posting restrictions for services supplied by low-cost countries in 2004-2005. The coefficient of the year before the reform  $\zeta_{2003}$  is normalized to zero. The regression includes calendar year and province fixed effects.  $\zeta_k$  compares employment in sectors exposed to the posting shock in provinces with high exposure to the reform in calendar year  $k$ , compared to employment in provinces with low exposure to the reform. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the province level. Panel B repeats the estimation using alternative definitions of high and low exposure to the shock, exemplifying the heterogeneities in employment effects depending on the intensity of local labor market exposure to the shock.

Figure A.10: Robustness to Baseline DiD



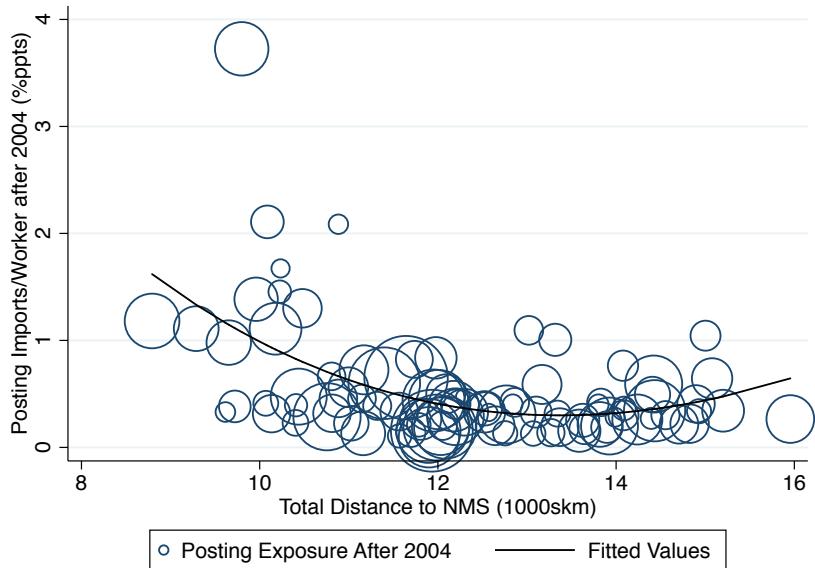
Notes: The figure repeats the baseline analysis presented in figure 7 with alternative thresholds to select top and bottom exposure provinces.

Figure A.11: 2SLS Robustness to “Delete-One” Test



Notes: The Figure shows the robustness of the baseline 2SLS result presented in Table 3, column (2), to excluding each of the province (observation) from the baseline regression.

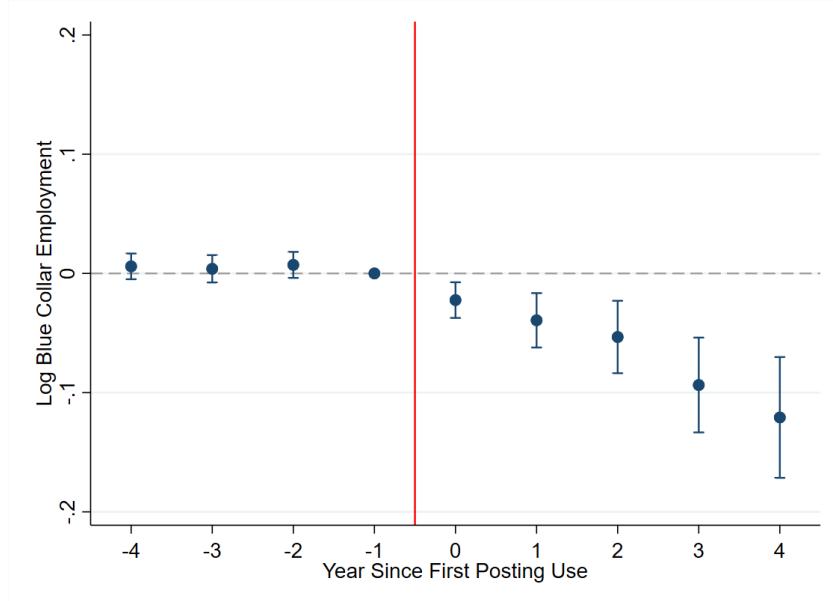
Figure A.12: Geographic Distance to NMS Countries And Posting Imports After 2004



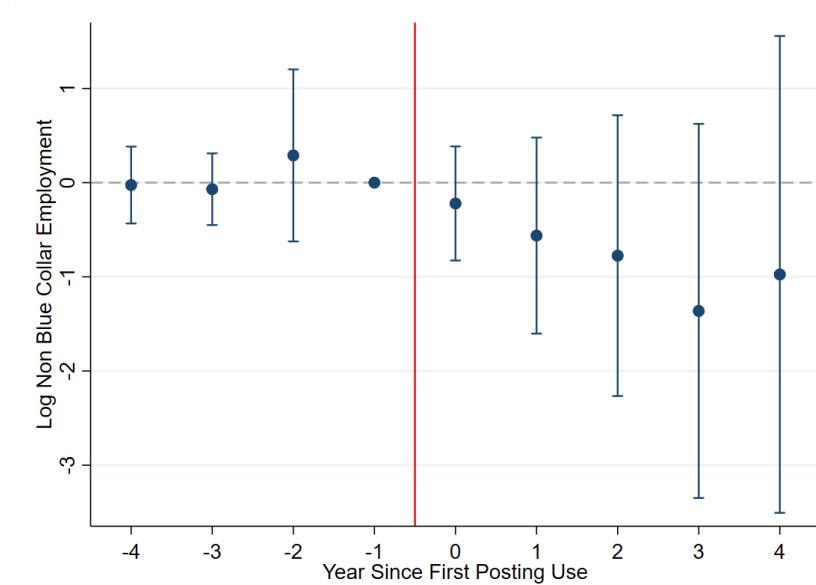
Notes: The Figure shows the correlation between a province imports of posting services per worker after 2004, and its geographic distance to NMS countries that gain the right to supply services in France after 2004. Geographic distance is computed as the sum of air distance of each province to each of the NMS countries. Observations are weighted by pre-liberalization population and the fitted values are computed with a quadratic term.

Figure A.13: Firm-Level Displacement: Heterogenous Workers Exposure Within-Firm

**A. Blue Collar Employment at Receiving Firms**



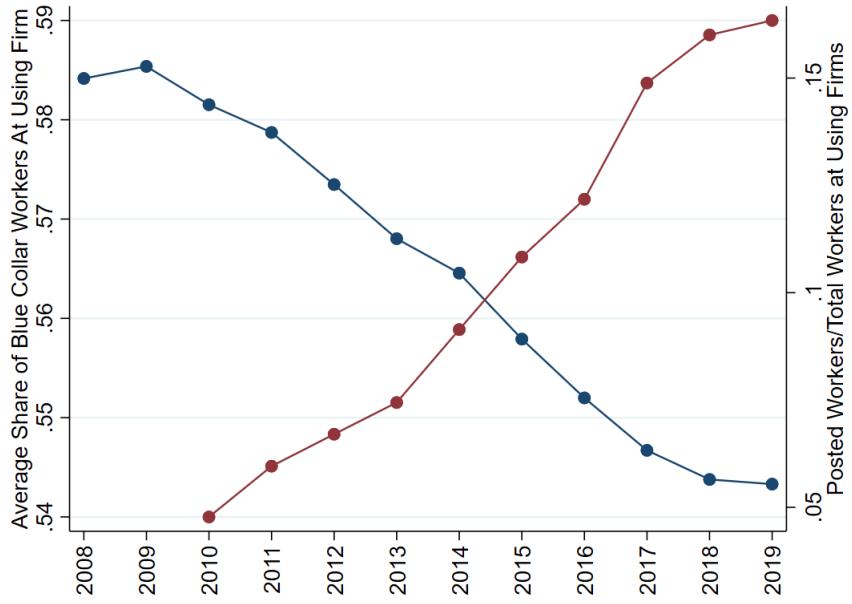
**B. Other Employment At Receiving Firms**



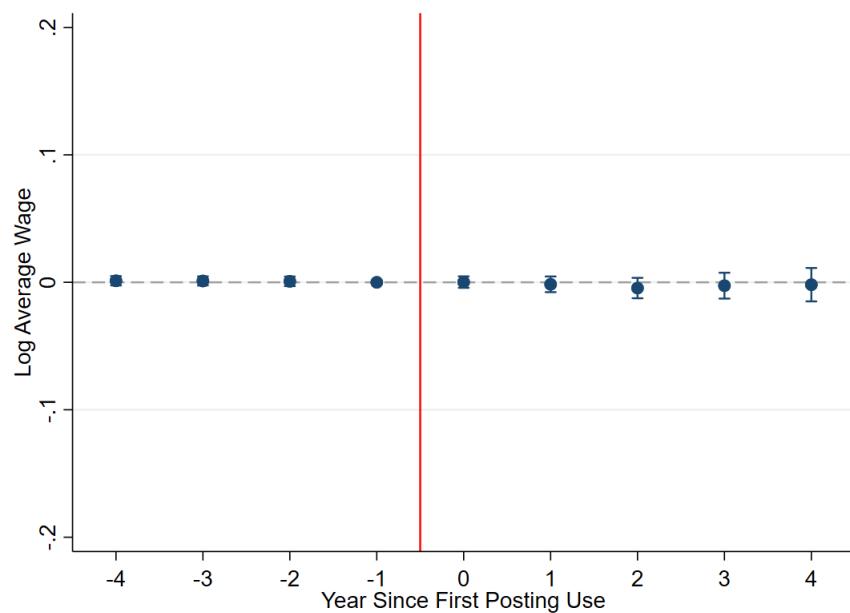
Notes: This figure uses exhaustive administrative posting records of Belgian firms merged with administrative employment data to select the 11,796 firms that started using posted workers for the first time between 2014 and 2019. The figure plots the estimated event study coefficients  $\gamma_k$  from Equation (8) for the period 2008-2019, where the dependent variable is log blue collar employment (Panel A) and log employment of other workers (Panel B). The event is defined as the first time a Belgian firm sources services to foreign posted employees. The coefficient of the year before the first posting use  $\gamma_{-1}$  is normalized to zero. The regressions include firm and three-digit sector  $\times$  calendar year.  $\gamma_k$  compares the outcomes of receiving firms in event year  $k$  to the outcomes of future posting firms in the same narrowly defined sector in the year before their event. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the calendar year  $\times$  province level.

Figure A.14: Additional Results on Receiving Firms Responses to Posting

**A. Aggregate Domestic Blue Collar Employment and Exposure to Posting Flows**



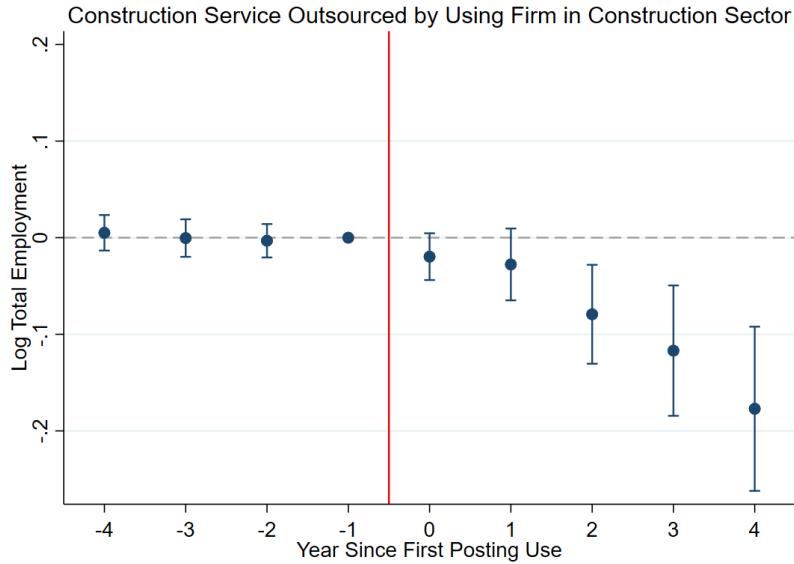
**B. Receiving-Firm Level Wage Rate After Using Posted Workers**



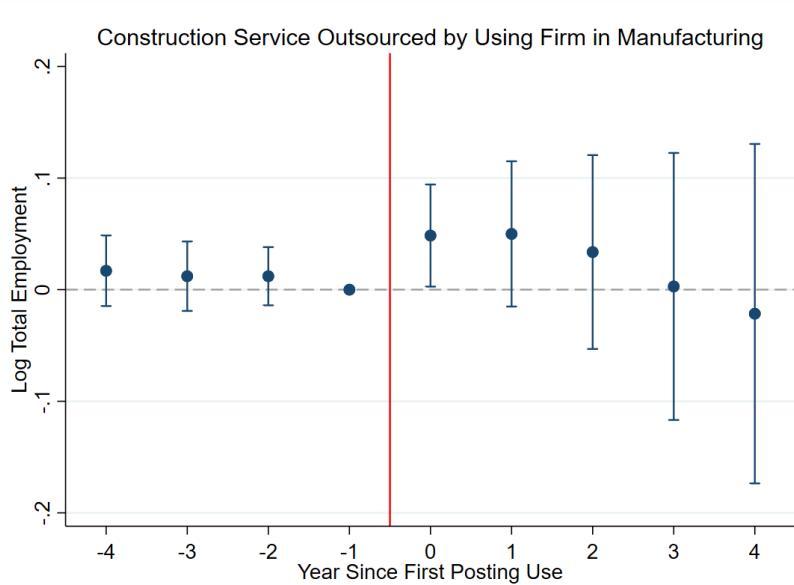
Notes: Figure A uses exhaustive administrative posting records of Belgian firms merged with administrative employment data to observe the 23,380 Belgian firms that purchased a posting service at some point between 2010 and 2019. For these firms, the graph displays the evolution of the share of domestic blue collar workers in total employment (blue line, left axis) and the evolution of posted workers in total employment (red line, right axis). Figure B plots the estimated event study coefficients  $\gamma_k$  from Equation (8) for the period 2008-2019, where the dependent variable is log wage. The event is defined as the first time a Belgian firm sources services to foreign posted employees. The coefficient of the year before the first posting use  $\gamma_{-1}$  is normalized to zero. The regressions include firm and three-digit sector  $\times$  calendar year.  $\gamma_k$  compares the outcomes of receiving firms in event year  $k$  to the outcomes of future posting firms in the same narrowly defined sector in the year before their event. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the calendar year  $\times$  province level.

Figure A.15: Firm-Level Displacement: Heterogenous Workers Exposure Across-Firm

**A. Posted Workers Performing Same Tasks than Domestic Workers**



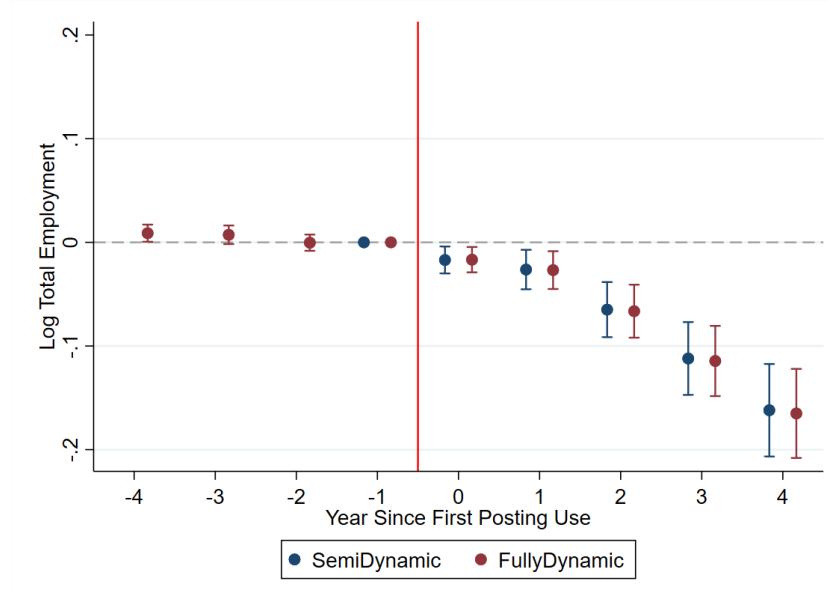
**B. Posted Workers Performing Different Tasks than Domestic Workers**



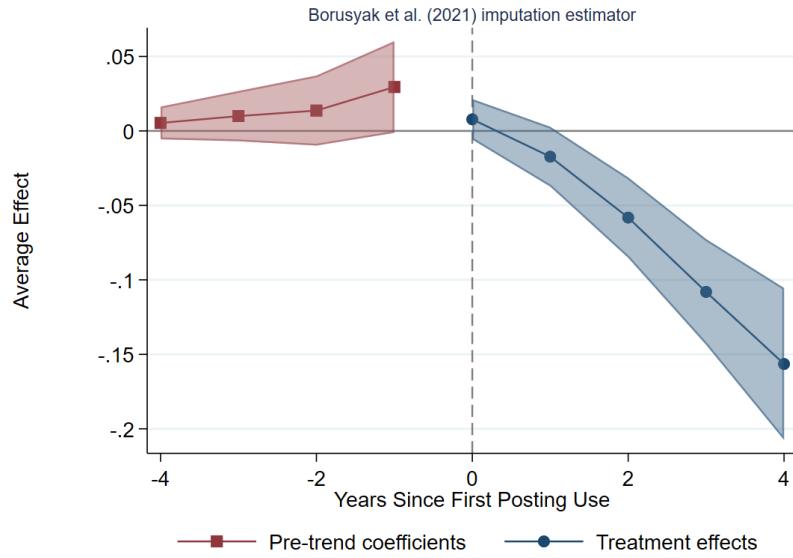
Notes: This figure uses exhaustive administrative posting records of Belgian firms merged with administrative employment data to select the 11,796 firms that started using posted workers for the first time between 2014 and 2019. The figure plots the estimated event study coefficients  $\gamma_k$  from Equation (8) for the period 2008-2019, where the dependent variable is log employment. The event is defined as the first time a Belgian firm sources services to foreign posted employees. The coefficient of the year before the first posting use  $\gamma_{-1}$  is normalized to zero. The regressions include firm and three-digit sector  $\times$  calendar year.  $\gamma_k$  compares the outcomes of receiving firms in event year  $k$  to the outcomes of future posting firms in the same narrowly defined sector in the year before their event. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the calendar year  $\times$  province level. Panel A focuses on the sample of Belgian clients that purchase a posting service in the same sector of activity than the one performed by their own domestic workers. Panel B focuses on Belgian firms that purchase a posting service in a sector of activity that is different than the main activity performed by domestic workers (a manufacturing firm purchasing a construction service).

Figure A.16: Firm-Level Displacement Effects: Alternative Specifications

### A. Fully and Semi-Dynamic OLS Estimation



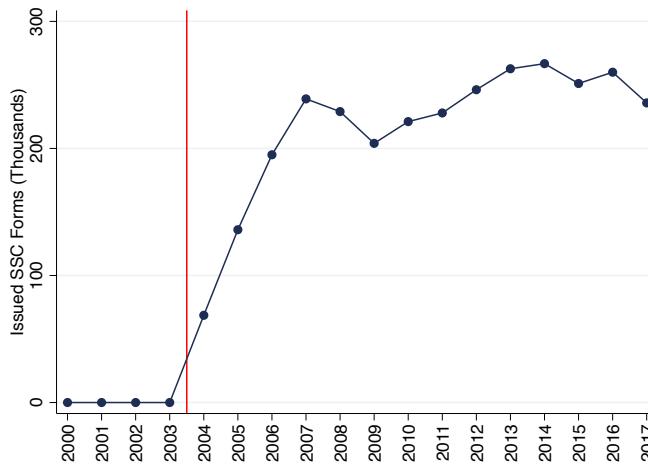
### B. Estimates Accounting for Heterogeneous Treatment Effects



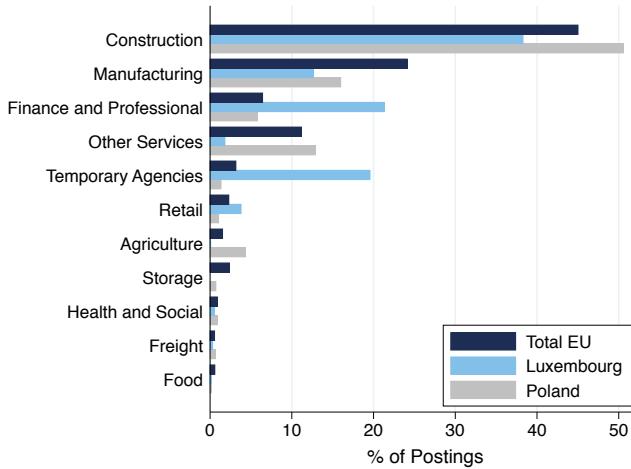
Notes: This figure uses exhaustive administrative posting records of Belgian firms merged with administrative employment data to select the 11,796 firms that started using posted workers for the first time between 2014 and 2019. The figure plots the estimated event study coefficients  $\gamma_k$  from Equation (8), investigating robustness to semi-dynamic specification (Panel A) and using an alternative estimator developed by [Borusyak and Jaravel \[2017\]](#) that accounts for heterogeneous treatment effects (Panel B).

Figure A.17: Effects of the Liberalization Reform on Postings From Poland

**A. Postings from Poland Post-2004**



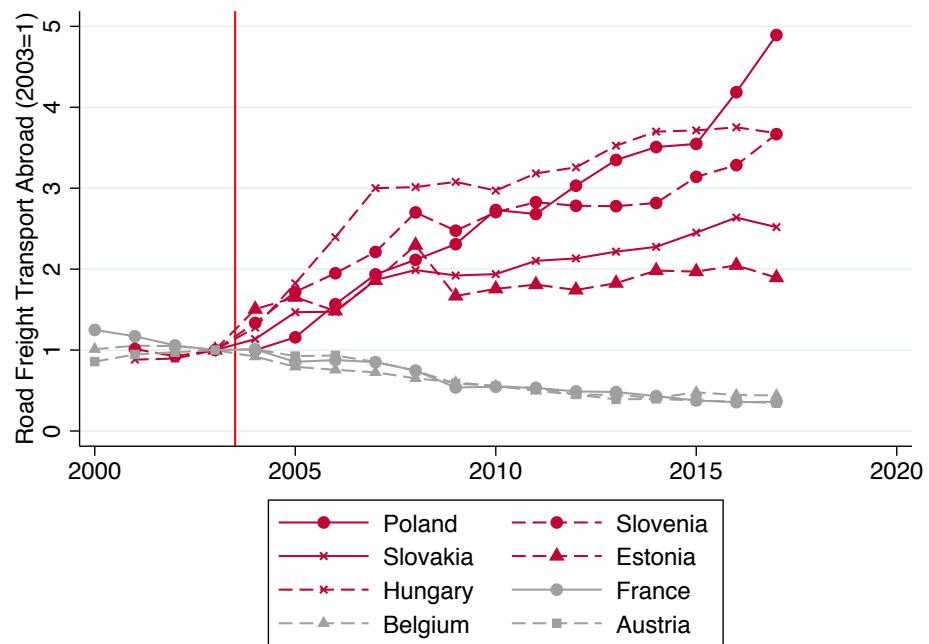
**C. Sectors of Services Supplied Through Posting**



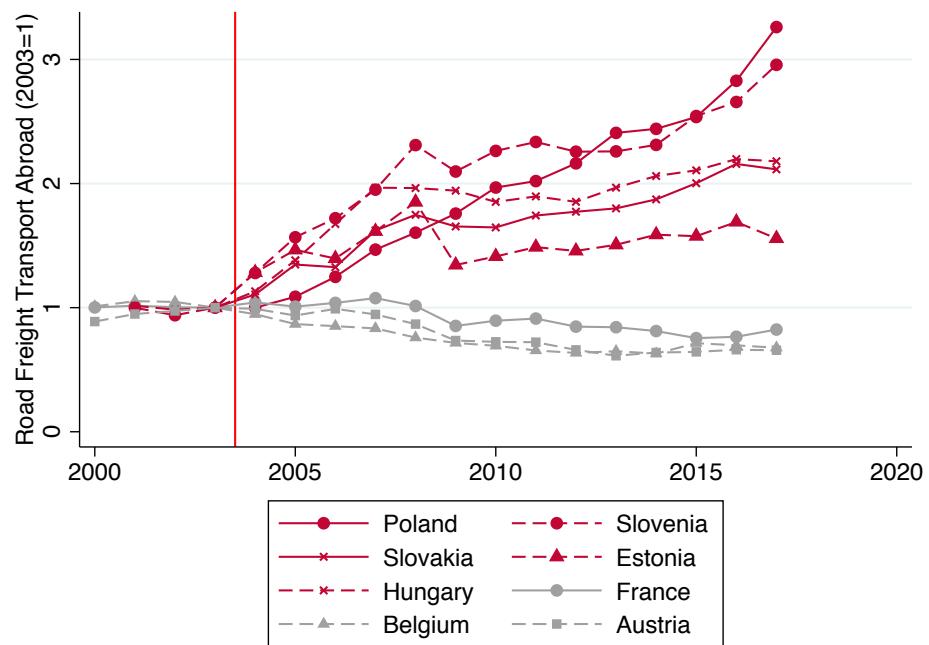
Notes: This figure shows the aggregate employment effects of posting openness for Poland, the first supplier of posting services since 2005. Poland became a EU member state in 2004. That year, all mobility restrictions for employees posted by Polish suppliers were lifted, except for postings from Poland to Austria and Germany that were deregulated in 2011 (the first-stage effects of these mobility reforms are analyzed in Figure 4). Panel A shows the effect of the 2004 service trade liberalization on E101/A1 mandatory posting forms issued by Poland. As described in the paper, E101/A1 forms are only measured for EU member states and are zero by construction for Poland before 2004. Panel B shows the heterogeneous exposure to the posting openness shock across sectors. Most of the postings from Poland occur in the construction sector, while regulated sectors like health, education, or public administration are covered by licensing regulations that prevent them from being performed abroad.

Figure A.18: Effect of Posting Policy on Non-Tradable Market Shares: Drivers Case-Study

**A. Exports of Drivers' Road Transport Services by Exporting Country**

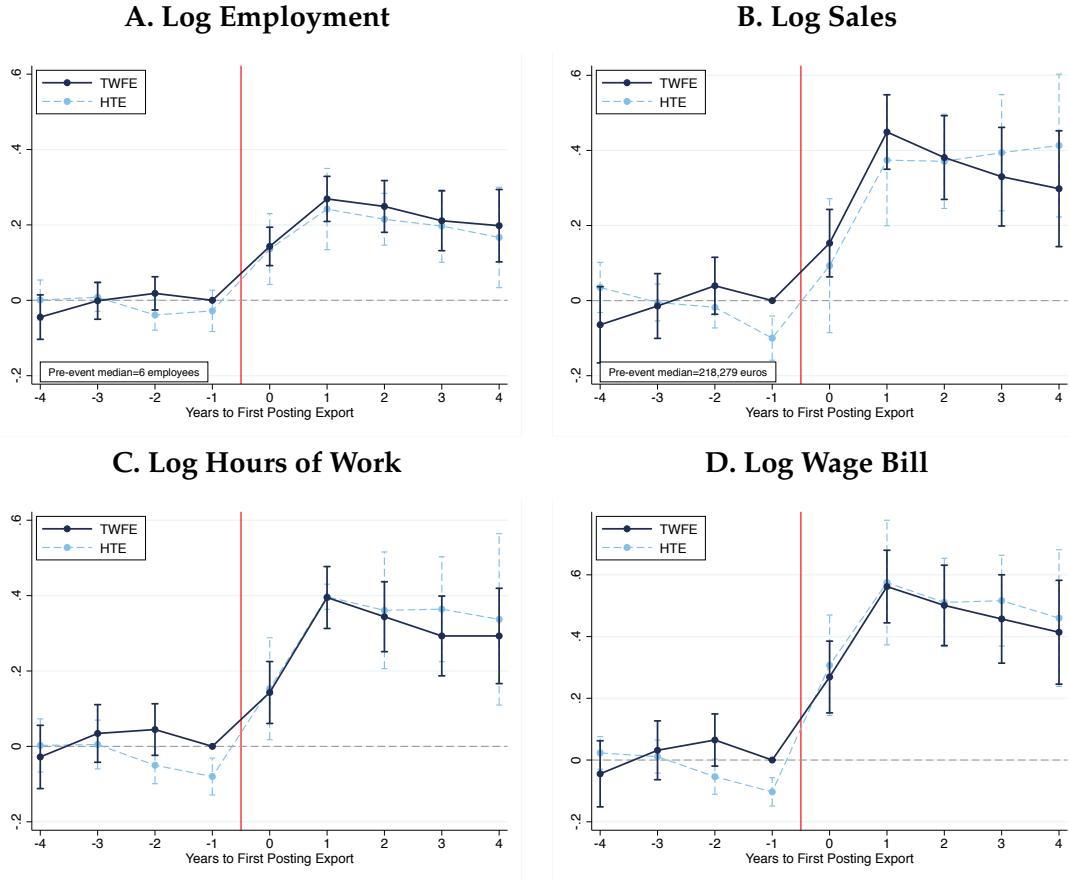


**B. Total Drivers' Road Transport Services by Country**



Notes: This figure shows the evolution of economic activity in the road transport service before and after that the posting policy was opened to NMS in 2004 (Poland, Slovakia, Slovenia, Estonia, Hungary). Economic performance in the road transport is measured in million-tonne kilometer performed by each country.

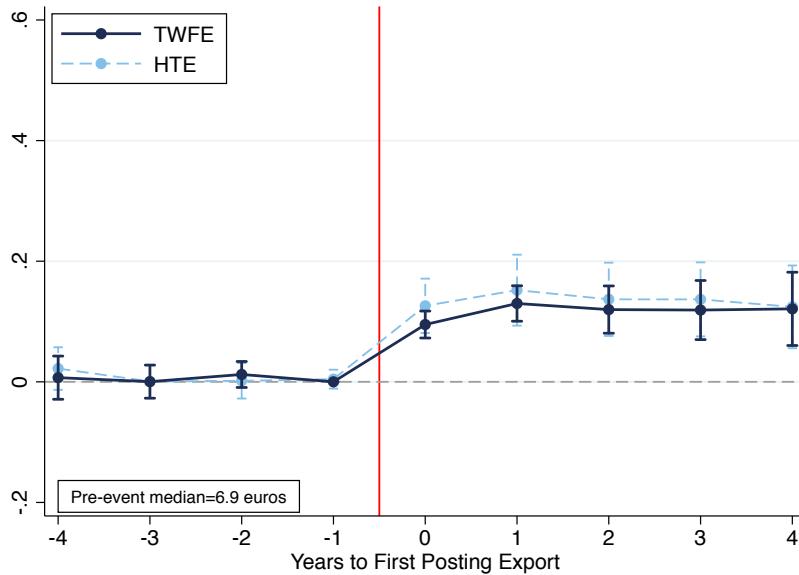
Figure A.19: Sending Firms Expand When Starting to Provide Services Abroad



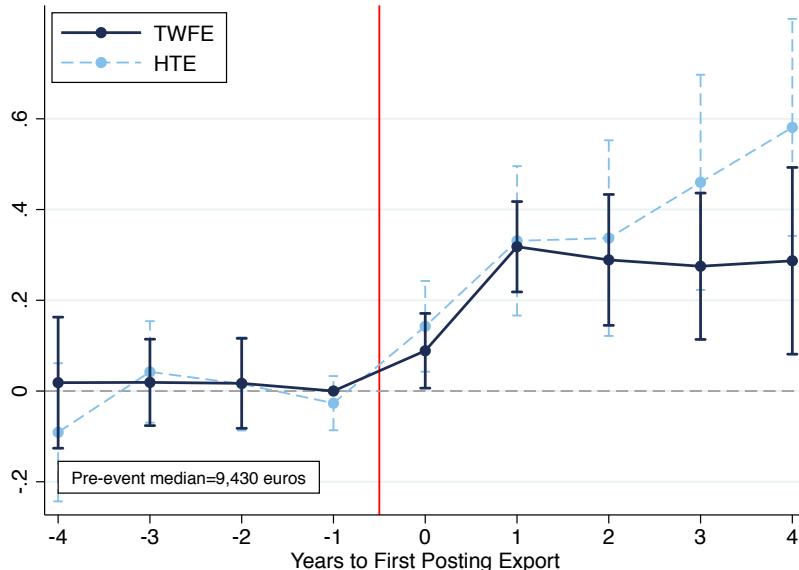
Notes: This figure studies how posting affects sending firms located in Portugal, one of the main suppliers of posting services in Europe. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country from 2006 to 2017 to select the 4,151 firms (with a median of more than three employees over the period) that start posting workers abroad for the first time between 2010 and 2015. The figure plots the estimated event study coefficients  $\theta_k$  from Equation (13) for the period 2006-2017 where the dependent variable is log number of paid employees (Panel A), log total hours worked by employees (Panel B), log total sales (Panel C), log domestic sales (Panel D), log total assets (Panel E), and log wage bill (Panel F). The event is defined as the first time a Portuguese firm provides non-tradable services in another EU country. The coefficient of the year before the first posting  $\theta_{-1}$  is normalized to zero. The regressions include firm and five-digit sector  $\times$  calendar year  $\times$  province fixed effects.  $\theta_k$  compares the outcomes of posting firms in event year  $k$  to the outcomes of future posting firms in the same narrowly defined sector and province in the year before their event. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the calendar year  $\times$  province level. The event study coefficients are reported in Table 6. The dataset and estimation sample are described in [Online Appendix](#).

Figure A.20: Surplus-Sharing Between Sending Firms and Posted Workers

### A. Wage Rate After Provision of Services Abroad



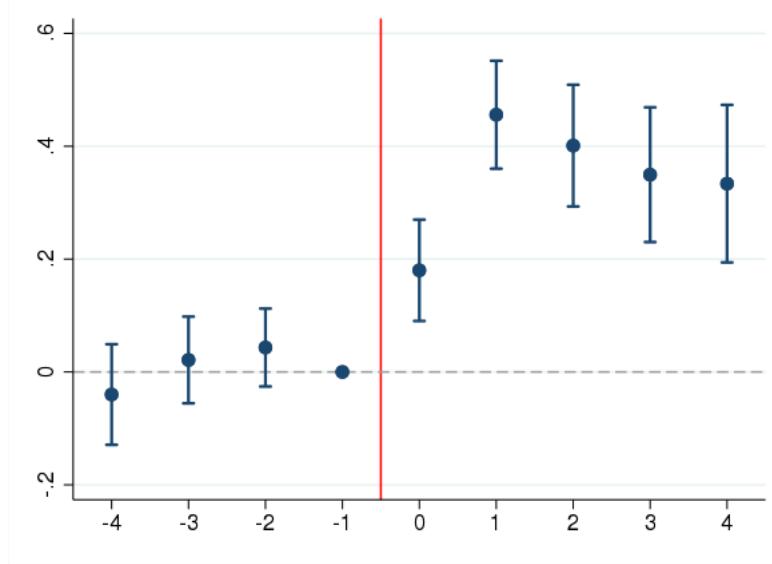
### B. Profits After Provision of Services Abroad



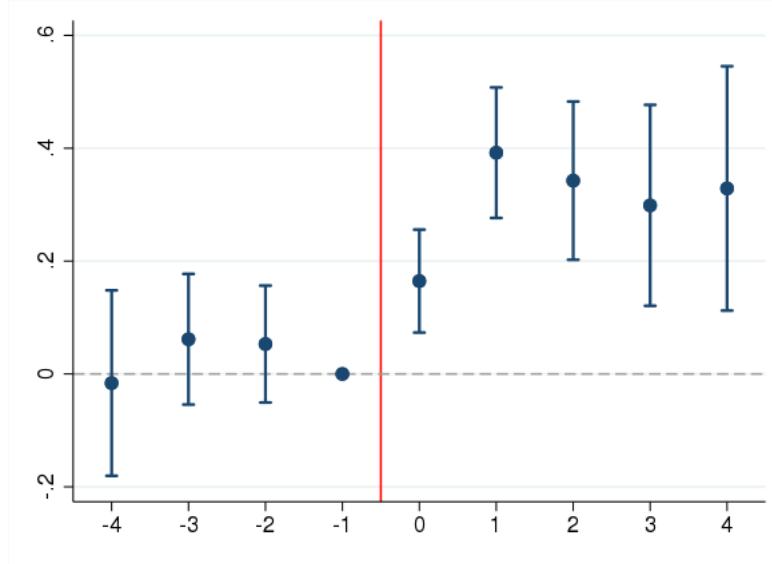
Notes: This figure studies how posting affects sending firms located in Portugal, one of the main suppliers of posting services in Europe. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country from 2006 to 2017 to select the 4,151 firms (with a median of more than three employees over the period) that start posting workers abroad for the first time between 2010 and 2015. The figure plots the estimated event study coefficients  $\theta_k$  from Equation (13) for the period 2006–2017 where the dependent variable is log wage rate (Panel A) and log earnings before taxes (Panel B). The event is defined as the first time a Portuguese firm provides non-tradable services in another EU country. The coefficient of the year before the first posting  $\theta_{-1}$  is normalized to zero. The regressions include firm and five-digit sector  $\times$  calendar year  $\times$  province fixed effects.  $\theta_k$  compares the outcomes of posting firms in event year  $k$  to the outcomes of future posting firms in the same narrowly defined sector and province in the year before their event. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the calendar year  $\times$  province level. The event study coefficients plotted in the figure are reported in Columns (1)–(2) of Table 7. The dataset and estimation sample are described in [Online Appendix](#). Estimates accounting for heterogeneous treatment effects are presented in Figure A.30 and in Figure A.20 together with pre-treatment median outcomes.

Figure A.21: Fiscal Externality of Posting for Sending Governments

**A. Payroll Taxes at Sending Firms After Provision of Services Abroad**

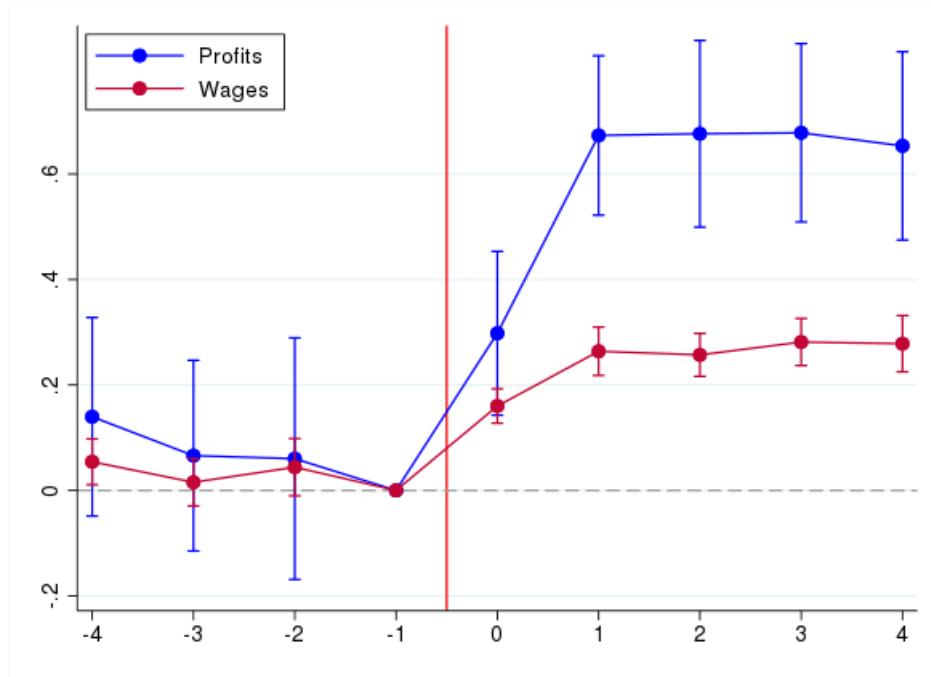


**B. Corporate Income Tax at Sending Firms After Provision of Services Abroad**



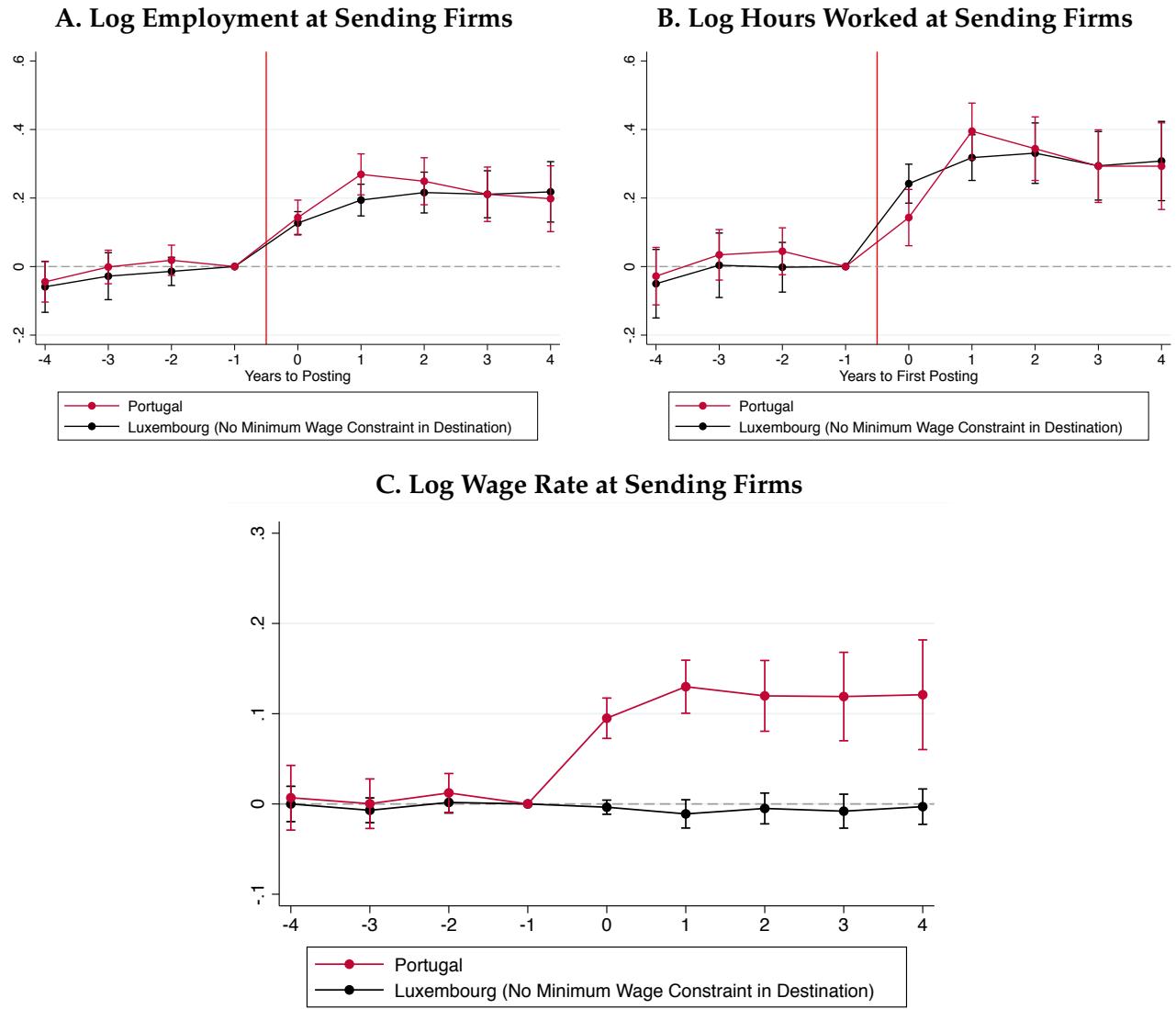
Notes: This figure studies how posting affects sending firms located in Portugal, one of the main suppliers of posting services in Europe. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country from 2006 to 2017 to select the 4,151 firms (with a median of more than three employees over the period) that start posting workers abroad for the first time between 2010 and 2015. The figure plots the estimated event study coefficients  $\theta_k$  from Equation (13) for the period 2006-2017 where the dependent variable is log social security contributions (Panel A) and log paid corporate income tax (Panel B). The event is defined as the first time a Portuguese firm provides non-tradable services in another EU country. The coefficient of the year prior to the first posting  $\theta_{-1}$  is normalized to zero. The regressions include firm and five-digit sector  $\times$  calendar year  $\times$  province fixed effects. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the calendar year  $\times$  province level. The dataset and estimation sample are described in [Online Appendix](#).

Figure A.22: Profits-Wage Split At Permanent Sending Firms



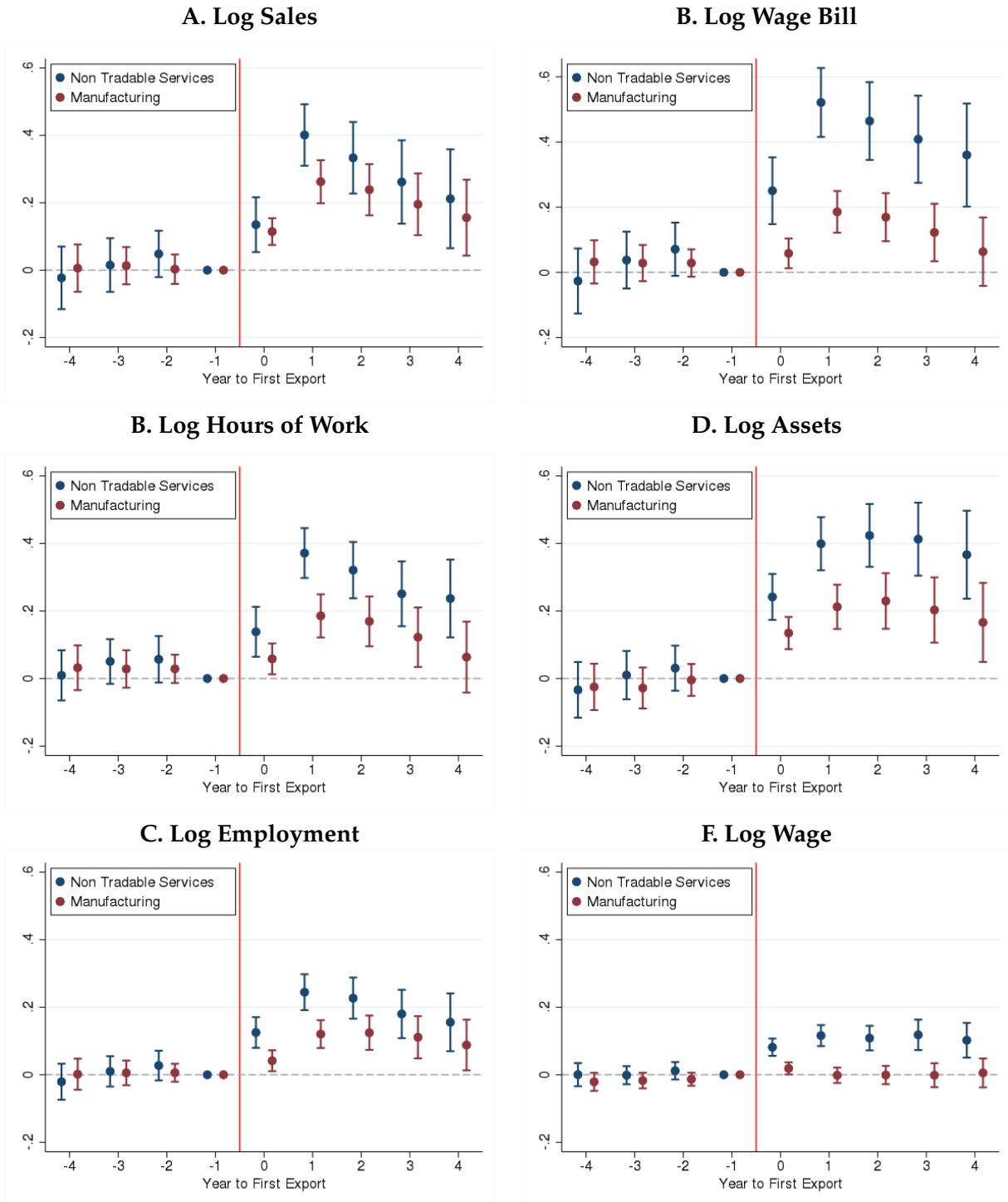
Notes: This figure studies how posting affects sending firms located in Portugal, one of the main suppliers of posting services in Europe. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country from 2006 to 2017 to select the 4,151 firms (with a median of more than three employees over the period) that start posting workers abroad for the first time between 2010 and 2015. This figure restricts the analysis to sending firms that permanently provide services abroad after their first posting event. The figure plots the estimated event study coefficients  $\theta_k$  from Equation (13) for the period 2006-2017 where the dependent variable is log wage rate (pink series) and log earnings before taxes (blue series). The event is defined as the first time a Portuguese firm provides non-tradable services in another EU country. The coefficient of the year before the first posting  $\theta_{-1}$  is normalized to zero. The regressions include firm and five-digit sector  $\times$  calendar year  $\times$  province fixed effects.  $\theta_k$  compares the outcomes of posting firms in event year  $k$  to the outcomes of future posting firms in the same narrowly defined sector and province in the year before their event. The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the calendar year  $\times$  province level. The dataset and estimation sample are described in [Online Appendix](#).

Figure A.23: Posted Workers' Wage Gains Come From Regulation Rather Than Surplus-Sharing



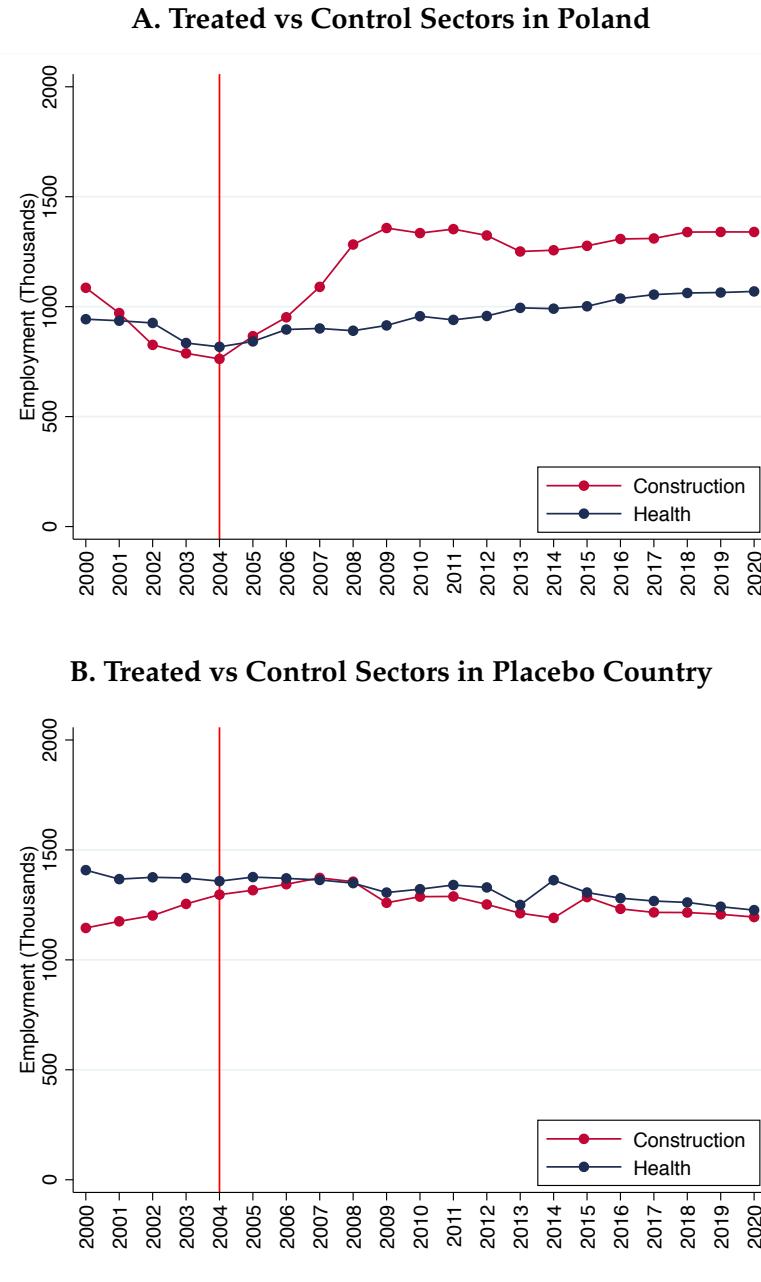
Notes: This figure compares sending firms' outcomes after a first posting event for firms located in two different countries affected differentially by destination-country minimum wages: Portugal and Luxembourg. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country from 2006 to 2017. I use exhaustive administrative employment registries of Luxembourgish firms merged with administrative records of services performed in another EU country from 2002 to 2020. To ensure comparability of these two samples, I focus on Luxembourgish firms operating in the same sectors than posting firms in Portugal, which are listed in [Online Appendix](#) and represent 70% of postings from Luxembourg. My two samples are: (i) the 4,151 Portuguese firms that start posting workers abroad for the first time between 2010 and 2015 and (ii) the 1,286 Luxembourgish firms that start posting workers for the first time between 2007 and 2017. The figure juxtaposes the estimated event study coefficients  $\theta_k$  from Equation (13) estimated separately on posting firms in Portugal (red) and posting firms in Luxembourg (black). The event is defined as the first time a firm posts workers to another European member states, and the dependent variable is the log number employees (Panel A), log hours of work (Panel B), and log average wage at sending firm (Panel C). The coefficient of the year before the first posting  $\theta_{-1}$  is normalized to zero. All regressions include firm fixed effects, five-digit sector  $\times$  calendar year  $\times$  province fixed effects for Portugal, and five-digit sector  $\times$  calendar year for Luxembourg (no provinces). The vertical line represents 95% confidence intervals computed from robust standard errors clustered at the event time  $\times$  province level for Portugal and at the event time  $\times$  five-digit sector for Luxembourg.

Figure A.24: Firms' Scale Up After First Export: Manufacturing Goods vs Posting Services



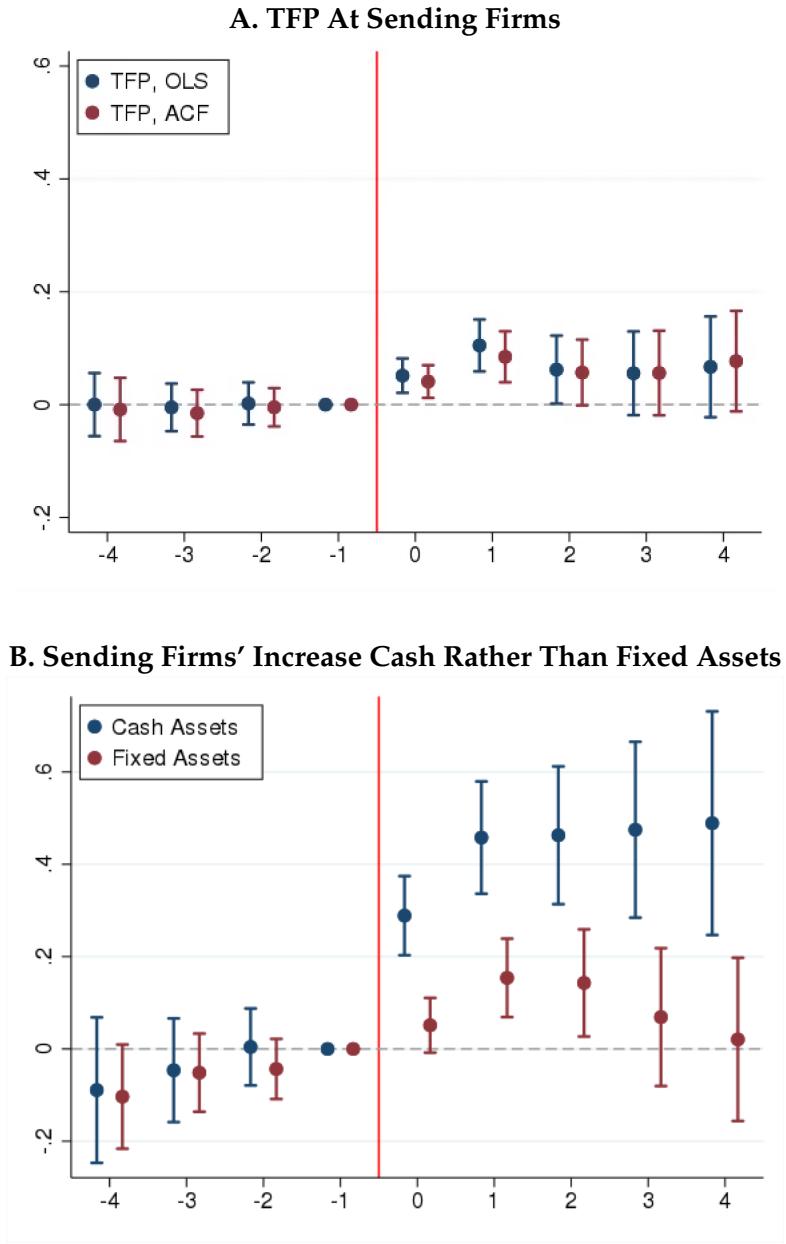
Notes: This Figure studies how export events affect firms located in Portugal, one of the main supplier of posting services in Europe. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country, as well as goods exported abroad, from 2006 to 2017 to identify two samples. The first sample is the group of 4,151 firms that start posting workers abroad for the first time between 2010 and 2015. The second sample is the group of manufacturing firms that start exporting manufactured goods abroad for the first time between 2010 and 2015. The Figure juxtaposes the estimated event study coefficients  $\theta_k$  from Equation (13) estimated separately on (i) manufacturing exporters (red) and (ii) posting firms (blue). The event is defined as the first time a Portuguese firm post (blue) or export (red) abroad. The regressions include 5-digit sector  $\times$  calendar year  $\times$  province fixed effects. The vertical line represent 95% confidence intervals computed from robust standard errors clustered at the event-time  $\times$  province level. Sample and descriptive statistics can be found in [Online Appendix](#).

Figure A.25: Effects of the Liberalization Reform on Sending Country Employment



Notes: This figure shows the aggregate employment effects of posting openness for Poland, the first supplier of posting services since 2005. The analysis is a triple differences approach that compares employment in exposed versus unexposed sectors before and after an exogenous posting openness shock in countries affected and not affected by the shock. Poland became a EU member state in 2004. That year, all mobility restrictions for employees posted by Polish suppliers were lifted, except for postings from Poland to Austria and Germany that were deregulated in 2011 (the first-stage effects of these mobility reforms are analyzed in Figure 4). Most of the postings from Poland occur in the construction sector, while regulated sectors like health, education, or public administration are covered by licensing regulations that prevent them from being performed abroad. Construction services can only be exported through posted workers: construction sectors should be directly affected by the liberalization but not by other trade tariff liberalizations that could occur simultaneously with the EU accession event. Panel A shows the differential evolution of Polish employment in exposed (red series) versus non-exposed sectors (blue series) before and after the posting openness shock of 2004 (red vertical line). Panel B repeats the analysis for a neighboring country, Ukraine, that never gained access to EU membership and therefore to free posting in the EU.

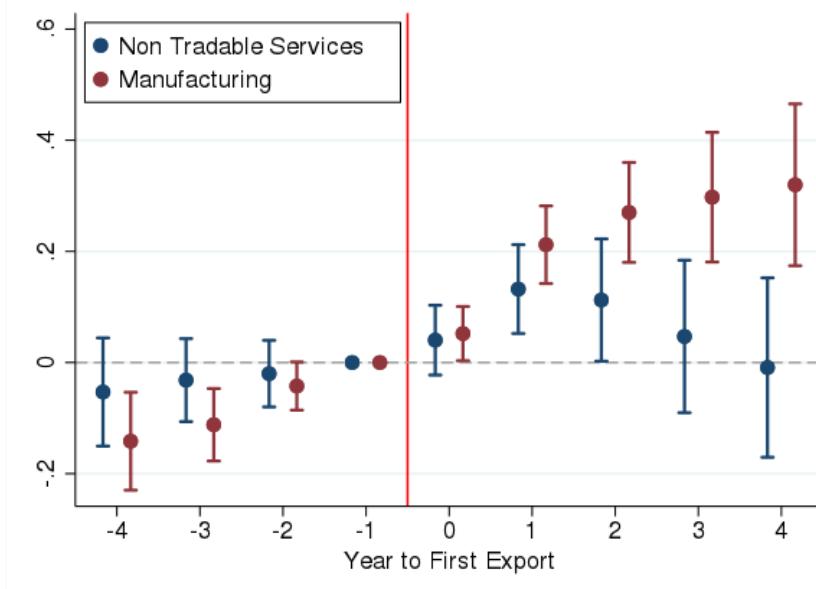
Figure A.26: Capital and TFP At Sending Firms



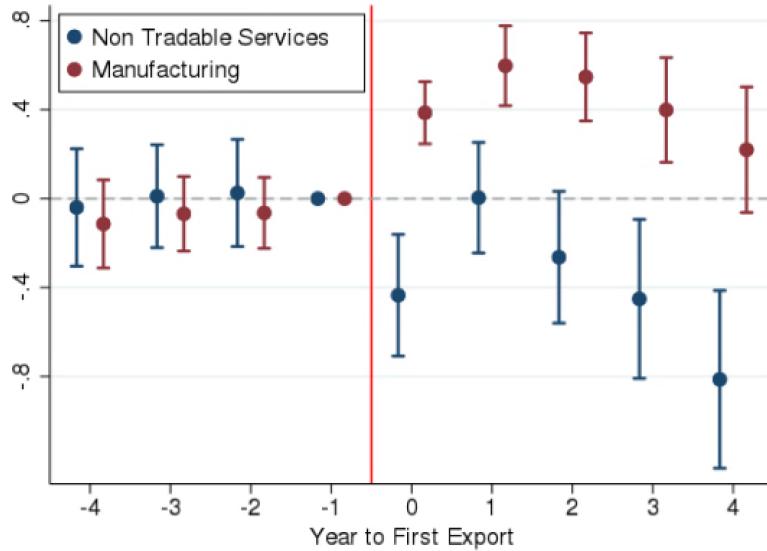
Notes: This Figure studies how posting affects sending firms located in Portugal, one of the main supplier of posting services in Europe. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country from 2006 to 2017 to select the 4,151 firms -with a median of more than 3 employees over the period- that start posting workers abroad for the first time between 2010 and 2015. In Panel A, I measure TFP assuming a standard Cobb-Douglas technology, using a simple OLS framework where sales are the dependent variable and where employment, net assets and cost of materials are used as time varying controls. To take into account potential endogeneity in input choices at the service supplier level, the red serie relies on the method proposed by [Ackerberg, Caves, and Frazer \[2015\]](#) (henceforth ACF) to compute an alternative measure of TFP. The event is defined as the first time a Portuguese firm provide non-tradable services in another EU country. The coefficient of the year prior to the first posting  $\theta_{-1}$  is normalized to zero. The regressions include 5-digit sector  $\times$  calendar year  $\times$  province fixed effects.  $\theta_k$  compares the outcomes of posting firms in event year  $k$  to the outcomes of future posting firms in the same narrowly defined sector and province in the year before their event. The vertical line represent 95% confidence intervals computed from robust standard errors clustered at the calendar year  $\times$  province level. The dataset and estimation sample is described in [Online Appendix](#). Figure B compares  $\theta_k$  using tangible assets (red) and cash assets (blue) as dependent variables.

Figure A.27: Industry-Specificities In Export Behavior: Non-Tradables vs Manufacturing

**A. Manufacturing Firms Select Into Exporting By Buying Tangible Assets**

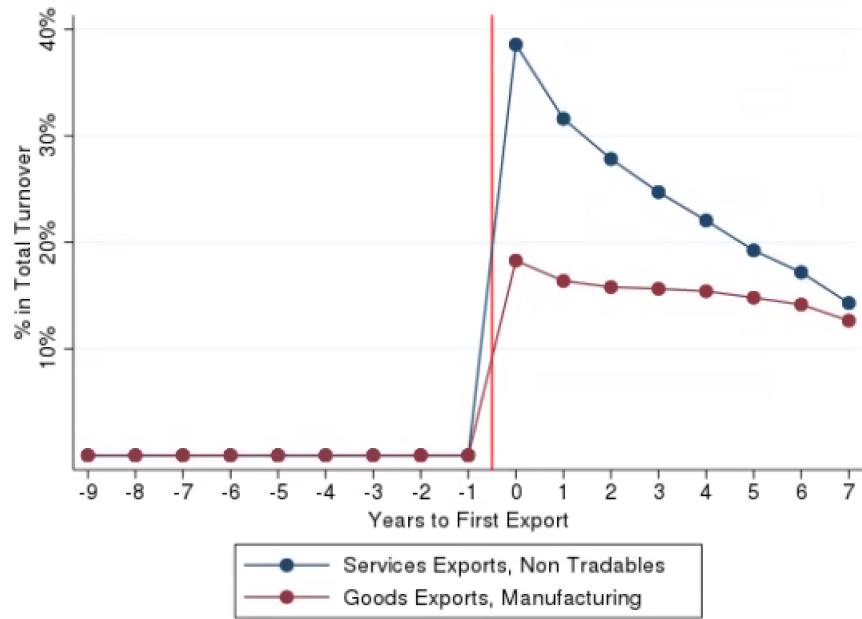


**B. Services Suppliers Shift From Domestic to Foreign Sales After First Export**



Notes: This Figure studies how export events affect firms located in Portugal, one of the main supplier of posting services in Europe. I use exhaustive administrative tax records of Portuguese firms merged with administrative records of services performed in another EU country, as well as goods exported abroad, from 2006 to 2017 to identify two samples. The first sample is the group of 4,151 firms that start posting workers abroad for the first time between 2010 and 2015. The second sample if the group of manufacturing firms that start exporting manufactured goods abroad for the first time between 2010 and 2015. The Figure juxtaposes the estimated event-study coefficients  $\theta_k$  from Equation (13) estimated separately on (i) manufacturing exporters (red) and (ii) posting firms (blue). The event is defined as the first time a Portuguese firm post (blue) or export (red) abroad. The dependent variable is log tangible assets (Panel A) and log domestic sales (Panel B). The regressions include 5-digit sector  $\times$  calendar year  $\times$  province fixed effects. The vertical line represent 95% confidence intervals computed from robust standard errors clustered at the event-time  $\times$  province level. Sample and descriptive statistics can be found in [Online Appendix](#).

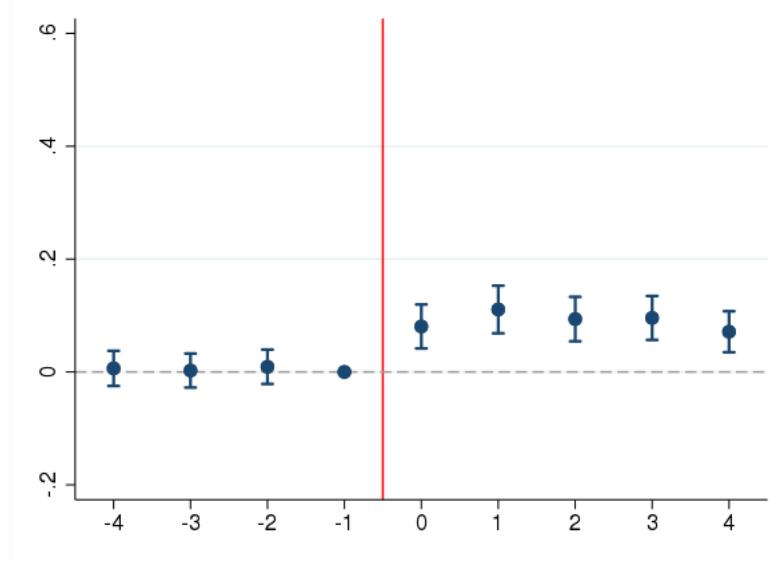
Figure A.28: Intensity and Persistence of Exports



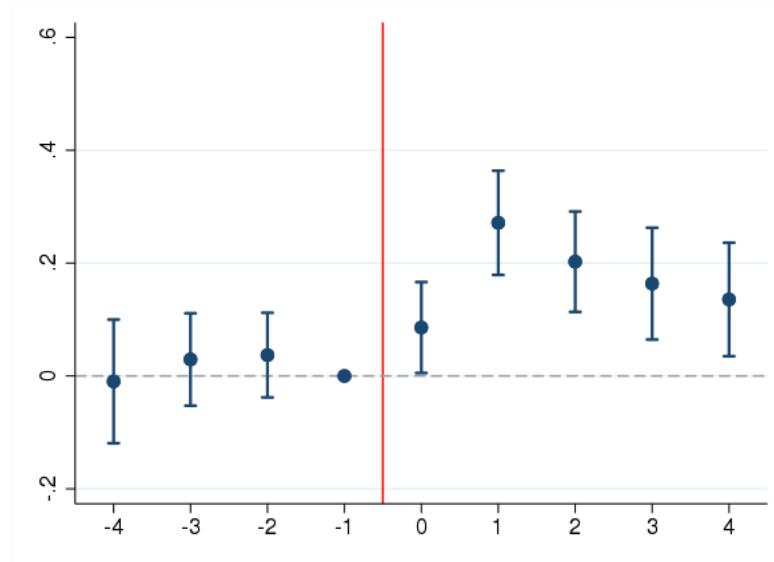
Note: This Figure shows the intensity of “first export” treatment for firms in manufacturing on non-tradable services industries. The dataset used is a detailed administrative firm-level balance-sheets data covering the universe of non-financial companies operating in Portugal between 2006 and 2017 merged with exhaustive information on trade in goods and services at the company-level. First export is defined for all firms that are observed exporting for the first time between 2010 and 2015, such that we can observe at least 4 years without export for firms that start exporting in 2007. The Figure displays the average exports/turnover ratio in years before and after first exports for exporters in manfuacturing (red) and non tardable services (blue).

Figure A.29: Export-Mobility Surplus: Using Non-Postable Sectors As Additional Control Groups

### A. Wage Rate Evolution Around First Provision of Services Abroad

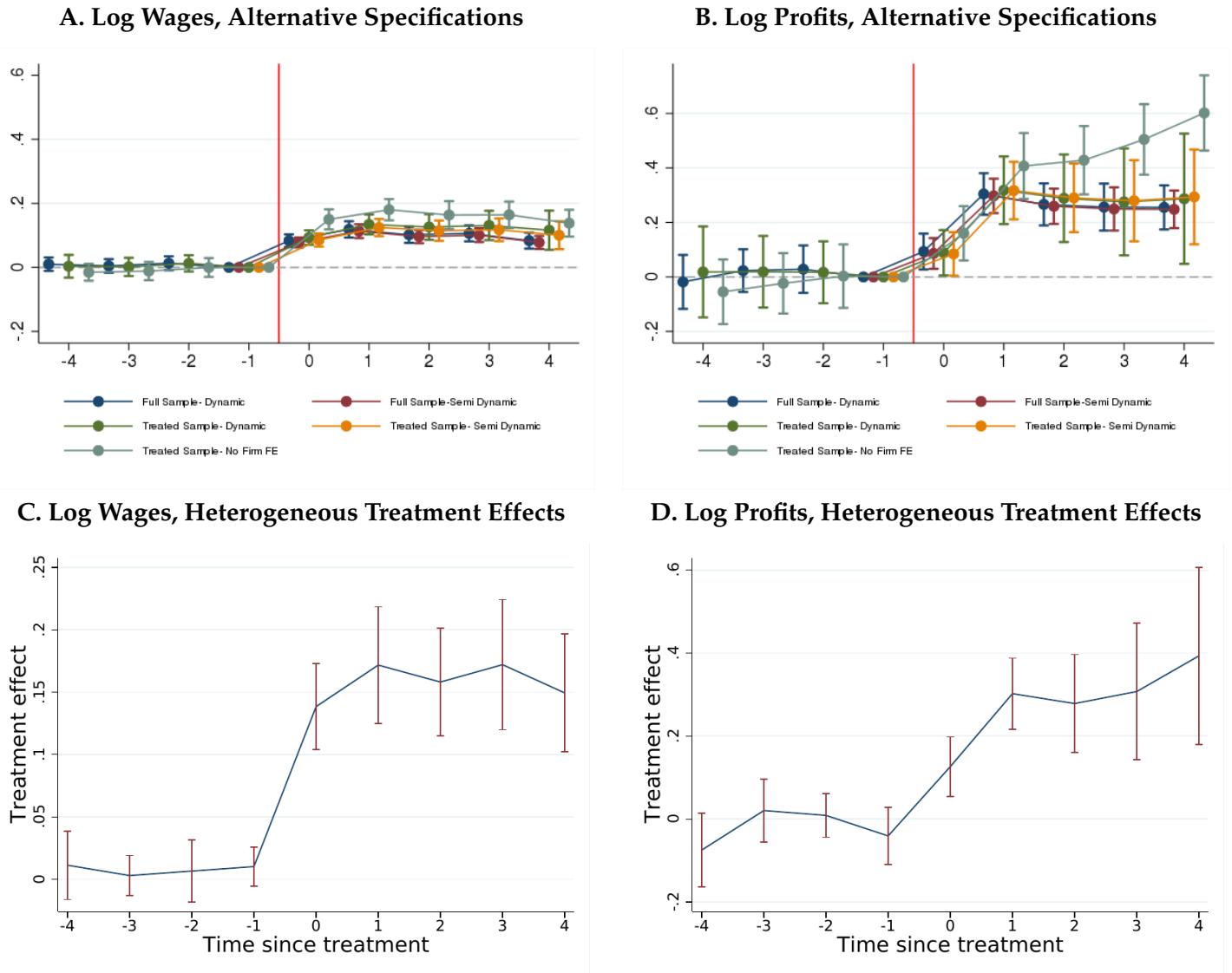


### A. Profits Evolution Around First Provision of Services Abroad



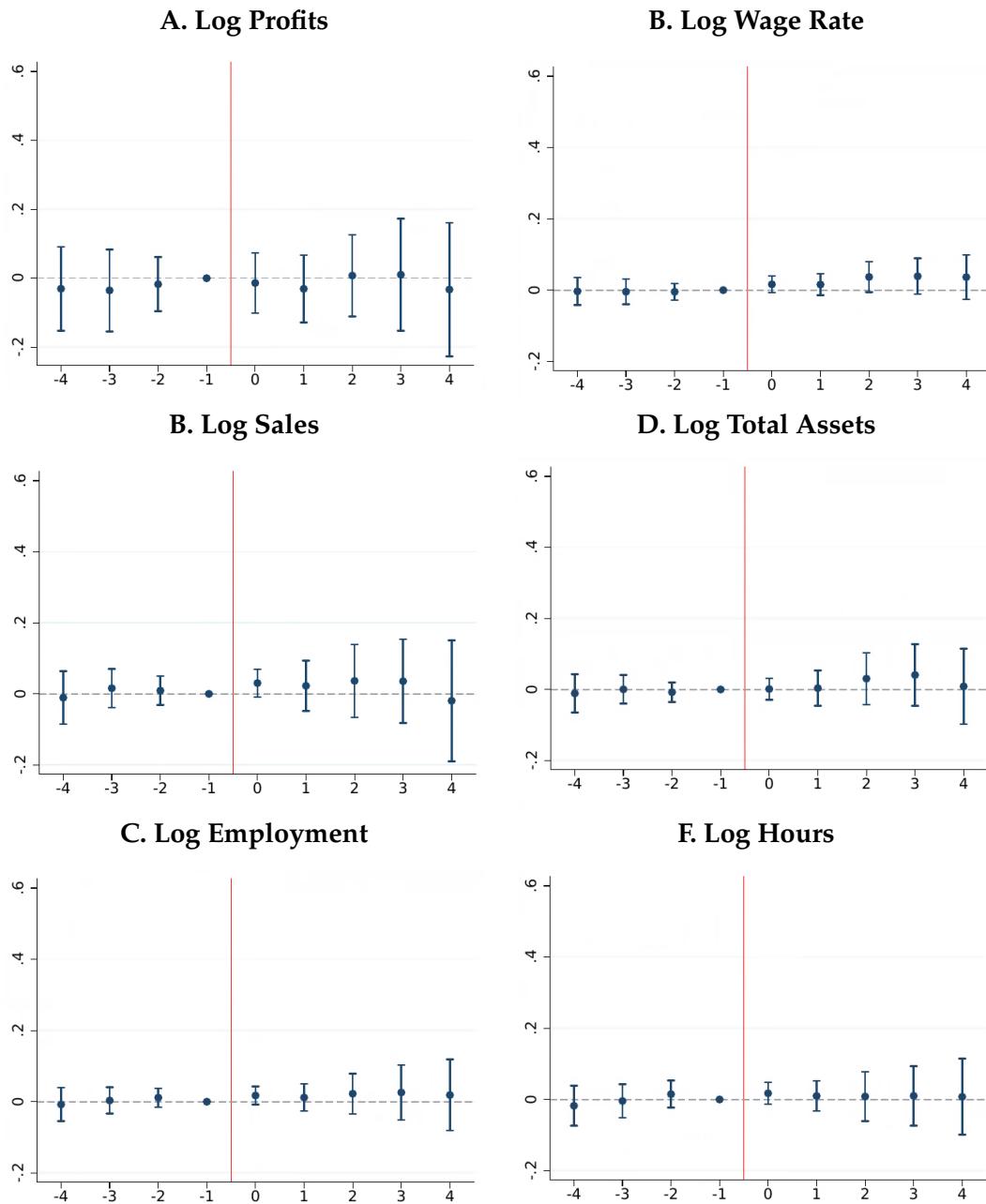
Notes: The Figure repeats the baseline analysis by adding firms in services sheltered from posting opportunities as additional control groups. This include firms operating in services activities that are not easily performed by mobile employees sent abroad, such as hotels, beauty salons, retail stores, licensed health professions etc. Provision of services abroad represent less than 2% of these sheltered sectors turnover. The Figure plots the estimated event-study coefficients  $\theta_k$  from Equation (13) for the period 2006-2017 using the baseline 4,151 treated firms and the group of firms in non-postable industries as control group. The regressions include calendar year  $\times$  province fixed effects and standard errors are clustered at the calendar year  $\times$  province level. The dataset and estimation sample is described in [Online Appendix](#).

Figure A.30: Robustness to Baseline DiD



Notes: The Figure plots the estimated event-study coefficients  $\theta_k$  from Equation (13) where the dependent variable is log wage rate (Panel A) and log earnings before taxes (Panel B) for various specifications. See the footnote under Figure 14 for details about the specification. The blue line shows the estimates of Equation (13) for all firms (4,151 treated firms and 28,803 control firms that never provide services abroad over the period), while the green line uses the restricted sample with only treated firms (baseline specification). The red and yellow line shows the estimates of the baseline event-study specification in a semi-dynamic fashion with  $\theta_k$  specified for only  $k > 0$ , while light green line omits firms' fixed effects in the baseline specification. These tests help to assess the plausibility of heterogeneous treatment effects and negative weighting issues in the baseline two-way fixed-effects specification, and follow suggestions by [Borusyak and Jaravel \[2017\]](#). The Figure uses an alternative estimator developed by [de Chaisemartin and d'Haultfoeuille \[2019\]](#) that corrects for negative weighting and is robust to negative weighting, using the build-in command `multiple_did gt` in stata.

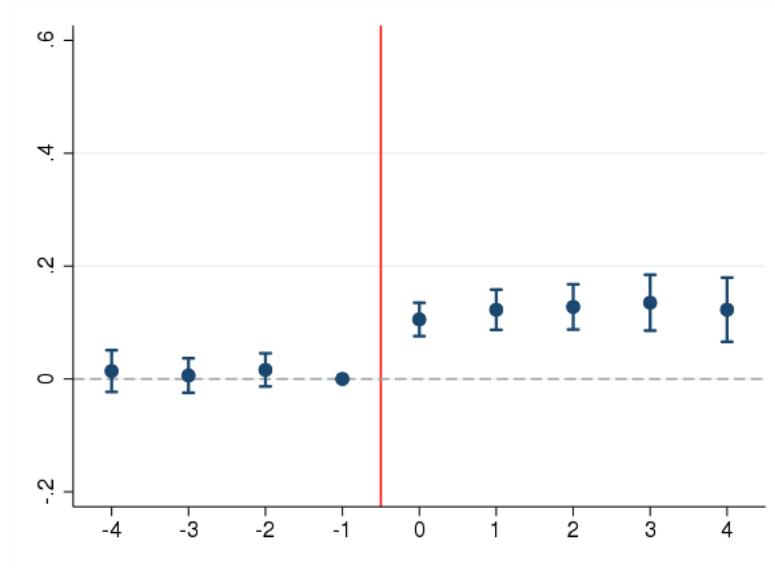
Figure A.31: Posting Surplus: Effects of Placebo Posting Events on Sending Firms



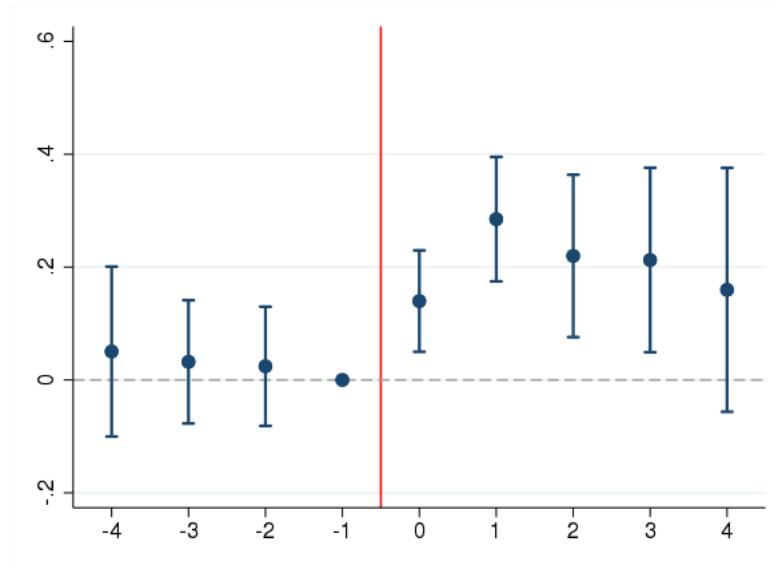
Notes: The figure repeats the baseline analysis presented in Figure 14 and Figure 12 by replacing the “first provision of services abroad event” by a placebo event. The placebo event year is randomly attributed across treated firms. All controls are the same than in the baseline analysis and are described in footnote of Figure 14 and Figure 12.

Figure A.32: Posting Surplus: Robustness to Balancing the Sample

A. Wage Rates Around First Posting



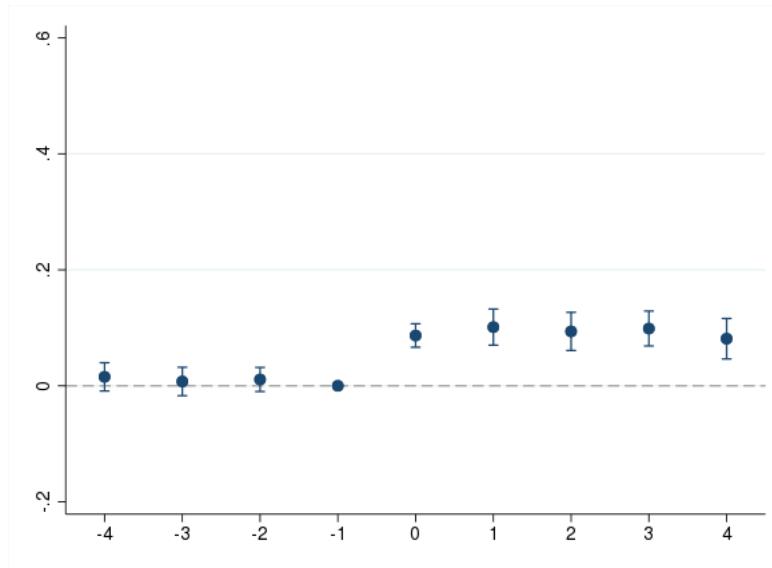
B. Profits Around First Posting



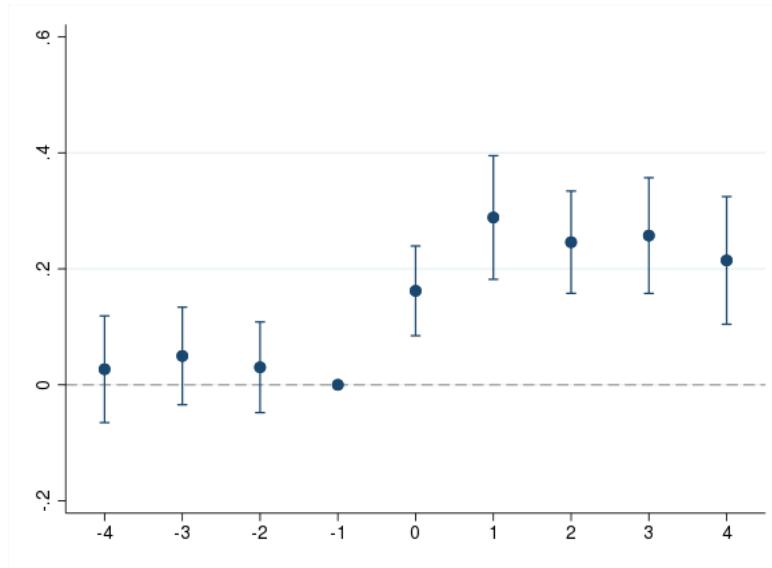
Notes: The Figure repeats the estimates plotted in Figure 14 where the baseline sample of estimation is balanced around event-time, keeping only firms that are observed the year prior and the year after the event of firms posting.

Figure A.33: Posting Surplus: Alternative Matching Estimators

**A. Wage Rates Around First Posting**



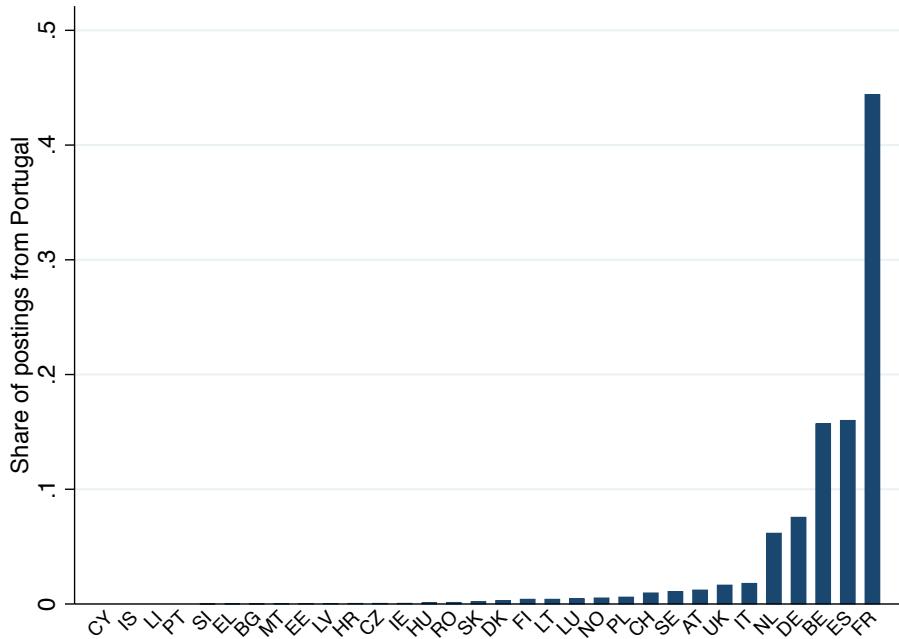
**B. Profits Around First Posting**



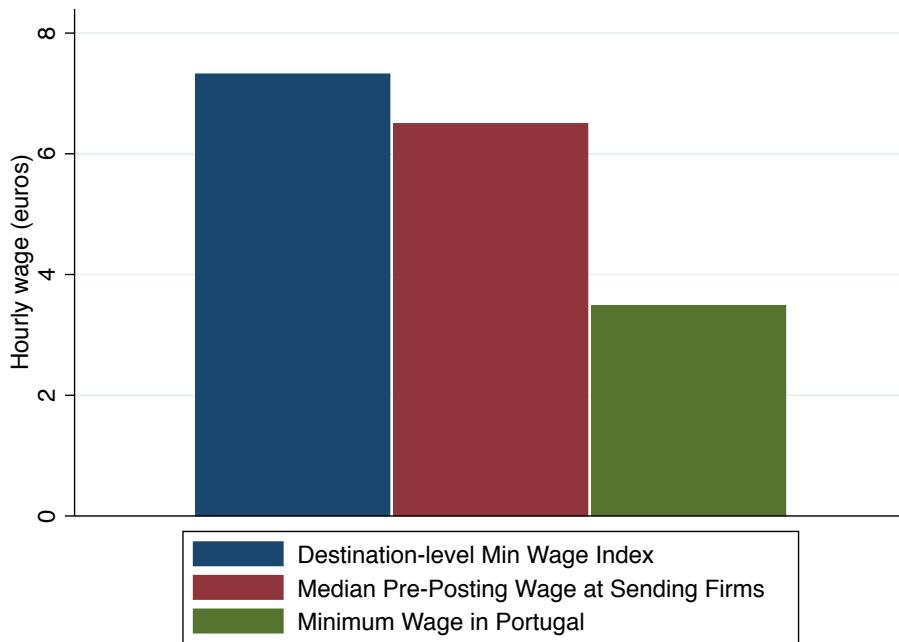
Notes: The Figure repeats the estimates plotted in Figure 14 using an alternative control groups built with matching method. More specifically, I match each treated firm observed as providing services abroad for the first time between 2020 and 2015 with a comparable firm that did not provide services abroad over the same period. The matching uses a propensity score matching to match treated firms with control firms in same province and sector, as well as with close pre-treatment characteristics (sales and number of employees). I then re-estimate Equation (13) with this novel control group.

Figure A.34: Destination-Level Minimum Wage Requirements for Portuguese Firms

**A. Posting Services Exported by Portugal by Receiving Country**

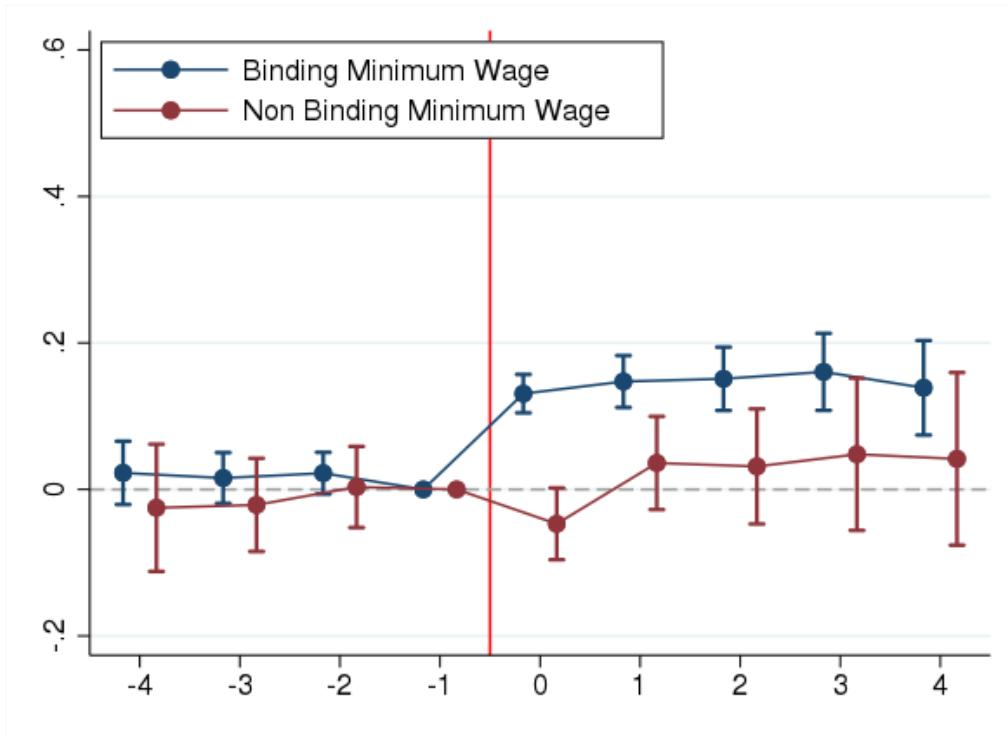


**B. Destination-Level Minimum Wage Requirements Faced by Portuguese Firms**



Notes: This figure describes destination-level minimum wage constraints faced by sending firms located in Portugal. The top panel shows the aggregate distribution of receiving countries for all missions performed by Portuguese companies, and is based on the EU-wide dataset on bilateral posting flows from A1 social security forms. The bottom panel shows the average destination minimum wage index faced by Portuguese companies based on the aggregate decomposition of receiving countries (blue bar). The red bar shows the median level of wages paid by sending firms the year before they start posting workers abroad.

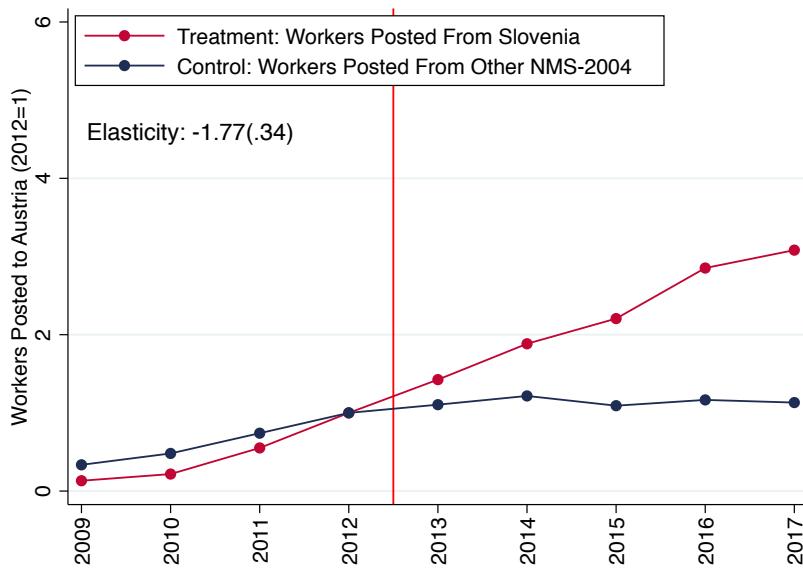
Figure A.35: Posted Workers' Wage Gains By Pre-Posting Bindingness of Wages



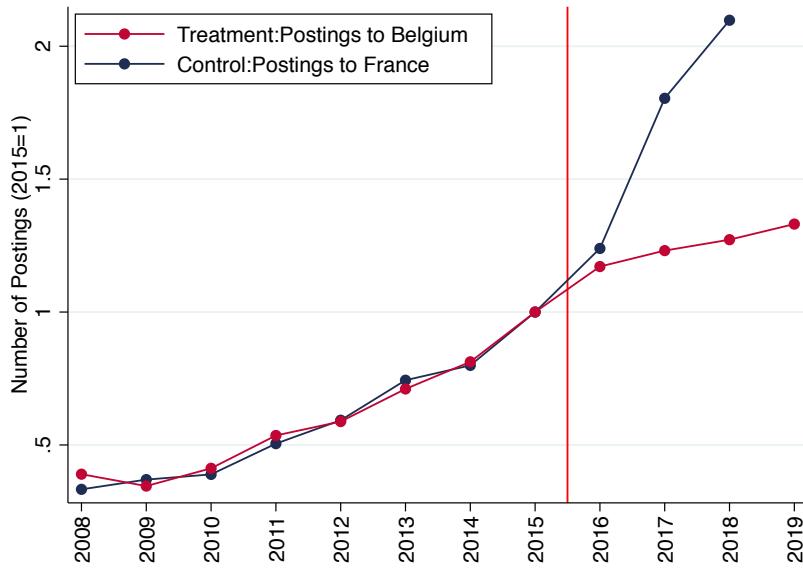
Notes: The Figure estimates Equation (13) using log wage as a dependent variable on two separate sample of sending firms located in Portugal. The blue line shows the estimated of  $\theta_k$  for firms with a pre-posting level of wage below the average destination-level minimum legal wage index. As posted workers cannot be paid under the destination-level minimum legal wage, these firms should be constrained to increase their workers' wages when supplying services abroad. The red series shows the same estimates for sending firms with pre-posting wages above the average destination-level minimum legal wage.

Figure A.36: Effect of Payroll Tax Reforms on Posting Flows

**A. Employers' Labor Cost Cut in Sending Country (Slovenia)**



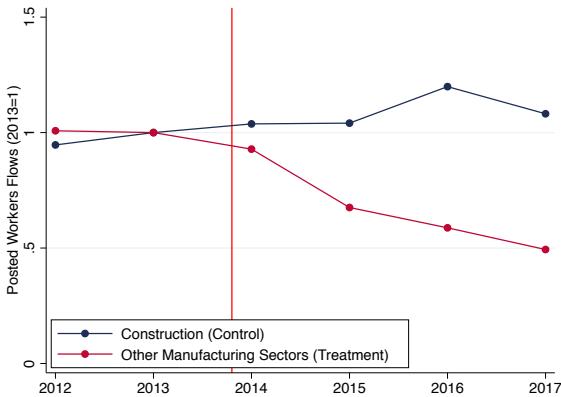
**B. Employers' Labor Cost Cut in Receiving Country (Belgium)**



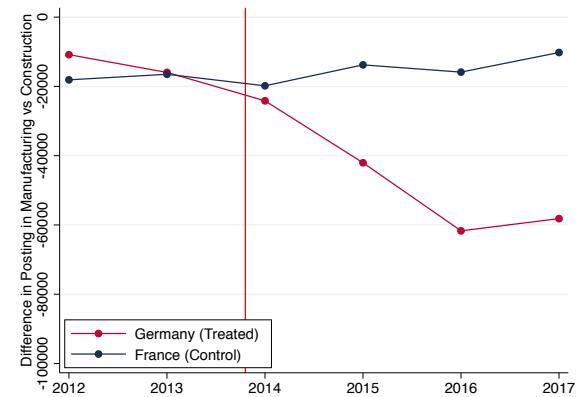
Notes: Posted workers pay origin-level labor taxes and are exempted from destination-level payroll taxes. This figure describes how posting flows are affected by exogenous labor cost reforms, exploiting two quasi-experimental changes in employers' labor cost in one of the main sending countries (Slovenia) and one of the main receiving countries (Belgium). A reform implemented at the end of 2012 in Slovenia decreased the labor cost of workers posted from the country by capping employers' social security contributions at 40% of the average Slovenian wage. Panel A shows how postings sent by Slovenia (treated, red series) evolved compared to posting flows from comparable countries (control, blue series) before and after the policy-induced change in labor cost. A reform implemented in Belgium in 2015 decreased Belgian employers' social security contributions by 8 percentage points. Panel B shows how postings received by Belgium (treated, red series) evolved compared to posting flows to comparable countries (control, blue series) before and after the policy-induced change in labor cost. All series are normalized to one the year before the implementation of the labor tax cut.

Figure A.37: Posting Flows Responses to Destination-Level Minimum Wage Reform

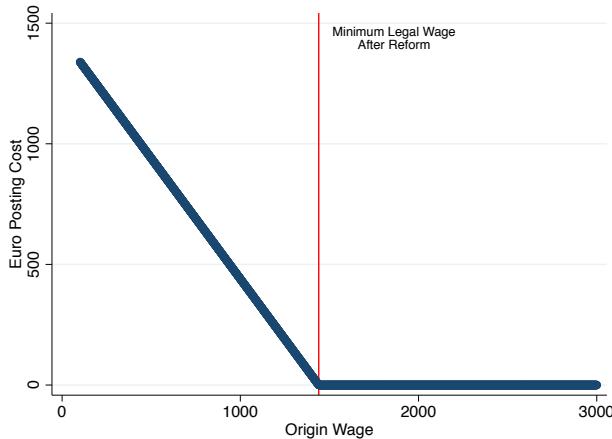
**A. Postings to Treated and Control Sector**



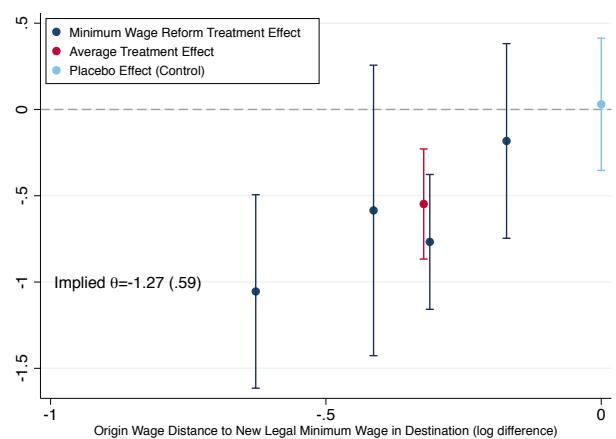
**B. Treated vs Control Destination Country**



**C. Exposure to Reform by Sending Country**

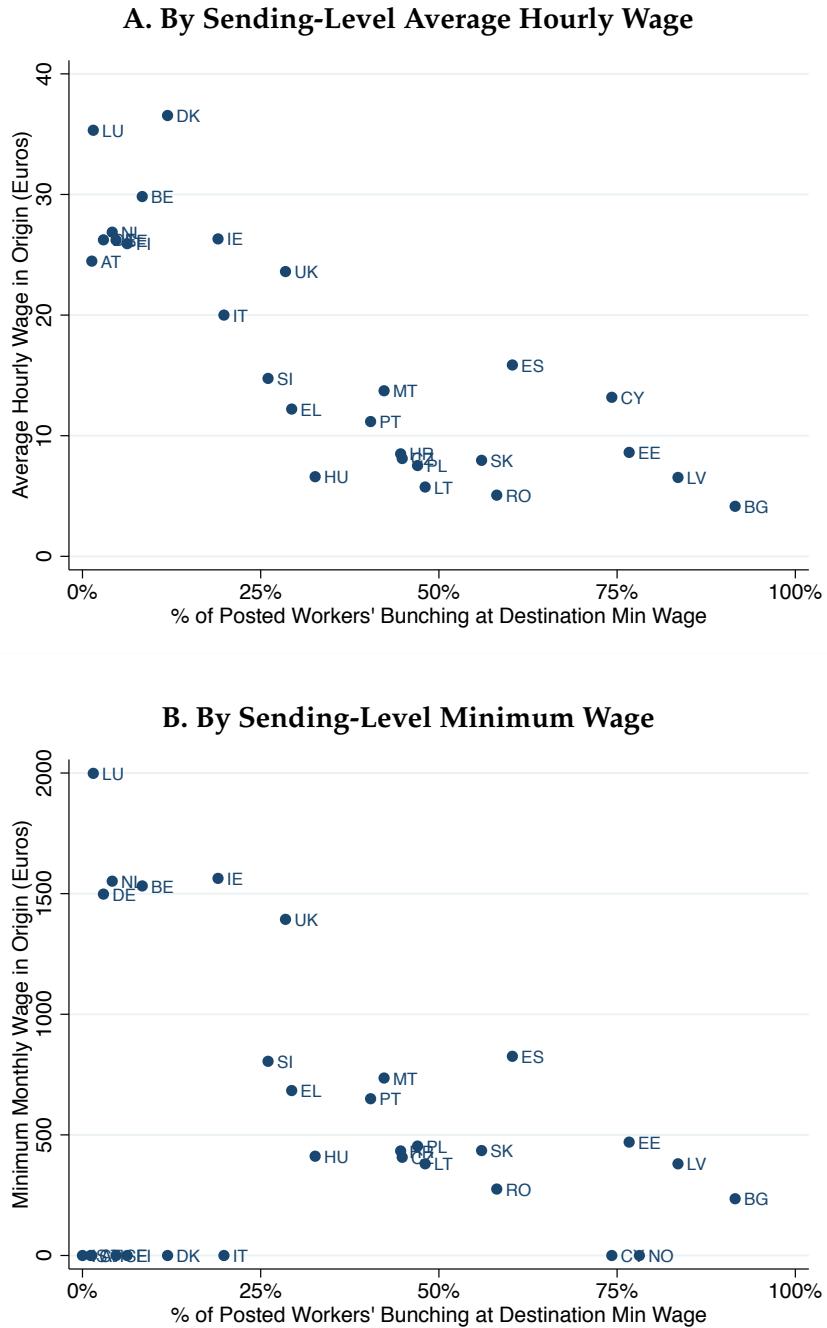


**D. Treatment Effects of the Reform**



Notes: Posted workers pay origin-level labor taxes but cannot be paid under the receiving country's minimum legal wage. This figure decomposes posting flows responses to a minimum wage reform in Germany. A minimum legal wage was implemented in the meat industry sector in August 2014 and in all other sectors in 2015. The construction sector was regulated by a minimum legal wage since 1996 (applicable to posted workers), while other manufacturing sectors had collective agreements for German workers (not applicable to posted workers). The reform created an additional cost for postings to the treated (manufacturing) sector from countries with wages below the novel minimum legal wage in Germany (8 euros per hour). The analysis of the reform exploits E101/A1 mandatory posting forms with sectoral information, available from 2012 to 2017 for a subsample of sending countries: Poland, Luxembourg, Hungary, Czech Republic, Lithuania, and Romania. For these sending countries, I observe the universe of posting missions performed in each receiving country in each sector. Panel A shows how postings to Germany in treated (manufacturing) versus control (construction) sectors evolved after the implementation of the minimum legal wage in Germany. Panel B shows the sectoral differential evolution in the treated (Germany) versus control (France) receiving country. Panel D exploits heterogeneous exposure to the reform *within* the treated (manufacturing) sector, exploiting the kinked relationship between the sending country's wage level and additional cost implied by the reform, as shown in Panel C. Panel D shows the treatment effect (and 95% confidence intervals) of the minimum wage reform by exposure to the reform, controlling for origin-year, destination-year, and pair-year fixed effects. The coefficient compares flows of postings in the manufacturing (treated) sector, before and after the German minimum wage reform, to Germany and other countries, for each sending country that have more or less exposure to that reform. The blue coefficient plots the estimated treatment effect for the sending country with zero direct exposure to the reform, Luxembourg (minimum wage above novel German minimum wage). The resulting elasticity with respect to additional posting cost implied by the minimum wage implementation is 1.27(0.59).

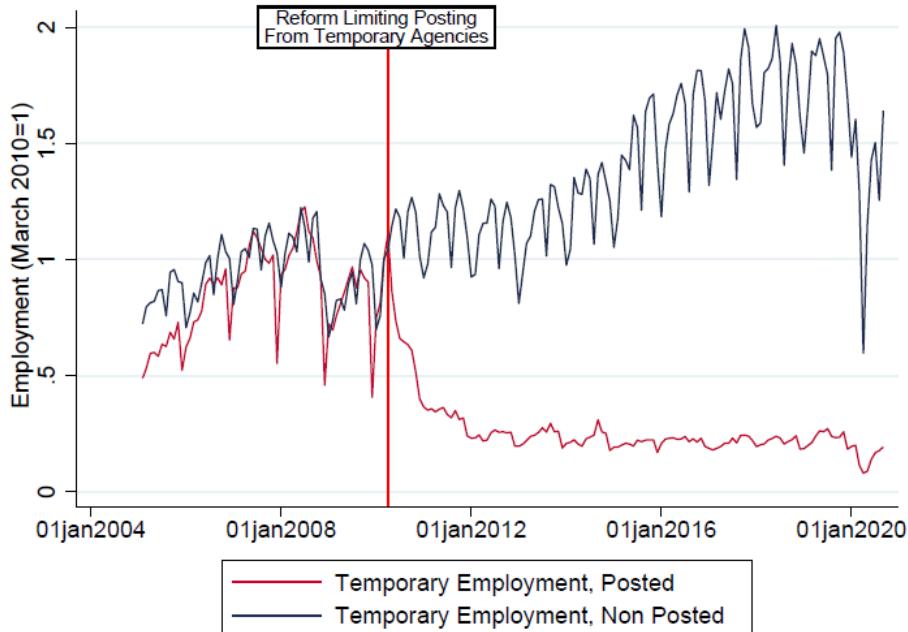
Figure A.38: Bunching at Destination-Level Minimum Wage by Sending-Level Wage



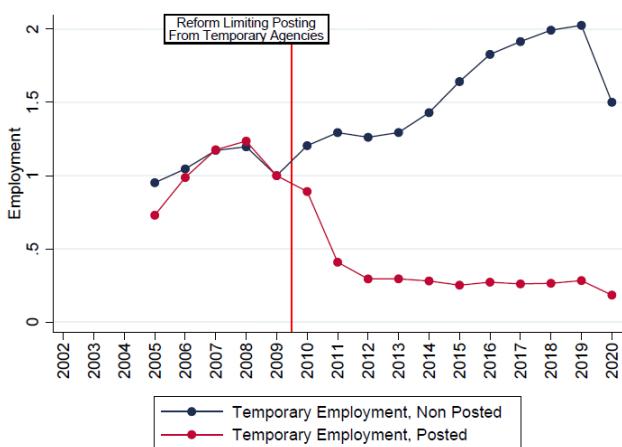
Notes: Posted workers cannot be paid under destination-level minimum legal wage. This Figure shows the relationship between destination-level wage and wages paid to posted workers in the second largest importer of posting services: France. I use the universe of mandatory posting declarations filed by foreign suppliers that send posted workers in the French territory (DPD/SIPSI dataset) from 2016 to 2020. The posting declarations contain information on wages paid by foreign firms to their employees posted in France during the posting mission, as well as detailed information on the posting contract. I use this information to compute the share of posted workers who are paid exactly at the minimum wage in France ("bunching at minimum wage") for each origin country. The share of posted workers bunching at destination-level minimum wage helps to assess the bindingness of the "prevailing wage" clause imposed by the posting policy. Panel A plots the relationship between origin country average hourly rate and the share of workers posted from that country that are paid exactly at the French minimum wage. Panel B plots the relationship between origin country minimum wage and the share of workers posted from that country that are paid exactly at the French minimum wage. Some origin countries have no minimum legal wage (Denmark, Italy etc).

Figure A.39: Effects of Destination-level Payroll Tax Exemption Reform on Sent Postings

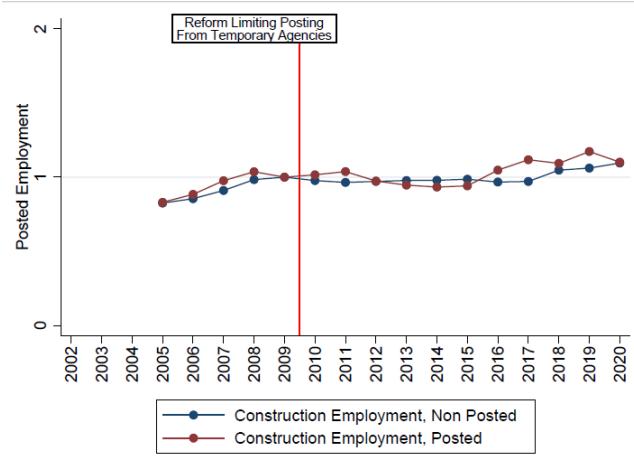
**A. Treated Sector, Posted vs Non Posted Employment (Monthly)**



**B. Treated Sector, Posted vs Non Posted (Annual)**

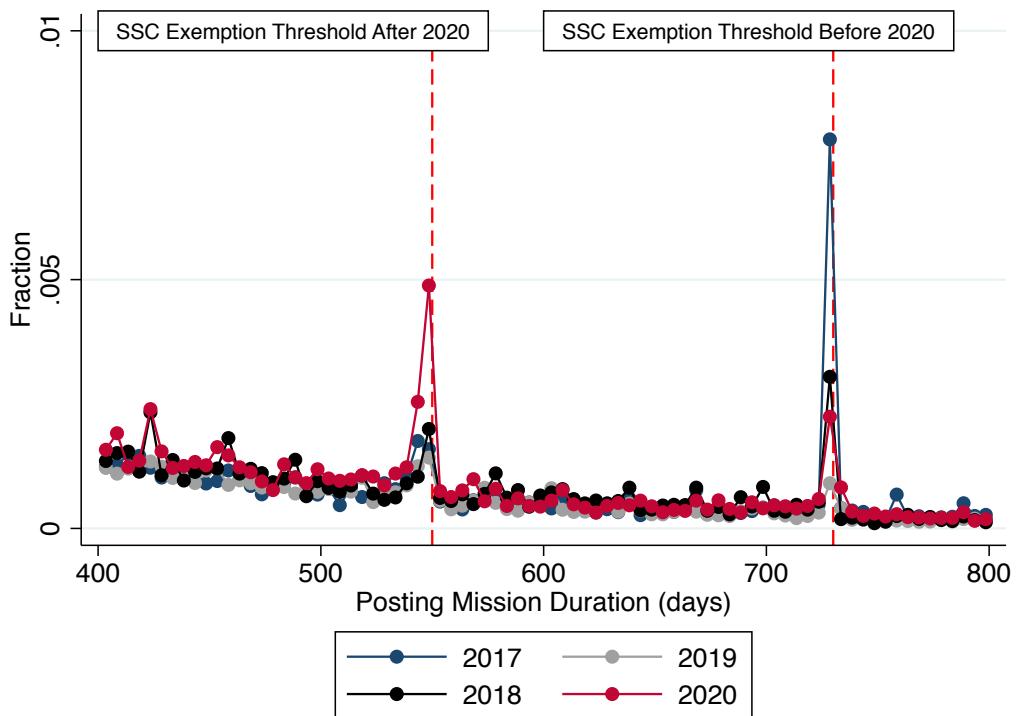


**C. Control Sector, Posted vs Non Posted (Annual)**



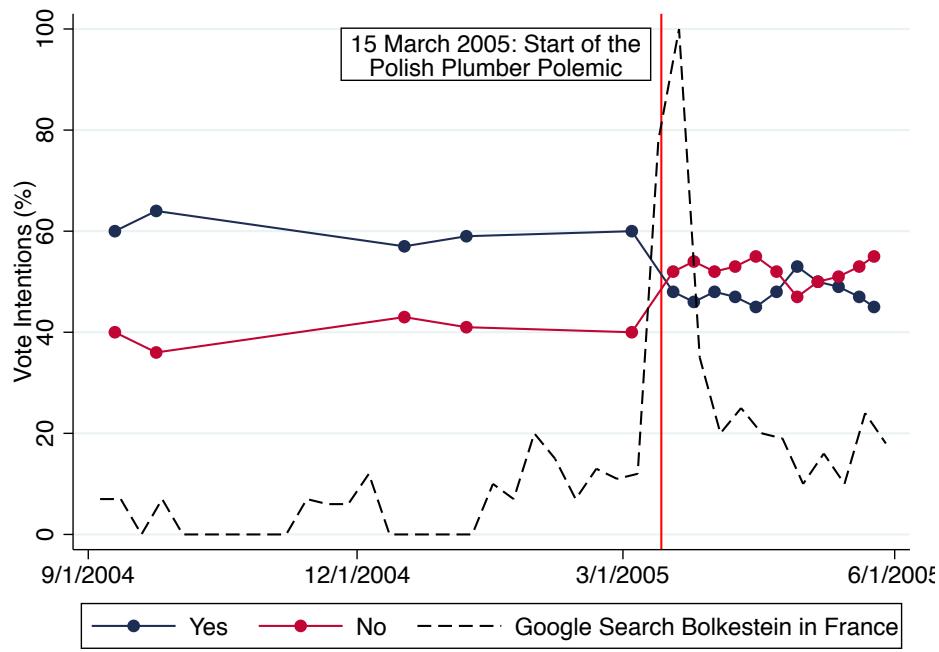
Notes: This Figure shows the effects of restricting posting-specific payroll tax exemptions in sending countries. I study a reform that restricted labor cost exemptions granted for workers posted from temporary agencies located in Luxembourg. The reform was implemented in May 2010 and described in Appendix C. To study this reform, I use exhaustive linked employer-employee data covering all job spells in Luxembourg from 2002 to 2020, merged with exhaustive mandatory posting declarations filed by Luxembourgish employers for 2004-2020. Panel A shows the monthly number of jobs (normalized to one in the month preceding the reform) at temporary employment agencies located in Luxembourg performed abroad by posted workers (red line) or performed in Luxembourg (blue line), before and after the reform (vertical red line). Panel B repeats the analysis at the annual rather than monthly level. Panel C shows the same comparison for an alternative sector in Luxembourg (transport) that was much less affected by the 2010 reform, compared to temporary employment agencies.

Figure A.40: Bunching at the Destination-level Labor Tax Exemption Threshold



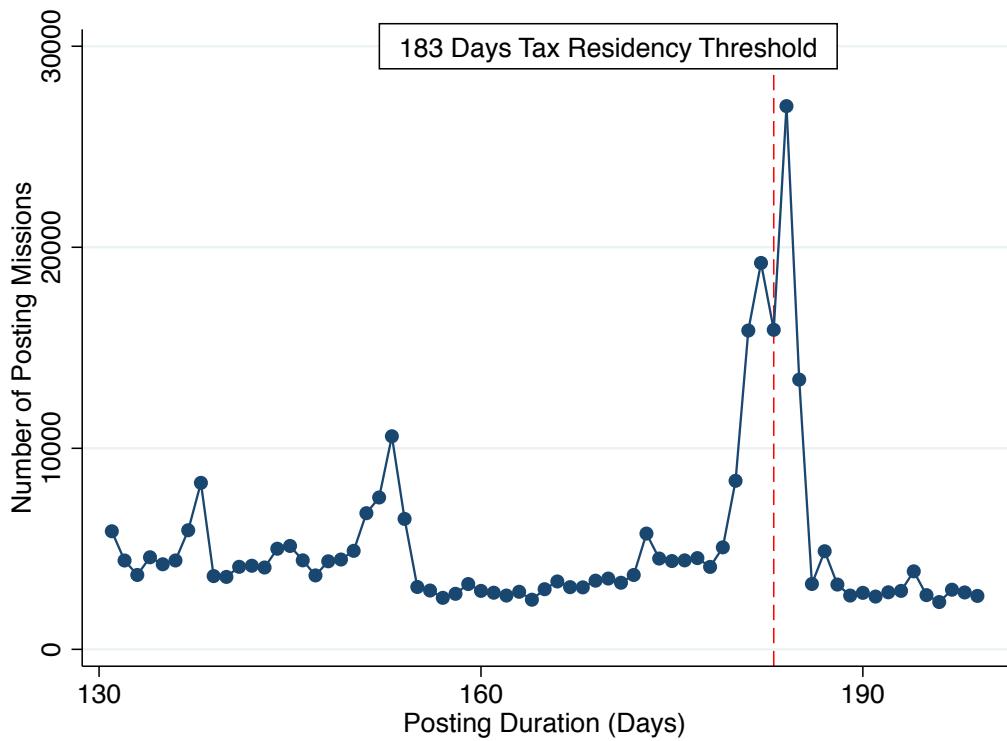
Notes: This Figure describes posting responses to a change in destination-level labor cost exemptions granted to posted workers, on data covering all posting missions performed in France. A European directive was voted in 2018 and entered into force in 2020 (see Appendix C for details). Before the adoption of the directive, destination-level labor tax exemptions were granted to individuals posted for less than 24 months. In 2020, the maximum duration to benefit from payroll tax exemptions in the country of work was decreased to 18 months. I use the universe of mandatory posting declarations filed by foreign suppliers posting workers to France to show the distribution of posting mission duration (in days) by unique posted worker and starting year of the posting mission. The new and old labor cost exemption duration thresholds are depicted by red dashed vertical lines.

Figure A.41: Support for European Integration and the Posting Policy



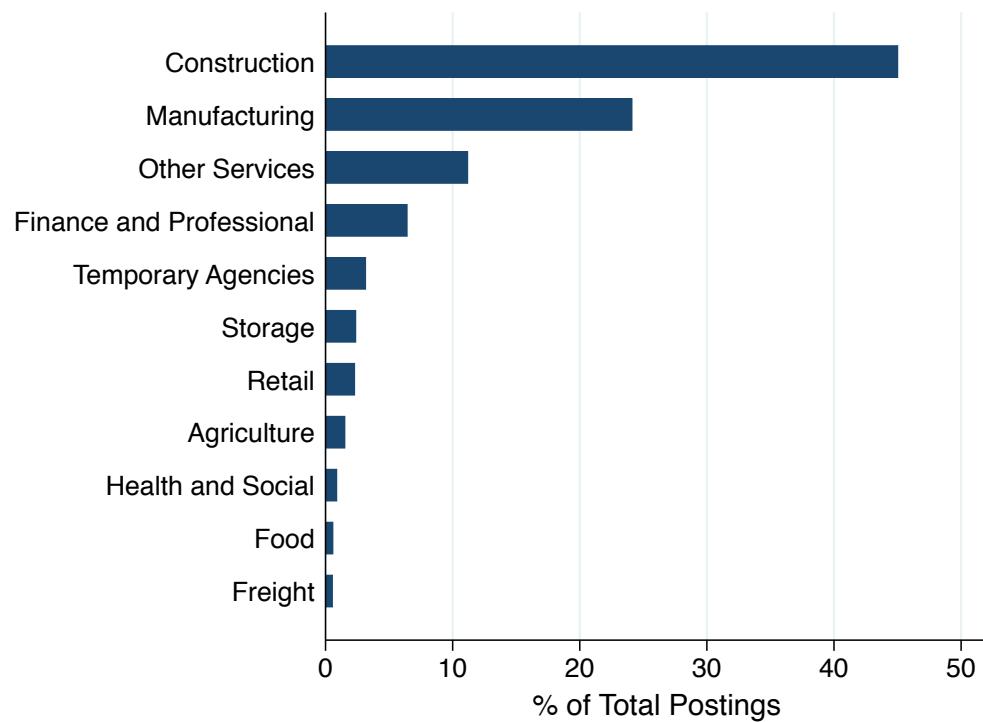
Notes: This Figure shows the effects of labor posting policy on support for European integration in one of the main European receiving country: France. In 2005, a referendum to adopt a European constitution was implemented in France. The Figure shows the vote intention, where "yes" denotes the option to increase European political integration. In march 2005, a proposition was made at the European commission to further liberalize the European posting policy, by exempting posted workers from all country of work regulations, including the minimum wage. This proposition (the Bolkestein proposition) led to massive debates in receiving countries, and gave birth to the "polish plumber" polemic the 15th of March 2005 when one of the main "no" leader, Philippe de Villiers, wrote a text evaluating that further services exports mobility liberalization will lead millions of French workers to loose their jobs. The same day, the number of searches for Bolkestein rose sharply in France. Few days after the polemic, the vote intentions against European integration rose, leading to reject the European political project in june.

Figure A.42: Posting Duration Around the Income Tax Residency Threshold in Belgium



Notes: The Figure shows the distribution of posting missions duration in Belgium for the period 2008-2019 around the 183 days tax residency threshold that is depicted by the vertical dashed line. International tax treaties establish that individuals pay income taxes in the country where the work activity is performed. However, if the employer is not located in the country where the work mission is performed by its employee, and if the employee works less than 183 days in the country of work, the income tax is exceptionally levied by the country of residence, and not the country of work. On the other hand, if the employee works for more than 183 days in one country, the income tax on the wage received for the work mission is levied by the country of work, and not the country of residence. The income tax rate paid by posted workers for the wage earned abroad thus depends on the 183 days threshold. In addition of the rules related to part of the wage earned abroad, the 183 days rule can also affect total tax residency determination. If workers do not have a "central financial interest" in their country of origin, they become tax resident of the country of work if they stay more than 183 days in this country.

Figure A.43: Posting of Workers by Sector of Work and Sending Member State



Notes: The Figure shows the sectoral composition of posted workers flows by sending member states in 2015. Data on posted workers flows build on social security forms issued for postings and collected from the European Commission for the period 2006-2017.

**Table A.1: Administrative Datasets on the European Posting Policy**

Dataset	Source	Period	Description	Posting
EC/A1	EC	2007-2017	Universe of SSC Forms Issued for posting in the EU	Yearly bilateral posted workers flows in the EU (by sector for some member states)
DPD/SIPSI	DGT/DARES	2000-2019	Universe of Administrative Forms for Workers posted to France	Yearly flows at the sending country-receiving province-sectoral level until 2015, individual data linkable to receiving companies and workers for 2016-2019
LIMOSA	ONSS/CBSS	2010-2019	Universe of Administrative Forms for Workers posted to Belgium	Individual-level data linkable to receiving firms data
GOTOT-OUT	ONSS/CBSS	2007-2019	Universe of Administrative Forms for Workers posted from Belgium	Individual-level data linkable to sending firms data
CBHP	BoP	2006-2017	Universe of Portuguese Firms' Balance Sheets data merged with data on Service Prestation to the EU Market	Identify companies sending their workers abroad to perform services
IGSS	IGSS	2002-2017	Universe of Matched Employer-Employee Data in Luxembourg	Identify workers hired in Luxembourg with an indicator if the worker is posted abroad during the employment period

Notes: The Figure summarizes the collected administrative datasets on the European mobility policy of posting and used for the empirical analysis. More details on the datasets can be found in the text. Each dataset on posting is also described in details in one dedicated appendix by dataset.

**Table A.2: Administrative Datasets on labor Markets in Receiving and Sending Countries**

Dataset	Source	Period	Description
Datawarehouse	BCSS	2007-2019	Administrative matched employer-employee data allowing to follow over time the universe of employment periods of the universe of workers hired in Belgium, that can be merged to the entire set of social security registries in Belgium.
AA	NBB	2007-2019	Balance sheets firm data from corporate tax returns covering the universe of non financial corporations established in Belgium
DADS Postes	INSEE	1970-2018	Administrative matched employer-employee data covering the universe of job spells in France
FICUS/FARE	DGFIP	2000-2017	Universe of corporate tax returns for the universe of firms established in France
IGSS	IGSS	2022-2017	Administrative matched employer-employee data allowing to follow over time the universe of employment periods of the universe of workers hired in Luxembourg, that can be merged to the entire set of social security registries in Luxembourg.
CBHP	BoP	2006-2017	Universe of corporate tax returns for the universe of firms established in Portugal

Notes: The Figure summarizes the collected administrative datasets on workers and firms in receiving and sending countries. More details on the datasets can be found in the text.

**Table A.3: Pre-Shock Exposure to Posting and Pre-Shock Local Labor Markets Demographics**

Pre-reform Level	Bottom 20 Exposure	Top 20 Exposure
Share of blue collar workers	24%	28%
Share of manufacturing employment	16%	18%
Share of Foreign Born	11.2%	7.9%
Share of Working Age Pop in Employment	65%	64%
Working Age Population (thousands)	490	407
Share with an International Border	6%	38%
Pre-reform Posting Imports per Worker	.01 %	.4%

Notes: This Table shows some province demographics by pre-reform exposure to posting measured by pre-liberalization imports of posting services per worker.

Table A.4: Imports of Posting Services Per Worker, France

	Imports of Posting Services per worker (in %)	
	Before Liberalization	After Liberalization (2005-2015)
Mean	.07	.52
Std deviation	.13	.51
Median	.03	.34
25th percentile	.01	.22
75th percentile	.06	.58

Notes: This table summarizes province-level exposure to posting services before the liberalization of posting (first column) and after (second column) in France.

Table A.5: Zero First Stage Test

	$\Delta$ , 1993-2003			
	Working Age Pop (1)	Exposed Emp (2)	Sheltered Emp (3)	Unemp (4)
Pre-reform Exposure to Posting	0.005 (.00349)	.0134 (.0123)	.004 (.005)	-.001 (.008)
Observations	94	94	94	94

Notes: This Table tests the correlation between pre-reform local labor markets outcomes with the measure of pre-reform exposure to imports of posting services.

Table A.6: Pre-Reform Exposure to Posting: First-Stage

	Post-Reform Exposure to Posting				
	Baseline 2003 Exposure (1)	2000 Normalization (2)	Distance to NMS (3)	Exposure Leave-Out (4)	Predicted Exposure (5)
Rank-Rank	.47*** (.04)	0.20*** (.09)	-0.34*** (.10)	.32*** (.09)	.45*** (.09)
Observations	94	94	94	94	94
Log-Log	.29*** (.065)	.28*** (.064)	-2.075*** (.539)	.294*** (.083)	.39*** (.060)
Fstat	19.49	19.81	14.10	12.49	44.2
Anderson-Rubin	15.36	15.41	21.8	15.9	38.9
Observations	94	94	94	94	94

Notes: \*p<0.10, \*\*p<0.05, \*\*\*p<0.01. Robust standard errors in parentheses. This table summarizes the predictive power of measures of pre-reform French provinces' exposure to the nation-wide 2004 liberalization. The dependent variable is province-level exposure to posting after the liberalization, measured as average province-level posting imports in 2005-2015 per pre-reform total employment. The baseline measure of pre-reform exposure is a province imports of posting services per worker  $e_p^{pre}$  computed following Equation (2). Column (2) uses 2000 employment normalization to avoid having the same denominator in both variables. Column (3) uses geographic distance to NMS countries gaining access to the French labor market in 2004 as a predictor for posting imports after the liberalization. Column (4) computes initial imports of posting services by province corrected with a leave-one-out approach as explained in the text. Column (5) uses predicted posting imports per pre-reform worker  $\hat{e}_p^{post}$  as an alternative predictor for posting exposure. It is computed by interacting the share of workers posted in a sector and in a province before the reform with national sectoral inflows of posted workers after the reform.

Table A.7: Effect of Posting Exposure on Receiving Country Employment: Robustness to Baseline Specification

Dependent Variable: Change in exposed employment/pop, 2003-2015 (%pts)						
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Posting Imports	-1.560*** (.299)	-1.604*** (.287)	-.529** (.258)	2.911*** (1.04)	-1.173*** (.329)	-1.588*** (.345)
Observations	94	94	94	94	94	94
Instrument	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline
	(7)	(8)	(9)	(10)	(11)	
Δ Posting Imports	-2.192*** (.710)	-1.571*** (.331)	-1.571*** (.335)	-1.992*** (.599)	-1.650*** (.351)	
Observations	94	94	94	94	94	
Instrument	Distance	2000 Norm	1990 Shares	Leave-Out	Predicted Inflows	
Fstat	14.10	19.81	20.15	12.49	44.2	

Notes: \*p<0.10, \*\*p<0.05, \*\*\*p<0.01. This table repeats the baseline specification of Panel B, table 3, with additional specifications and robustness. Column (1) uses pre-reform weighting instead of pre-reform population. Column (2) clusters the standard errors at the region level (there are 21 regions in France). Column (3) excludes industrial services from the estimation. Column (4) uses posting exposure per worker in percentage points rather than log as a regressor. Column (5) controls for inflows of standard migrants after the reform.

Table A.8: Robustness: Instrumenting with Geographic Distance to NMS

Dependent Variable: Change in exposed employment/pop, 2003-2015 (%pts)			
	(1)	(2)	(3)
Δ Posting Imports	-1.604*** (.338)	-1.571*** (.331)	-1.650*** (.351)
AKM standard errors	(.045)	(.033)	(.409)
Observations	94	94	94
Instrument	Baseline	2000 Norm	Predicted

Notes: \*p<0.10, \*\*p<0.05, \*\*\*p<0.01. This table repeats the baseline specification using Adao et al. [2019b] inference for standard errors.

**Table A.9: Robustness: Instrumenting with Geographic Distance to NMS**

	Post-reform (2003-2015)			Falsification Test 2000-2003
	(1)	(2)	(3)	(4)
Δ log Posting Imports/worker	-2.192*** (.710)	-1.889*** (.683)	-2.664*** (.921)	-.443 (.313)
Observations	94	94	94	94
Fstat	14.10	9.23	14.80	14.10
Δ Posting Imports/worker (% ppts)	-2.722*** (1.092)	-4.123*** (.683)	-3.360*** (1.280)	-.810 (.532)
Observations	94	94	94	94
Fstat	7.8	4.2	10.8	7.8

Notes: \*p<0.10, \*\*p<0.05, \*\*\*p<0.01. This table repeats the baseline specification displayed in table 3 using geographic distance to NMS countries as an alternative instrument for post liberalization imports of posting services.

**Table A.10: Exporters and Employment in Non-Tradable Services Sectors**

Mobility-Dependent Sector	% of non-financial corporations (1)	% of salaried employment (2)	% of firms that export (3)
Roofing activities	.03	.03	17.7
Test drilling and boring	.02	.03	5.9
Construction of water projects	.01	.04	12.5
Construction of railways	.01	.04	19.5
Demolition	.03	.04	6.5
Plastering	.1	.05	9.8
Construction Utility Projects for fluids	.05	.08	6.2
Other Building Completion	.2	.1	15
Installation of Industrial Machinery and Equipment	.1	.12	23.4
Site preparation	.15	.13	2.9
Painting and glazing	.2	.1	6.7
Floor and wall covering	.3	.2	20.1
Construction of utility projects for electricity	.05	.2	13.7
Joinery installation	.4	.2	13.6
Installation of conditioning air	.3	.2	8.4
Installation of plumbing	.4	.2	5
Repair of machinery	.2	.2	13.9
Other construction installation	.2	.3	11
Construction of bridges	.01	.35	29
Other misc construction activities	.4	.4	11
Construction of roads	.09	.7	11
Construction of other civil engineering projects	.4	.7	6.7
Electrical installation	1	.9	5.4
Freight transport by road	2.0	2.4	29.7
Temporary employment agency activities	.1	3.4	34
Construction of residential and non residential buildings	5.7	3.9	6.2
Total Non-Tradable Services Sectors	12.6	15.3	11.5

Notes: This Table shows describes firms in mobility-dependent services sectors. The estimations are based on detailed administrative firm-level balance-sheets data covering the universe of non-financial companies operating in Portugal merged with exhaustive information on trade in goods and services at the company-level.

Table A.11: Exporters and Employment in Manufacturing Sectors

Manufacturing Sector	% of non-financial corporations (1)	% of salaried employment (2)	% of firms that export (3)
Bleaching and dyeing	.02	.16	16.5
Manufacture of medicaments	.02	.17	44.3
Processing and preserving of poultry	.01	.17	44.7
Sawmilling of wood	.12	.17	27.1
Treatment of metals	.12	.19	11.3
Manufacture of parts of footwear	.08	.19	28.1
Manufacture of marble	.20	.20	40.8
Processing and preserving of meat	.03	.20	35.0
Cotton-type weaving	.02	.20	52.1
Manufacture of motor vehicles	.01	.21	28.7
Operation of dairies and cheese-making	.06	.2	29.2
Support activities for crop production	.22	.22	2.7
Production of meat	.09	.25	40.0
Machining	.22	.26	18.9
Growing of vegetables	.30	.26	8.2
Manufacture of pastry and cakes	.22	.26	7.7
Manufacture of other metal products	.19	.28	37.6
Manufacture of textile	.14	.31	34.0
Manufacture of wine	.2	.32	44.5
Mixed farming	.8	.33	9.8
Manufacture of underwear	.07	.34	41.9
Manufacture of metal moulds	.16	.38	39.6
Other printing	.30	.39	29
Manufacture of plastic products	.13	.40	53.2
Manufacture of doors	.58	.51	28.9
Manufacture of metal structures	.22	.54	28.2
Manufacture of vehicles' parts	.06	.84	49.9
Manufacture of bread	.0.67	1.0	2.9
Manufacture of footwear	.42	1.6	31.5
Manufacture of ready-to-wear outerwear	.76	2.2	21.9
Aggregate Manufacturing	12.3	23.7	23.3

Notes: This Table shows describes firms in manufacturing sectors. The estimations are based on detailed administrative firm-level balance-sheets data covering the universe of non-financial companies operating in Portugal merged with exhaustive information on trade in goods and services at the company-level.

Table A.12: Exporters' Premium in Manufacturing vs Non-Tradable Service Trade

	Exporters vs Non Exporters Manufacturing (1)	Non Trad. Services (2)	Exporters Manufacturing vs Non Trad. Services (3)
Log Turnover	.157*** (.01)	.84*** (.01)	.68*** (.01)
Log Employment	.91*** (.01)	.63*** (.01)	.55*** (.01)
Log Wage	.18*** (.00)	.22*** (.00)	-.04*** (.00)
Log Capital/Worker	.64*** (.01)	-.14*** (.01)	.48*** (.01)
Log Payroll/Turnover	-.32*** (.00)	.04*** (.00)	-.19*** (.00)
Log EBT/Worker	.15*** (.01)	-.02* (.01)	.12*** (.01)
Fixed effects	Year×Sector×Prov	Year×Sector×Prov	Year×Prov

Notes: \* $p<0.10$ , \*\* $p<0.05$ , \*\*\* $p<0.01$ . This Table shows differences in firms exporting goods in standard manufacturing sectors and firms providing non-tradable services listed in Table A.10. The estimations are based on detailed administrative firm-level balance-sheets data covering the universe of non-financial companies operating in Portugal between 2006 and 2017 merged with exhaustive information on trade in goods and services at the company-level. A firm is defined as an exporter in a given year if exporting manufacturing goods or non-tradable services this year. Column (3) summarizes average differences between exporters' outcomes in manufacturing vs non-tradable services sectors. It shows the estimate from a OLS regression of log exporters' outcomes on a dummy that is equal to one if the exporter is operating in the manufacturing service, controlling for year×province fixed effects, and clustering standard errors at the firm level. Columns (1) and (2) summarize the average differences between exporters and non-exporters within respectively manufacturing and non-tradable services industries. It shows the estimate from a OLS regression on log firms' outcomes on a dummy equal to one if the firm is exporting in that given year, controlling for year×province fixed×5digit sector fixed effects, clustering standard errors at the firm level, run separately on all manufacturing firms (Column (1)) and all mobility-dependent services suppliers (Column (2)). Column (1) estimating the exporter premium in manufacturing is comparable in spirit with the estimates produced by [Bernard, Jensen, Redding, and Schott \[2007\]](#).

Table A.13: Export Exposure in Manufacturing vs Non-Tradable service trade

	Manufacturing (1)	Non Trad. Services (2)
Exports in Turnover	25%	45%
% Shifting Full Activity Abroad	3%	19%
% Exporting in Founding Year	9%	21%
Average Export Duration (years)	5	3.2
% Permanently Exporters	41%	37%

Notes: This Table summarizes descriptive statistics on exports of manufacturing and non-tradable services, based on detailed administrative firm-level balance-sheets data covering the universe of non-financial companies operating in Portugal between 2006 and 2017 merged with exhaustive information on trade in goods and services at the company-level.

Table A.14: **Magnitude of Provision of Services Through Posted Workers in the EU**

<b>A- Overall Internationally Mobile Service Trade Within-EU (2017)</b>					
	Posting forms (thousands)	Posting flows (billion euros)			
Within-EU	1,730	280			
<b>B- Worker and Firm Level Exposure</b>					
	Sending firms per year	Ever sending firms	Employees at sending firms per year	Sent posted workers per year	Period
Portugal	5,938	19,437	181,549	-	2006-2017
Luxembourg	1,884	6,891	137,272	11,433	2004-2019
	Using firms per year	Ever using firms	Employees at using firms per year	Posted workers per year	Period
France	12,780	-	3,358,236	227,991	2017-2019
Belgium	9,300	23,305	-	236,791	2014-2019

Notes: The table summarizes descriptive statistics on the magnitude of posting of workers in the European Union. The top panel describes posting flows at the EU level. The number of posting forms issued in 2017 is based on mandatory social security forms that posted workers must hold when providing services abroad. The monetary value associated with these flows is computed by applying the standard balance of payment methodology (MSITS 2010) to service trade flows in the entire EU by BPM6 sectors, which allows me to recover provision of services through the movement of natural persons (mode 4). The bottom panel is based on country-level micro registries on postings. Data for postings from Portugal are based on exhaustive firm-level tax declarations merged with information on services provided in another EU country from 2006 to 2017. Data on postings from Luxembourg are based on exhaustive firm-level payroll declarations covering all job spells in Luxembourg merged with information on services provided in another EU country from 2004 to 2020. Data for postings to France are based on exhaustive posting declarations filed by foreign suppliers performing services in France merged with French-linked employer-employee data. Data for postings to Belgium are based on exhaustive posting declarations filed by foreign suppliers performing services in Belgium merged with Belgian-linked employer-employee data. The number of sending (using) firms relates to the number of firms that export (import) posting each year, while the number of never-sending (using) firms relate to the unique number of firms that exported (purchased) posting services during the period of observation.

## B Industry-Level Gains From the Liberalization: The Truck Drivers Example

To further document the aggregate industry-level gains from the posting policy, I take advantage of unique European data on economic activity in one sector heavily affected by the posting policy: road transport.<sup>86</sup> After 2004, truck drivers from NMS were granted the right to perform their activity in other EU countries. The data allows me to observe precisely measured economic performance in that sector (million-tonne per kilometer) in each European Member State, and conveniently disaggregates economic activity between services performed domestically or in other member states' territories. Figure A.18, Panel A, shows the evolution of truck driving services performed by European countries in other countries' territory, before and after the liberalization of posting. NMS export of driving services started to increase dramatically after they gain the right to post workers abroad. For instance, exports of road transport services from firms located in Poland has been multiplied by 5 between 2004 and 2017. Figure A.18, Panel B, shows that as they gain access to foreign markets, NMS countries increase their overall economic activity in the treated sector. At the same time, economic performance of firms located in other countries such as France, Belgium or Austria, starts to decrease following NMS entry. It thus exemplifies the large redistribution of market shares in formerly non-tradables sectors that followed the expansion of the posting policy to low-wage countries.

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<sup>86</sup>Unfortunately, there is not harmonized data on economic performances in other sectors like construction. I thus focus on the road transport sector as Eurostat provides very detailed information on economic activity in that sector.

## C Reduced-Form Estimates of the Posting Elasticity

### C.1 Causal Effect of Payroll Tax Reforms on Posting Flows

In this section, I illustrate how posting flows are affected by large and exogenous reforms in employers' payroll taxes. If posting flows significantly respond to labor cost reforms in sending or receiving countries, this implies that payroll tax exemptions granted to posted workers by receiving countries significantly shape cross-border services provision. I test this assumption with two quasi-natural experiments: (i) a large reform in employers' social security contributions in one of the largest sending countries (Slovenia), (ii) a large reform in employers' social security contributions in one of the largest receiving countries (Belgium).

I first study the implementation of a reform in Slovenia that decreased the labor cost for workers posted by companies located in Slovenia. The reform was implemented in December 2012 by a new social security regulation (*ZPIZ-2 par 144*). It establishes that payroll taxes paid by Slovenian firms on posted workers' wages are capped to 60% of the average annual salary in Slovenia, introducing a large labor cost cut for workers posted by Slovenian suppliers.<sup>87</sup>

To estimate the effect of this origin-specific tax cut on posting flows, my empirical strategy is a difference-in-differences where I compare the flows of workers posted from Slovenia affected by the payroll tax cut after 2012 with workers posted from similar countries not affected by the tax cut, within the same receiving country. My control group contains workers posted from other new member states (NMS) of 2004: these countries face the same posting restrictions as Slovenia in all receiving EU countries and are similar in many aspects (geography, development path, industrial specialization). Given that posting flows from Slovenia and other NMS of 2004 are affected by similar shocks, they should have followed similar trends absent the reform's implementation in Slovenia.

Figure A.36 shows graphically the differences-in-difference setting provided by the reform. The top panel plots the number of posted workers from 2008 to 2017 (normalized to one in 2012 just before the reform implementation) sent by Slovenia (treatment) and by other NMS (control) to Austria, the main receiving country for workers posted from Slovenia.<sup>88</sup> The figure shows compelling evidence that the number of workers posted from Slovenia increased after the payroll tax cut compared to workers posted from other comparable countries. While the series were following parallel trends before the reform, the number of workers posted from Slovenia to Austria increased threefold five years after the tax cut. Over

<sup>87</sup>The effect of this payroll tax cut "posted bonus" has been documented by a worker union (EFBHW) that filed an official complaint at the European court of Justice in 2019. The complaint against Slovenia argues that this payroll tax cut for workers posted from Slovenia lowers labor cost for Slovenian suppliers and creates unfair competition between European countries.

<sup>88</sup>Focusing on the differential evolution of treated versus control flows to the same receiving country allows me to graphically differentiate out the destination-specific term  $\Phi_{jt}$  that should affect demand for workers posted from Slovenia and other NMS 2004 countries similarly.

the same period, posting flows from control countries stayed very stable, suggesting the observed increase in Slovenian postings has been primarily driven by the reform. The reduced-form elasticity of posted worker flows with respect to origin-specific labor cost given by this country-level experiment is large and significant, with a point estimate of -1.77 (0.34) in Austria, -1.70 (0.38) in Germany, and -1.6 (0.33) for all receiving countries, controlling for destination-year fixed effects.

I complete this finding by studying a large exogenous payroll tax cut reform in one of the main receiving countries, Belgium. At the end of 2015, the Belgian government announced a large decrease in labor taxes (“tax shift”): employers’ social security contributions rate on all employees hired in Belgium was decreased from 33% to 25% starting at the beginning of 2016.<sup>89</sup>

To empirically investigate the effects of this destination-specific payroll tax cut on posting inflows, I rely on a difference-in-differences setting where I compare the flows of workers posted to Belgium before and after the reform to the flows of workers posted to a similar receiving country not affected by the tax shift. I use workers posted to France as my control group because of common characteristics between these two countries: they share a border and a language, are among the largest receiving countries, and have a similar origin and sectoral composition of posting inflows. Postings to France and Belgium should be affected by similar regional and origin-specific shocks, while only posting flows to Belgium should be affected by the reform.<sup>90</sup>

Figure A.36 shows graphically the differences-in-difference setting provided by the reform. The bottom panel plots the number of posted workers from 2010 to 2018 (normalized to one in 2015 just before the reform implementation) sent to Belgium (treatment) and to neighboring France (control). Posted worker flows to these two receiving countries were following perfectly parallel trends before 2015, suggesting that posting to France provides a credible comparable counterfactual for postings to Belgium. Postings to Belgium started to slow down immediately after the tax shift was implemented, while the number of workers posted to France kept growing at a fast rate. In line with the previous experiment, the bottom panel of Figure A.36 provides compelling evidence that the large decrease in employers’ labor cost implemented in Belgium significantly slowed down posting flows to this country compared to a comparable neighboring receiving country. The implied estimated elasticity of posting flows with respect to destination-specific payroll taxes is 1.44 (0.35).

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<sup>89</sup>The decrease in employers’ social security labor cost was progressively implemented, and the rate of contributions was decreased from 33% to 30% in 2016, then from 30% to 28% in 2017 and from 28% to 25% in 2018.

<sup>90</sup>Focusing on a receiving country with a similar composition of posting inflows allows me to filter out the importer-specific effect while exploiting a shock in the destination-specific term  $\Phi_{jt}$ .

## C.2 Causal Effect of Minimum Wage Reforms on Posting Flows

I have shown that two large employer labor cost reforms have significantly affected posting flows in Slovenia and Belgium, with estimated reduced-form elasticities of 1.7 and 1.4, already suggesting that destination-level labor cost policies, such as payroll tax exemptions, shape mobility-dependent trade flows. I complete these findings by showing how minimum wage reforms affect posting flows.

I study the effects of minimum legal wage implementation in Germany, where no national minimum statutory wage was in place until 2015: minimum pay rates were agreed upon at the sectoral or firm level and were therefore not applicable to posted workers.<sup>91</sup> Since 1996, only construction-related industries are entitled to a minimum legal wage regulation at the sectoral level.<sup>92</sup> In August 2014, the meat processing industry implemented a minimum legal wage in the sector, and before that a national minimum wage was implemented in January 2015 in all sectors.

To investigate the effects of this reform, I use A1/E101 data on bilateral *sectoral* posting flows that are available for a subset of sending countries: Poland, Luxembourg, Hungary, Czech Republic, Lithuania, and Romania. I can observe postings to all of these sending countries since 2012 in manufacturing and construction. In a double differences spirit, I look at differences in posting inflows to Germany's construction sector where a prevailing wage was already in place compared to manufacturing sectors that were affected by the introduction of a minimum legal wage. Panel A of Figure A.37 shows that postings to Germany in construction and manufacturing were similar in 2012, but the two series started to diverge in 2014 when the prevailing minimum wage was implemented in the meat industry. Postings to the German manufacturing industries decreased further in 2015 when all the manufacturing industries became regulated by a minimum wage, while postings in construction stayed close to their pre-reform level. The corresponding estimates indicate that postings differentially decreased by 60% in sectors treated by the reform, accounting for origin-year and destination-year fixed effects.

To confirm that this finding is not driven by origin-specific sectoral supply shocks simultaneous to the minimum wage reform, I use a triple differences approach and compare the evolution of postings in treated and untreated sectors in countries treated and untreated by the minimum wage reform. Graphically, I use France as a control group because Germany and France are neighboring countries and the two largest users of posting services. The bottom panel of Figure A.37 shows that the gap between manufacturing and con-

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<sup>91</sup>Foreign services suppliers are only bound to comply with destination-level minimum legal wages, or generally applicable rules. Therefore, most industry-level or firm-level minimum pay rules do not apply to posted workers.

<sup>92</sup>In 1996, the prevailing wage policy for posted workers was implemented in Europe and adopted by German national law through the "Posted Workers Act" (AEntG law). Remarkably, this law created the first legal basis for minimum sectoral legal wage in Germany. Since 1996, sectoral minimum legal wages in Germany have been thus implemented through the addition of branches in the AEntG scope. This anecdote shows that not only do prevailing wage policies play the role of trade policies for on-site offshoring, but they also triggered the implementation of sectoral minimum wage for domestic workers as a way to protect domestic labor markets from foreign competition.

struction mobile services stayed stable in the control country (France), while it decreased drastically after the minimum wage reform in 2014 in Germany. This confirms that the decrease in manufacturing versus construction postings to Germany is not driven by origin sectoral shocks that would have affected France and Germany similarly. The full triple differences model accounting for origin-year, destination-year, and pair-year fixed effects indicates that postings to Germany in the treated sector differentially decreased by 57%.

The double and triple differences models rest on the assumption that the construction sector provides a credible control group for postings in manufacturing. These sectors could, however, be affected by unobserved shocks within a receiving or sending country. A particular concern is that the implementation of the minimum wage in manufacturing affects the demand of posting services in that sector through other channels than the change in posting cost. To make progress on this issue, I exploit further variations *within* the treated industry across receiving and sending countries. The identifying variation comes from the *kinked* relationship between the posting allowance shock caused by the minimum wage reform and the initial wage level in sending countries, illustrated in Panel C of Figure A.37. Workers posted from low-wage countries such as Romania or Hungary receive a large additional allowance after 2014, while wage cost of workers posted from high-wage countries such as Luxembourg should not be directly affected by the new rule.

I then compare how in the treated sector (construction) posting flows from a given sending country evolved differentially in Germany versus other countries, before and after the German minimum wage reform, controlling for origin-year and destination-year fixed effects. The estimated coefficients plotted in Panel D of Figure A.37 show that following differential exposure to the reform, postings from countries experiencing the largest “posting allowance shock” see the largest differential decline in postings to Germany. The corresponding elasticity of posting flows with respect to wage cost change after the reform is -1.3 (0.29), which is, again, remarkably similar to the elasticity estimates obtained with payroll tax reforms in sending and receiving countries exploited in Figure A.36.

### C.3 Causal Effect of A Reform in Labor Tax Exemption Rules

I study a change in the European regulation on social security coordination (EC Regulation 883/2004) that entered into force as from 1 May 2010 and that affected labor tax exemptions granted to posted workers in specific countries and sectors. The reform was implemented in a context where potential tax avoidance strategy and artificial posting practices were questioned by Member States, in particular from temporary employment agencies located in Luxembourg. In particular, postings of French workers to France through temporary employment agencies located in Luxembourg started to boom in 2008, and could easily be

described as “artificial posting”.

The reform of 2010 aimed at strengthening the posting rules, targetting specifically posting through temporary agencies, and reinforcing the rules related to social security exemptions in some contexts that could be interpreted as tax avoidance. The reform first establishes that workers that have not been affiliated to the SSC organization of the origin country for at least a month cannot be exempted from country of work labor taxes if they are posted abroad. Second, the reform reinforces the condition under which payroll tax exemptions can be granted to individuals who are posted to their own country of residence. After the implementation of the reform, a French resident posted to France by a company established in Luxembourg has to pay the French social security contribution and cannot stay affiliated to the Luxembourg regime only. Finally, the reform implements clearer limitations under which the companies can post workers abroad while staying affiliated to the origin country social insurance system: sending firms must perform more than a pure administrative activity in the sending country (*“substantial activity rule”*).

I begin by studying how the 2010 labor tax exemptions reforms affected postings from affected sending countries and treated sectors. I take advantage of unique administrative matched employer-employee data for all firms located in Luxembourg merged with information on all postings from Luxembourg since 2004. Luxembourg is an ideal laboratory to study the effects of this reform, as it is the country where (i) “artificial” postings were the most substantial and (ii) postings from temporary employment agencies is prevalent. The 2010 reform limited social security exemptions granted to posted workers for temporary employment agencies, compared to other sectors. As temporary employment agencies specialize in hiring and providing labor to (domestic and foreign) using firms, hiring of workers from abroad in order to post them immediately to a third country is more likely to occur through temporary employment agencies. Most of French residents posted to France from Luxembourg were hired by temporary employment agencies. These sending firms are also more likely to be affected by the substantial activity rule enforced by the reform.

I show in Figure A.39 the evolution of workers hired in temporary employment agencies located in Luxembourg that are posted abroad (red line) and that perform work in Luxembourg (blue) line, before and after the labor tax reform. While the two series followed similar trends in months preceding the reform, workers posted abroad by temporary agencies started to decline immediately after that the 2010 reform was implemented. Is this effect driven by a simultaneous unobserved shock that would affect all mobile service provision flows, beside the effects of the labor tax exemption reform? When looking at sectors less affected by the exemption restrictions, such as transport, mobile service provision did not decline compared to non-posted employment after the reform.

I further investigate in [Online Appendix](#) the counterpart of this reform on a receiving perspective. I

compare the evolution of incoming posted workers in a French province exposed to posting from Luxembourg, against postings to a neighbouring French province that does not share a border with Luxembourg. The graph shows that export of mobile services to the geographically exposed *département* (Moselle) declined substantially immediately after the implementation of the reform, and this decline was concentrated on French workers posted to France, that were mostly affected by the reform. By comparison, posting of workers to the neighbouring province with no immediate border with Luxembourg were not affected by the reform.

This emphasizes the large mobile service provision response to a reform in posted workers' labor tax exemptions. The reform that restricted labor tax exemptions granted to some posted workers drastically reduced postings sent from treated origin countries and sectors, and decreased the number of postings received in treated destination countries.

#### C.4 Bunching Posting Responses to Payroll Tax Exemptions Rules

In 2018, a novel directive on posting was voted at the European level and implemented novel rules to regulate mobile service provision. First, the new directive extends the prevailing wage rule: workers posted to a country are now entitled to the wage earned by domestic workers at the using firm, rather than destination-level minimum legal wage. Second, the new regulation changed the maximum posting duration to benefit from destination-level payroll tax exemptions. From 2010 to 2018, posted workers could be exempted from destination-level taxes and rules if they were posted for less than 24 months in that country. The 2018 directive reduced this duration threshold to 12 months with an almost guaranteed extension to 18 months if the service provider submits a motivated notification. The EU directive was transposed in the French labor law in 2019, and entered into force in July 2020. I investigate how the reform in the social security exemption threshold changed posting behaviours. I show in Figure A.40 the distribution of posting duration by year of posting mission start: 2017, 2018, 2019, 2020. After that the novel exemption rule was implemented, a substantial bunching at the new threshold appears, while bunching at the old exemption threshold is substantially lower.<sup>93</sup> These distortions in the distribution of posting mission duration around the social security exemption thresholds provides evidence that mobile service provision is significantly affected by labor taxes exemptions granted in destination countries.

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<sup>93</sup>The decrease in bunching at the 2-year exemption threshold started earlier. This can be explained by the fact that there were important uncertainties about the application of the 2018 directive in the French law. As the application decree was not yet implemented, it was also uncertain whether posting missions starting in 2018 (after that the directive was voted in the EU) for a 2 year period could be affected by affiliation to the French social security system after that the directive would formally be implemented in national law.