International Trade Responses to Labor Market Regulations

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Abstract

This paper studies how differences in labor market regulations shape countries' comparative advantage in labor-intensive services, using administrative data on cross-border supply of physical services within Europe from 2004 to 2018. I exploit exogeneous variations in labor taxes and minimum wages faced by exporting firms engaged in a large European trade program: the posting policy. Firms from different countries compete to supply the same physical service in the same location but are subject to different payroll taxes and minimum wages; and those rules varied across countries, sectors, and over time. Both reduced-form countries case-studies and gravity estimation show evidence of large trade responses to lower labor taxes and minimum wages, with an elasticity that is above one. The Bolkestein directive, by exempting foreign firms from all labor regulations in the destination country, would have double exports of physical services from Eastern European countries, rationalizing the wave of protests that led to the withdrawal of the proposal. Overall, those findings emphasize that labor market regulations are meaningful determinants of trade competitiveness in labor-intensive tasks when trade liberalization is not paired with social standards harmonization.

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1 Introduction

It is a well-known theoretical result that trade is mutually beneficial because countries specialize in activities where they have a relative cost advantage. In public discourse, policymakers often emphasize benign sources of comparative advantages, such as factor abundance, technology or economies of scale, leaving more politically controversial explanations aside. For instance, former WTO director Pascal Lamy once argued that lower taxes and weaker social standards are unlikely to govern international trade patterns because *"differences in wages largely reflect differences in labor productivity"*.[1]

In practice, labor markets are characterized by important features that are not fully consistent with this view. Most countries have welfare states that are largely funded by domestic taxes on labor; and impose labor market regulations, such as minimum wages, to protect workers. There is also vast evidence that labor markets are characterized by market power (Card, 2022). While most economists now agree that wage differences do not only reflect true productivity gaps, but also differences in labor institutions and wage-setting power, we haven't fully grasped the implications of this new consensus for trade specialization, and international trade patterns.

Yet, social standards could represent an entirely distinct form of comparative advantage, in contrast to conventional explanations of global competition. First, people reject the idea that international trade should be based on differences in institutional choices, that they view as unfair and contrary to their values (Di Tella and Rodrik, 2020). Second, if labor institutions cause trade, some countries might then be tempted to lower their standards to gain market share in labor-intensive sectors, leading to inefficiently low levels of labor taxes and regulations (Krueger, 1996). This race to the bottom could stop certain countries from maintaining their preferred levels of redistribution and workers' protection, which would lower political support for economic integration (Rodrik, 1998).

Despite its policy relevance, the role of social standards for international trade has remained underexplored partly due to important measurement and identification challenges. First, studying this question would ideally require to measure jointly the impacts

[1] This is from a 2010 Lamy's speech on "facts and fictions" in international trade.

of regulations on unit labor costs, and the labor-content of trade flows, which are rarely observed in trade datasets (Rodrik, 1996). Second, credible exogeneous variations in labor market regulations are needed to identify their causal effects on trade flows. Cross-country correlations between measures of social standards and trade competitiveness can be informative (Alesina and Perotti, 1994; Mah, 1997) but cannot distinguish the effects of different productivity levels from the effects of labor market institutions. Another approach is to look at the effects of domestic policy on exports (Gan et al., 2016; Malgouyres and Mayer, 2018). The issue is that when fundamental changes to domestic labor market regulations occur, those reforms can affect many other domestic factors, or can be directed at trade competitiveness itself, complicating identification.[2] Well-identified studies often focus on domestic impacts of such reforms (e.g Saez et al., 2019; Cengiz et al., 2019; Dustmann et al., 2022), because information on trade flows (and their labor content) is scarce, and because worker-level exposure designs are less suitable to the study of trade-related margins. Finally, even in the presence of clean variations and relevant data, some labor regulations are hard to translate into ad-valorem costs, making it difficult to interpret and extrapolate estimated elasticities, which can be crucial for welfare and counterfactual analysis (Arkolakis et al., 2012).

This paper tackles these challenges and provides evidence on the effects of payroll taxes and minimum wages–a key dimension of labor market regulations–on international trade in labor-intensive services. I exploit a European trade program for physical services that offers three important advantages to study this question.

First, the EU posting policy allows to directly trade workers and labor institutions across borders, akin to the textbook model of trade in tasks proposed by Grossman and Rossi-Hansberg (2008). The policy regulates temporary contracts performed locally by foreign firms. For instance, a Polish construction firm (exporting country) can build in France (importing country) by sending its employees to France. These posted workers maintain their Polish employment contracts but physically work in France, serving the same customers, at the same location, using shared capital and infrastructure, all while

[2]There is also a growing literature focused on "responsible sourcing" (Harrison and Scorse, 2010; Boudreau, 2021; Alfaro-Ureña et al., 2021) or "fair trade" (Dragusanu, Montero and Nunn, 2022) policies that originate from consumers, activists or producers' initiatives.

operating under different employment laws. This setting keeps most determinants of comparative advantages constant while labor market regulations vary by origin of the exporting firm. Furthermore, disparities in productivity for physical services across countries are minimal (Balassa, 1964; Samuelson, 1964), making institutional factors a plausible primary driver of wage determination in the context of posting.

Second, the EU Commission records payroll tax information on workers involved in cross-border physical service contracts within the EU. Thus, I have administrative records of trade in labor services and directly observe the units of labor (workers) involved in those cross-border transactions from 2009 to 2018. Those datasets have been previously used in a different paper (e.g in Muñoz, 2024) to measure the labor market and product effects of this policy. To study the different question of labor market regulations and trade in labor services, I have augmented those datasets with information on wages, payroll taxes and minimum wages applicable to firms engaged in the program.

Third, I can exploit many sources of variation in both tax policy and labor market regulations (keeping other trade costs constant) to identify the causal effect of social standards on trade in labor services : (a) payroll taxes and minimum wages vary across countries and over time (b) the EU has imposed destination-based payroll taxation on some exporting firms (c) the EU has enforced destination-based minimum wages to some exporting firms. Together, these policy changes create compelling quasi-experimental variation to identify the causal effects of labor market regulations on trade in labor-intensive tasks.

I first set out a simple conceptual framework to illustrate how payroll taxes and minimum wages affect incentives to trade labor services in the EU. Foreign and domestic firms compete for the same service contract that must be performed "on-site"; the service is produced with labor only. Payroll taxes are origin-based: domestic and foreign firms face different tax rates, even if foreign and domestic workers are paid at similar wages and work at the same location. Countries are allowed to impose domestic minimum wages to foreign firms. Anytime a country imposes its minimum wage to posted workers, foreign firms located in low-wage countries are disproportionately affected by the change in cost.

I then proceed to estimate the elasticity of posting flows to labor market regulations in the EU at three successive levels. I start by exploring simple cross-country correla-

tions between labor cost differentials and cross-border supply of labor services. I find a strong positive correlation between bilateral posting flows and labor cost differentials in the cross-section, with an implied steady-state elasticity of 0.6. This provides suggestive evidence that labor cost differentials matter for trade in physical services in the long-run.

I then turn to quasi-experimental evidence of posting responses to country-specific reforms in payroll taxes and minimum wages. I focus on four reforms that create compelling identifying variation and provide conclusive evidence of this relationship in the medium-run. Tests for pre-existing trends and anticipation, and a difference-in-differences framework, validate using payroll tax and minimum wage reforms as a source of identification. For instance, I show that exports of temporary employment agency services from Luxembourg dropped dramatically after that a EU regulation suddenly imposed (much higher) destination-based payroll taxes to Luxembourgish firms engaged in the program and operating in the temporary employment sector. In comparison, both domestic supply of the same services, and exports of posting services in sheltered sectors, remained unaffected. The reduced-form elasticity of exports with respect to the implied (exogeneous) change in wage cost for exporters is large, and above one. The size of the responses suggests that Luxembourgish firms were mostly competitive because of origin-based payroll taxation. After the neutralization of this advantage through destination-based taxation, exports of temporary employment services from Luxembourg shrinked dramatically.

I also exploit a German reform that focused on the minimum wage component of exporting firms' wage cost. Germany always had sectoral wage floors defined by collective or firm-level agreements for German workers, but those regulations did not bind for foreign firms. This means, for instance, that Romanian posted workers could work in Germany while being paid at the Romanian minimum wage ($\approx$ 2 euros per hour) (Wagner and Hassel, 2016). The only exception was in the construction sector, where sectoral wage floors were defined "generally applicable" by law since 1997. In 2015, the German government introduced a nationwide generally applicable minimum wage ($\approx$ 8 euros per hour), resulting in a new wage floor for exporting firms operating in the non-construction industries.[3] German imports of posting services differentially decreased by 60% in sec-

[3] Dustmann et al. (2022) have studied the effects of this reform on German employment (that excludes by

tors treated by the reform, relative to the construction sector; and relative to neighboring importing countries where minimum wage requirements stayed constant. The implied reduced-form elasticity of posting imports with respect to exporting countries' wage cost is again substantial and way above one. The bulk of the reduction in exports to Germany came from highly exposed low-wage exporting countries. In contrast, the effects for exporting countries where the new German minimum wage was not binding are not statistically different from zero. Posting was thus used to avoid German minimum wage floors before 2015. Services suppliers located in low-wage countries became less competitive after that they became subject to the same regulations than German firms.

Finally, I present the results from the estimation of a theory-based gravity model, using all sources of variation in payroll tax rates and minimum wages across all EU countries from 2009 to 2018. This EU-wide dataset has consistent data for posting flows at the origin-destination level aggregated for all sectors. Hence, I must omit sector-specific variations in labor market regulations studied in the country case-studies, and focus on nationwide payroll tax and minimum wage reforms instead. This allows me to generalize my previous findings while exploiting a different set of identifying variations. Consistent with the reduced form results, I find large responses to changes in labor costs in the gravity model. My estimates of the elasticity range between 1.2 and 2.4, and are at the lower end of the medium-run elasticities obtained from the difference-in-differences country-specific designs. Using those estimates, I assess the impacts of various labor taxation and minimum wage reforms for posted workers that have been under recent discussion in the EU.

I outline in the conclusion of the paper that the link between social standards and trade in labor services had political implications for the EU. I show that the proposal to eliminate the domestic minimum wage requirements for posted workers, pushed by Eastern European countries in the aftermath of the EU enlargement, significantly reduced support for EU integration in France's 2005 referendum, a country with high social standards. This confirms Rodrik (1998) theory that voters reject comparative advantage based on institutional choices that conflict with social norms in importing countries. Because international convergence in social standards has yet to be acchieved, even within relatively homoge-

definition workers sent by foreign firms).

neous free trade areas such as the EU, my results overall outline the tensions arising from trade liberalization without social standards harmonization.

Contributions This paper contributes to a broad literature investigating the sources of international competition. Previous studies have often studied benign institutional determinants of trade such as financial development (Manova, 2008), the security of contract enforcement (Levchenko, 2007; Nunn, 2007), institutional quality (Vogel, 2007) or labor market rigidities (Helpman and Itskhoki, 2010; Cunat and Melitz, 2012).[4] My focus is on two key components of domestic labor market regulations, namely minimum wages and payroll taxes. I show that social standards play a substantial role in shaping global competition in labor-intensive sectors, even within a relatively homogeneous free trade area like the EU. This is consistent with a small but growing literature showing that international capital and trade flows are sensitive to differences in corporate taxation (Griffith, Hines and Sørensen, 2010; Tørsløv, Wier and Zucman, 2018) or environmental regulations (Hanna, 2010; Shapiro and Walker, 2018); although studies of profit-shifting exploit the distribution of multinationals' profits across countries (Bilicka et al., 2022; Wier and Zucman, 2022) instead of tax reforms. Imposing domestic standards to foreign firms is one kind of trade policy ("social clause" in the WTO language), hence my findings also relate to the large literature of trade responses to trade policy, that usually focuses on commodities and tariffs (Head and Mayer, 2014), although more recent work has studied non-tariffs barriers (Càrrere et al., 2022; Dhingra et al., 2023).

My findings open a debate on whether policy is needed to regulate competition on payroll taxes and labor laws in a globalized world. So far, most academic debates on the regulation of companies engaged in international transactions have been focused on destination-based corporate taxes (Avi-Yonah and Clausing, 2007; Auerbach, 2010) while neglecting payroll-based regulations for two reasons.[5] First, capital has traditionally been

[4] Those studies reviewed by Chor (2010) are mostly theoretical, but some present empirical tests. They usually correlate measures of an industry's dependence on particular institutional conditions with countries' relative export shares in those industries. Instead, I exploit quasi-experimental variations in labor regulations. There is also an earlier theoretical body of work that revisited the conventional findings of classical trade theory by integrating particular labor market characteristics, including aspects like minimum wage (Brecher, 1974) or equitable wages (Agell and Lundborg, 1995)

[5] See also work on border-adjustment taxes (Lerner, 1936; Barbiero et al., 2019; Costinot and Werning,

viewed as much more mobile than labor, making it more sensitive to international differences in regulations (Kanbur and Keen, 1993; Keen and Konrad, 2013). However, there is increasing evidence that international movements of workers are responsive to income tax differentials (Kleven et al., 2020), and that demand for foreign workers can be affected by labor regulations (Naidu, Nyarko and Wang, 2016). Posting is one channel that makes labor more mobile, thereby increasing opportunities of labor-related regulatory arbitrage. But other policies or technological changes, for instance remote work, can also lead to challenges in determining where labor laws and employer-related taxes should be based. The size of the posting elasticity suggests that the geography of economic activity may be very responsive to any regulatory arbitrage opportunity emerging in other contexts.

Second, the canonical competitive labor market model predicts that the incidence of payroll taxes, even if nominally paid by employers, ultimately falls on workers' net market wages, leaving firms' labor costs unchanged. But in the presence of labor market frictions, this result no longer holds, meaning that changes in labor regulations shape labor costs, and potentially trade. My results confirm that payroll tax and minimum wage reforms were able to affect trade competitiveness in EU labor services.[6] This adds to a new wave of evidence of employment responses to payroll tax rates because of imperfect wages adjustments (Saez, Schoefer and Seim, 2019; Ku, Schönberg and Schreiner, 2020; Guo, 2023). In the EU context, full pass-through to labor costs can be rationalized by the presence of nominal rigidities, including minimum wages. Furthermore, tax reforms targeted at some exporting firms or some sectors like those I study are unlikely to generate market-wide wage adjustments (Lobel, 2022). My empirical designs also let me document dynamic trade flows adjustment to changes in labor regulations, with responses growing over time.[7] This goes against the belief that payroll tax cuts ("fiscal devaluations") may only boost exports in the short-run (Farhi, Gopinath and Itskhoki, 2014).

The paper is organized as follows. Section 2 describes the institutional setting and sets out a conceptual framework guiding the empirical analysis. Section 3 describes the data, Section 4 shows reduced-form graphical evidence, Section 5 presents gravity regres-

2019).

[6] Fajgelbaum et al. (2019) also document full pass-through for tariffs leading to lower traded quantities.

[7] Similar dynamic effects have been documented for tariffs by Boehm et al. (2023).

sion estimates and policy counterfactuals. Section 6 concludes by discussing how global competition based on social standards affected voters' support for EU integration.

2 Description of the Policy

2.1 EU Posting Policy: A Large Trade Program for Physical Services

I study the relationship between labor market regulations and trade in a large trade program for services called the posting policy. Established in 1959, this program regulates temporary contracts performed locally by foreign firms. The 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 contract.[8] This large EU policy was first studied in Muñoz (2024): posting accounted for one third of all within-EU trade in services in 2017 (2% of EU GDP), while 2 million workers (in full time equivalents) were involved in those cross-border transactions in 2019. Because the services must be supplied "on-site", posted workers mostly operate in labor-intensive tasks: the first sector is construction, followed by manufacturing services, road transportation, temporary employment agencies and agriculture. Hence, posted workers are also mostly blue-collar workers.

Regulatory costs Posting was established in 1960 as part of the four economic freedoms in the EU. Its aim is to facilitates cross-border supply of services by minimizing regulatory costs. Foreign undertakings can directly serve customers in other EU countries; there is no need to open an establishment in that country. Foreign firms do not need to obtain a license or a work authorization to access another EU country market. Though the policy is intended for temporary service provision, there is no legal limit to posting contracts. Exporting firms must only fill out an administrative form which allows their employees to claim formal employment and insurance in the exporting country while effectively working in the importing country.

[8] Posting is known as mode IV export of services in the WTO general framework for trade in services, and is part of the general agreement on trade in services (GATS). It is not specific to the EU and exists in many other areas of the world, although mode IV is much more regulated elsewhere.

Labor Market Regulations The general principle of the posting framework is that firms (and their workers) are subject to regulations and laws in the country of origin only; which is defined as the country where the firm exerces its "usual activity". In the initial project of posting; there is no differences in tax treatment or regulations between firms that export washing machines, or firms that export workers to supply construction services abroad: all regulations are in theory set in the country of origin.

In the 1990s, the initial legal framework underwent changes due to concerns about unfair competition in cross-border services among Western EU states. Although trade barriers are generally not allowed in the common market, the first "Posted Workers Directive" was voted in 1996 with the aim to prevent "social dumping". This new legal framework allows member states, under certain conditions set by the EU, to impose *some* of their domestic regulations to foreign firms engaged in the program.

First, importing countries can impose some components of their labor law to exporting firms, although the scope of those regulations is restricted by the EU directive. Only the "hard core" of domestic labor regulations can be extended to foreign firms: maximum hours of work per week, safety and hygiene, equal pay between men and women, and minimum wages. However, only "generally applicable" wage floors are binding for foreign firms. The destination-specific minimum wage only applies to firms that would pay their workers below that level otherwise; and it does not apply to self-employed. Other wage floors that are not generally applicable; and all labor regulations that are outside the "hardcore" of rules listed in the directive; do not apply to foreign firms.

Second, payroll taxes become destination-based if service contracts last more than a certain duration. This duration was 12 months until 2010, 24 months from 2010-2020, and 18 months since 2020. Since 2010, payroll taxes also become destination-based for companies located in border regions that post workers with temporary employment contracts.

Since 2020, the scope of domestic rules that can be be applicable to foreign firms has been extended by a new EU directive. Since 2020, posted workers must receive the same *pay* as domestic employees (including some bonuses and other components of compulsory salary) at the receiving firm and become covered by some collective labor agreements. This reform, pushed by Emmanuel Macron after his election in 2017, was based

on the argument that most of wage differences between origin and destination countries are driven by coutry-specific regulations, and that the minimum legal wage alone was not sufficient to impose similar standards to both domestic and foreign firms.

Enforcement Importing countries have no right to refuse the intervention of foreign supplier of services in their territory, but can control that the rules are enforced. They can perform inspections on job sites where the foreign firms are operating. They can also request that exporting firms fill out a form ("notification") when operating in their territory.[9] The enforcement of domestic standards is facilated by the fact that exported services are performed in the importing country's territory. This contrasts with the enforcement issues usually associated with social standards or responsible sourcing policies (Alfaro-Ureña et al., 2021), where importing countries can hardly control production processes abroad. This makes posting an interesting setting to study the effects of enforcing domestic labor market regulations on foreign firms.

While the enforcement of "social standards" is plausibly much stronger for posting than for other forms of trade, it is also likely that it remains lower than the enforcement of domestic regulations for domestic workers. For instance, violations of some EU labor regulations– e.g applicable minimum wages and maximum amount of hours– have been repeatedly documented in various policy reports. In practice, this means that I will always estimate "intent-to-treat" effects of changes in labor regulations, assuming perfect compliance of exporting firms engaged in the program.

2.2 Conceptual Framework of Trade in Services with Social Standards

I lay out a simple conceptual framework to clarify how labor market regulations may shape trade in physical services within the EU. The model serves two purposes: explaining the conceptual role of changes in labor market regulations on posting flows and guiding the empirical analysis of the labor market regulations reforms. The model suggests what regression to run, what the coefficients in that regression should identify and out-

[9] However, as stated in the EC Court of Justice jurisprudence "reporting requirements in importing countries should not serve the purpose of imposing higher barriers to foreign suppliers of services".

lines which endogeneity problems seem particularly worth worrying about.

Hourly Labor Cost There is a finite number of countries $i \in S$ and a continuum of services Ω_n that every country can produce. To produce services in any country j, firms in country i must pay a hourly wage w_i to their employees hired in country i. Firms must also pay payroll taxes τ_{ij}, and those payroll taxes vary by importing and exporting country due to specific rules in the posting program. Finally, exporting firms must also pay an additional wage component to posted workers to reach the minimum legal wage in the importing country $\bar{w}_j$. I call this additional wage component the posting allowance. This term is zero if the importing country does not have a minimum legal wage ($\bar{w}_j = 0$), if the exporting country's wage level is higher than the minimum wage abroad ($w_i \geq \bar{w}_j$), or if the service is produced at home ($j = i$). The hourly labor cost for services performed by workers posted from i to j is:

$$\begin{cases} \underbrace{c_{ij}}_{\text{labor cost to export from i to j}} = \underbrace{w_i}_{\text{wage in i}} + \underbrace{\tau_i \cdot w_i}_{\text{payroll taxes}} + \underbrace{\mathbb{1}_{w_i < \bar{w}_j}(\bar{w}_j - w_i)}_{\text{posting allowance for min. wage}} \\ \underbrace{c_{jj}}_{\text{labor cost to produce in j}} = \underbrace{w_j}_{\text{wage in j}} + \underbrace{\tau_j \cdot w_j}_{\text{payroll taxes}} \end{cases} \tag{1}$$

The purpose of this Section is to guide the empirical analysis by illustrating how rules on payroll taxes and minimum wages in the posting program could affect relative cost differences. To keep the conceptual framework as general (and simple) as possible, I follow Grossman and Rossi-Hansberg (2008) and do not take a stance at the determination of the equilibrium wage w_i and thus do not model wage-setting. It is worth noting, however, than in a standard Ricardian model like Balassa (1964); Samuelson (1964); each country has the same productivity in physical services but wages for service workers differ across countries because of differences in outside options that are set by wages (and productivity) in the tradable sector. In standard trade models, physical services can never be traded and therefore, wage setting in the service sector does not matter for international trade patterns. But posting allows trade in formerly "non-tradable" services, turning wage differences in services into a potential source of relative cost advantage.

Of course, an important question in this context is whether the outside option for workers sent from Poland to France is the equilibrium wage in France or in Poland. Grossman and Rossi-Hansberg (2008) and Rodríguez-Clare (2010) previously approached this question theoretically. In their models, offshoring allows to pay workers with the same productivity at different equilibrium wages (set in the foreign and home country). Both papers emphasize that immigration, by restricting wage discrimination between otherwise comparable foreign and domestic workers, does not generate the same "productivity " effect than offshoring where wage differences across countries can be exploited by firms. It is interesting to note that in workhorse trade models, the ability for firms to markdown wages of similarly productive workers is the source of efficiency gains from trade, while the common view in the labor literature would be that market-power over migrant workers is a source of inefficiency (Naidu et al., 2016).

In the context of posting, which is a form of offshoring through temporary migration, Muñoz (2024) documents substantial within-workplace differences in gross wages paid to posted and domestic workers; even after accounting for tenure, contract duration or productivity (e.g workers fixed effects). The wages of foreign workers are closed to fixed at the French minimum wage, which is enforced by the EU law, while comparable domestic workers are paid 30% more on average.[10] This suggests that there are enough institutional and information frictions to enable wage discrimination between posted and domestic workers.[11] This also suggests that competition between exporting firms is to weak to pull up wages of foreign workers as much as for domestic workers. This likely occurs because the share of posting firms remains small in destination countries, and because the labor market for posted workers is very segmented. It is worth emphasizing that wage discrimination between posted and domestic workers also reflects differences in regulations. For instance, a French worker (or regular immigrant hired through a French contract) will

[10]This refers to gross wages and does not account for additional differences in payroll tax rates.

[11]Posted workers are bound to their exporting firms; making it hard to switch jobs during the contracts. Their right to be posted is also based on their exporting firms. Furthermore, their employment contract (and related wages) is set before the posting contract. Albert and Monras (2022) also emphasize that migrants can be affected by their origin country index price, meaning that their reservation wage can differ from natives. Muñoz (2024) finds large wage discrimination between domestic and posted workers in France, but not between domestic and foreign-born workers employed through French contracts, consistent with the theory of Grossman and Rossi-Hansberg (2008) and Rodríguez-Clare (2010).

have to be paid extra for working at night, in the evening, outside or in the week-ends; and will be protected by additional firm-level or branch-level wage floors and regulations; but those domestic rules won't apply to posted workers.

Another key mechanism to bear in mind in this context is that wages can in principle adjust to tax reforms. The presence of nominal downward rigidities, in particular minimum wages, can however restrict the ability for firms to decrease gross wages after a tax hike. Similarly, targeted tax reforms (e.g at sectors or exporters) are often too narrow to lead to market-level wage adjustments (Saez, Schoefer and Seim, 2019). Empirically; the elasticity with respect to total wage costs (c_{ij}) will capture potential gross wage responses to tax reforms. I will also estimate this elasticity with respect to the change in the statutory tax rate (τ_{it}); which will capture the reduced form effect of payroll tax rates on posting flows without making any assumption on pass-through to net labor costs.

The impact of destination-based minimum wages on net labor costs is clearer as the rule directly targets gross wages paid to employees. However, there is a possibility that exporting firms might pay the higher destination-specific minimum wage during the posting contract and then reduce workers' gross wages upon their return, leaving net labor costs unaffected. Muñoz (2024) shows that exporting firms align workers' gross wages with the destination-specific wage floor during the posting contract, but wages return to pre-posting levels (and not lower) after the activity abroad concludes. This pattern suggests downward nominal rigidities on wages in the EU context, especially as numerous posted workers receive minimum wage levels in their origin countries.

Gravity I then use one of the most standard trade model (Eaton and Kortum, 2002) to illustrate how labor market regulations may shape the equilibrium flows of posting contracts in the EU. Services are produced by combining hours of labor with country i's efficiency in producing services n; denoted $z_i(n)$. Unit labor costs in sending countries are gross wages paid to workers divided by productivity. To supply services from country i to country j, firms also pay for bilateral mobility costs m_{ij}. The unit cost for posting services exported from i to j is given by:

$$\underbrace{C_{ij}(n)}_{\text{unit cost to export from i to j}} = c_{ij} \cdot m_{ij} \cdot \frac{1}{z_i(n)} \tag{2}$$

There is perfect competition across service suppliers. As in Head, Mayer and Ries (2009), each service is purchased from the country that offers the service at the lowest unit cost, including bilateral mobility costs. A service n is exported from i to j if and only if:

$$C_{ij}(n) \leq min_{i' \in S} \left\{ C_{i'j}(n) \right\} \tag{3}$$

Using the assumption of Frechet distributed productivity with $F_i(z) = exp\left\{ -\left(T_i z\right)^{-\theta} \right\}$, I can derive for each service n the probability that country i provides the lowest price service in country j. The density distribution of productivity together with the condition for optimal sourcing choices determines the total number of posting contracts from country i to country j. The share of services in country j performed by firms from country i is:

$$\lambda_{ij} = \frac{T_i \left(c_{ij} \cdot m_{ij}\right)^{-\theta}}{\sum_{k \in S} T_i \left(c_{kj} \cdot m_{kj}\right)^{-\theta}} = T_i \left(c_{ij} \cdot m_{ij}\right)^{-\theta} \Phi_j^{-1}, \tag{4}$$

where $\Phi_j = \left[\sum_{k \in S} T_i \left(c_{kj} \cdot m_{kj}\right)^{-\theta} \right]$. Denoting S_j the total number of labor services demanded in country j, the number of posting contracts exported by i to j is:

$$S_{ij} = S_j T_i (c_{ij})^{-\theta} m_{ij}^{-\theta} \Phi_j^{-1}. \tag{5}$$

Equation 5 summarizes the relationship between labor costs and cross-border supply of labor services.[12] The parameter θ is the elasticity of cross-border supply of services with respect to changes in wage costs c_{ij}.

Imposing domestic standards to foreign employees mimics the trade protection effect of a bilateral import tariff. To see this, consider France, an importing country with high redistributive standards funded by an average 40% employers' social security contribution rate, and high labor regulation standards with a 11 euros minimum legal hourly gross wage (60% of the median wage). If France requires that foreign firms pay the French pay-

[12] As any gravity model, this model can be solved in general equilibrium by using macro-level restrictions (e.g trade balance and market clearing), see Head and Mayer (2014).

roll tax rate when supplying services in France, the increase in wage cost will be high for Polish firms that previously faced a 15% payroll tax rate, while Belgian firms will not experience substantial changes given the similarity of tax rates in Belgium and France. Similarly, the posting allowance that foreign firms must pay to reach the French minimum wage will be large for firms located in low-wage countries, but is not binding for firms located in high-wage countries. The heterogeneity in bindingness of destination-specific minimum wages by exporting country is showed in Figure 2, using micro data on posted workers' wages. If imposing domestic regulations to foreign firms mimics the trade protection effect of a tariff, the incidence of this alternative trade instrument is different. Social standards do not mechanically increase collected revenues for importing countries. Rather, they are supposed to benefit foreign workers, while increasing prices for domestic customers.

This framework ignores several interactions betwen social standards and relative cost differences in services. First, labor market regulations solely influence foreign service demand via their impact on labor costs. But if consumers value higher social standards for foreign workers, or associate better protections for posted workers with more safety or better quality, social standards could also increase the demand for foreign services, even if the prices of those services increase due to higher regulations. Second, taxes and minimum wages only affects labor costs, although one could imagine that better social norms could influence countries' productivity in producing services too.

3 Data

3.1 Datasets on cross-border supply of labor services (S_{ij})

I use administrative social security forms ("A1") issued for each posting contract within the EU. This form is a mandatory document filed by foreign firms that workers must hold during their assignment abroad to prove their formal employment and insurance in the exporting country. If employers do not fill this form and non-compliance is detected upon job site inspection, the foreign firm will face a fine and legal pursuits, and the contract

will be interupted. Compared to standard custom data, this dataset directly measures the number of unit of labor (workers) involved in the production of the service abroad. There is also no minimum reporting threshold, which minimizes missing flows in my context.

I collected all posting forms issued and received by 25 European member states from 2007 to 2018 from the European Commission. The countries are Austria, Belgium, Bulgaria, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Croatia, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, Netherlands, Poland, Portugal, Romania, Sweden, Slovenia, Slovakia, United Kingdom. The dataset records posting flows for each origin and destination country each year. One limitation is that when workers are sent by their firm to more than one country in a given year; only one social security form is issued by the sending country; and this form cannot be linked to a specific receiving country. This means that this dataset under-estimates imports of labor services; but exports (and thus flows aggregated across exporting countries) are not affected by this measurement limitation. For more recent years, I observe the average duration of posting contracts by exporting countries. For a subsample of six exporting countries (Poland, Romania, Luxembourg, Lithuania, Czech Republic and Hungary), I obtained the same bilateral flows further disaggregated by sector categories.

In France, Belgium and Luxembourg, I further have access to micro registries of posted workers. Those datasets come from country-level registration tools that supplement the European forms in some receiving or sending countries. Compared to the EU-wide dataset, those datasets have a higher coverage (when focusing on imports) because they register all incoming posting contracts regardless of the number of countries the workers are serving during the year. They also provide more granular information on the duration of posting assignments; the wages paid to posted workers; and 5-digit sector activities of contracts.

In Belgium, foreign companies must file a posting notification (LIMOSA) when supplying a service there, and I have access to all posting contracts performed in Belgiun since 2010 by country of origin. In France, foreign companies must file a posting notification (DPD/SIPSI) when supplying a service there, and I have access to all posting contracts performed in France by sector and origin since 2005. Since 2017, the notification has to be filed electronically, meaning that I also observe disagregated posting contracts performed

in France for 2017-2020, with information on posting contracts' duration and associated wages.[13] In Luxembourg, I have access to a matched employer-employee dataset that covers the universe of workers and firms in Luxembourg with information on whether a given worker is posted abroad each month.

I use those additional data sources for several purposes in the paper: (i) obtaining measures of posting contracts at the 5-digit industry level to study sectoral reforms (ii) obtaining additional measures of aggregate imports of posting inflows (iii) studying the distribution of posting contracts' duration around regulatory discontinuities (iv) studying the wage distribution of foreign workers around regulatory thresholds introduced by the minimum wage regulation and (v) performing "out of sample" checks using an alternative data source to study the effects of the same reform.

3.2 Datasets on employers' labor cost (c_{ij})

I measure each component of hourly labor cost for each importing and each exporting country using data collected from Eurostat, taking into account the variations introduced by specific rules in the EU posting program. I measure average wages in each country using the labor cost indicator (LCI) dataset from Eurostat, available from 2009 to 2018. It measures the average hourly gross wage (in euros) paid by employers and is built from national firm-level administrative datasets. The LCI dataset also measures the non-wage component of labor cost. It is based on paid social security contributions and labor taxes minus subsidies received by employers. To distinguish social security contributions from other taxes and subsidies, I also collected social security contribution statutory rates for employers from the OECD Taxing Wages Dataset. This reflects more directly policy changes by recording the legal rates faced by employers in each country. Finally, I collected information on nationwide minimum legal wages for the same period.

Combining information on hourly gross wages, employers' effective labor tax rates

[13] Due to this change, there is a potential break in series in 2017. To be conservative and avoid overestimating posting inflows in France since 2017, I correct the series by using information on A1 posting forms from the European Commission where reporting requirements have not changed during the period. I compute the ratio between A1 and DPD/SIPSI forms in 2016, and constraint this ratio to remain equal in 2017. This enables me to compute how much of the change in DPD/SIPSI forms in 2017 is driven by the change in reporting requirement. I then use this factor to scale-down DPD inflows after 2017.

and minimum wages with the rules described in Equation 1, I can reconstruct the yearly hourly wage cost for employers exporting labor services from country i to country j. This requires the assumption that nationwide average wages are a good proxy for the equilibrium wages for workers supplying physical services. For instance, if the equilibrium wage for posted workers in the origin country is way above the average wage; I could wrongly infer that destination-level minimum wages are binding for exporting firms. Similarly, if domestic workers supplying services at home are paid at the minimum wage, I could over-estimate differences in wage costs between foreign and domestic firms.

Fortunately, micro-level data on posted and domestic workers' wage help to gauge the credibility of those assumptions. Figure 2 shows that most posted workers sent to France from countries where the average wage is below the French minimum wage are paid exactly at the French minimum legal wage. This is evidence that their equilibrium wage in the exporting country is such that the French minimum wage enforced by the EU policy is binding. On the contrary, French workers competing with posted workers are paid close to the French average wage level, and way above the French minimum wage.[14]

I merge my measure of c_{ij} with the EU-wide dataset on bilateral posting flows. The final dataset is a gravity dataset measuring the number of exported service contracts for each importer-exporter pair with corresponding measures of hourly labor costs.

4 Some Descriptive Facts on Labor Costs and Trade in Services in Europe

4.1 Wage Cost Differentials

Figure 1 illustrates the disparities in gross wages, payroll taxes, and minimum wages within the EU. Despite the absence of regulatory barriers to trade and migration in the single market, Panel A shows that gross hourly wage differences (that partially reflect differences in productivity levels) in the EU are large. Panel B adjusts those wages by prices.

[14] In 2018 the average wage of workers at firms importing posting services was 21.1 euros while the nationwide average hourly wage was 24 euros (Muñoz, 2024).

There is less dispersion in real than nominal wages but the EU still experiences substantial heterogeneities in real wages. Firms located in different countries face different level of equilibrium wages w_i when recruiting workers to perform the same service contract.

Panel C and D show the differences in payroll taxes and minimum wages in the EU. For instance, France and Luxembourg have relatively similar levels of gross wages, but payroll taxes are three times higher in France. Countries with similar levels of wages do not mechanically impose similar minimum wages. The minimum wage is set at 60% of the median national wage in France, against 45% for the Netherlands. Finally, some countries like Sweden, Italy or Germany (before 2015) do not have a minimum wage established by law and choose branch-level or firm-level wage floors instead. Figure 1 thus highlights the diversity in social insurance systems and national preferences across EU member states.

Of course, Figure 1 only captures some of the heterogeneities in labor market regulations across EU member states. For instance, countries also have different rules regarding severance payments, employment termination or worker protections and those regulations also matter for net labor costs. I will not be able to directly measure those sources of wage cost heterogeneity nor to isolate their causal effects on service trade. But my double and triple difference designs will control for those differences by only exploiting changes in the components of wage costs that I can accurately measure.

4.2 Trade Specialization in Services

Figure 3 investigates which EU countries specialize in trading services, regardless of the mode of supply. The assumption is that low-wage countries can have a comparative advantage in services because personnel costs amount to a larger share in the costs of services. Those comparative advantages should be reflected in trade balances. Panel A of Figure 3 shows that EU members with higher GDP per capita have higher balances of trade in goods. Conversely, the poorer countries in the EU have significantly higher balances of trade in services. The relationship holds when focusing on differences in payroll taxes only, abstracting from differences in wage (and potentially productivity) levels.

In Panel E, I derive a more accurate measure of a country comparative advantage in exporting services, that is the revealed comparative advantage (RCA) ratio for services. A

ratio above one indicates that a country has a revealed comparative advantage in services (compared to the rest of the EU countries). The figure shows a clear decreasing pattern: low payroll tax rates are associated with a stronger comparative advantage in services. Even if Figure 3 has no causal meaning, those simple correlations suggest that differences in the tax treatment of labor may be reflected in trade specialization in services; even when not focusing on "physical" services only.

5 Reduced-Form Estimates of Posting Responses to Labor Taxes and Minimum Wages

I now turn to the estimation of posting responses to changes in labor taxes and minimum wages. I start the analysis by showing reduced-form graphical evidence of the impact of labor market regulations on cross-border trade in physical services. First, I study cross-country correlations between labor cost differentials and posting flows. This provides suggestive evidence that "social standards" matter for the geography of trade in services in the long-run. Second, I consider country-specific salient reforms in minimum wages and labor taxes that create compelling identifying variations and provide conclusive evidence of this relationship in the medium-run.

5.1 Steady-State Correlation Between Posting Flows and Labor Costs

I first study the correlation between hourly wage costs and trade in physical services. The model described in Section 2.2 predicts that exports of labor services should be larger within country-pairs where the total wage cost of exporting firms is much lower than that of domestic firms.

I show in Figure 4, Panel A, the binned scatter plot of (log) bilateral posting flows and (log) destination-origin labor cost differentials for all country pairs during the 2009-2018 period.[15] I depict the best linear fit using a univariate regression. A tight aggregate relationship holds between posting flows and labor cost differentials: posting services

[15]Figure A.2 shows the same relationship in levels.

tend to be exported from low to high labor cost countries, with a cross-sectional correlation between (log) posting flows and (log) destination-origin labor cost ratios of 0.61(.08). This means that a 1% higher labor cost differentials between two countries is associated with 0.6% more bilateral trade in physical services between those countries. Panel B shows an equally large correlation when focusing on differentials in the non-wage component of labor costs, e.g social security contributions and taxes.[16]

If the cross-sectional relationship can be informative of the steady-state impact of labor costs on cross-border trade in labor-intensive services, many factors could be simultaneously correlated with employers' labor costs and the magnitude of posting flows, including differences in productivity levels. Those static comparisons across countries also load the effects of unobserved differences in other components of labor regulations and wage costs, for instance rules on employment termination. To properly estimate the causal effect of labor market regulations on trade flows, it is crucial to exploit exogenous variations in labor costs while controlling for these simultaneous factors. Next, I consider quasi-experimental variations created by tax and minimum wage reforms to alleviate these identification threats.

5.2 Country-Case Studies: Graphical Evidence

This section studies posting responses to large and exogenous reforms in labor market regulations. I study four reforms: (i) a large reform in employers' social security contributions in one of the largest receiving countries (Belgium) (ii) the introduction of destination-based payroll taxation for temporary employment agencies exporting posting services in border areas (Luxembourg) (iii) the introduction of destination-based payroll taxation for contracts exceeding a certain duration (France) (iv) a minimum wage reform impacting firms supplying services in manufacturing sectors (Germany). For each country specific case study, Table 1 presents elasticity estimates using a difference-in-differences comparison of the treatment country and the control country before and after the reform. Those

[16]The elasticity is equally large when weighting cross-border trade flows by wages (Figure A.3) and duration of posting assignments (Figure A.6) or when using the (log) of employers' social security contribution statutory rates ratio as an alternative measure of labor costs (Figure A.4). Figure A.5 uses the log odd ratio $\ln(S_{ij})/\ln(S_{jj})$ as an alternative measure of bilateral trade; the resulting elasticity is .52(.08).

estimates capture medium-term responses as I compare outcomes a few years before the reform to a few years after the reform. Tests for pre-existing trends and reforms anticipation validate using payroll tax and minimum wage reforms as a source of identification.

5.2.1 The Belgian Tax Shift

I first study a large exogenous payroll tax cut reform in one of the main importing 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.[17] The payroll tax cut was implemented by the Belgian government to decrease the budget deficit and applied to the entire Belgian labor market. The tax change was not introduced in response to posting-specific trends, alleviating worries that the tax cut would affect the volume of services imported by Belgium through other channels than the policy change itself. The reform was meant to be revenue neutral meaning that the payroll tax rate cuts were compensated by increases in VAT, excise duties and dividend taxation.

To the extent that the payroll tax cut in Belgium decreased wage costs for Belgian firms, the model predicts that Belgium should import less posting services after the reform. To test this prediction, I rely on a difference-in-differences setting where I compare labor services imported by Belgium to labor services imported by a similar country, before and after the reform. I use France as my main control group, because of its country-specific notification tool (similar to that of Belgium) that allows me to observe aggregate imports of posting services in both countries. France and Belgium also share a border and a language and are among the largest importing countries of posting services. The identification assumption is that postings to France and Belgium should be affected by similar time-varying factors, while only Belgian demand for posting services should be exposed to the tax cut. Pre-reform trends allow me to gauge the plausibility of this assumption.

Figure 5 shows graphically the differences-in-difference setting provided by the re-

[17] 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.

form. It plots the number of posting contracts from 2010 to 2018 (normalized to one in 2015 just before the reform implementation) imported by Belgium (treatment) and by neighboring France (control). The dashed line (and right axis) shows the evolution of employers' statutory payroll tax rates in Belgium and France, before and after the reform. Payroll taxes decreased by roughly 30% in Belgium between 2015 and 2018, but remained stable in France during the same period.[18] Belgium and France were importing posting services at a similar trend before 2015, suggesting that postings to France provides a credible comparable counterfactual for postings to Belgium. Imports of posting services started to slow down in Belgium immediately after the reform, while postings to France kept growing at a similar rate than before 2015. The figure suggests that the payroll tax cut significantly slowed down imports of services in Belgium relative to France.

I compute the corresponding elasticity from a 2SLS regression of the form $\log S_{jt} = e \log c_{jt} + \gamma_t + \gamma_j + \varepsilon_{jt}$, instrumented with $\mathbb{1} \cdot (j = Belgium) \times \mathbb{1} \cdot (t \geq 2015)$. The implied estimated reduced-form elasticity of posting flows with respect to destination-specific payroll tax rates (τ_{jt}) is large with a point estimate of 1.45(.3). I then compute this elasticity with respect to total labor cost (c_{jt}), instrumented with the reform interaction. This specification now accounts for endogeneous changes in equilibrium gross wages w_{jt}, although Figure A.7 shows no distinguishable wage responses to the reform. The elasticity with respect to the total wage cost is larger with a point estimate of 3.4(.7).

Theory predicts that the payroll tax cut should also boost exports of posting services from Belgium. Figure A.8 confirms that the reform had similar (but opposite sign) effects on exports of labor services from Belgium. The elasticity of posting exports with respect to the (instrumented) total wage cost in exporting countries is -3.3(1.5). High-wage countries like Belgium and France however export little volume of labor services, leading to noisier measures of posting flows and visually less compelling pre-trends.[19]

The tax shift reform was not targeted at firms operating in specific sectors and is therefore not immune to the identification challenges outlined in the introduction. One worry

[18] In 2013, France introduced a targeted tax credit (CICE) for firms employing workers paid less than 2.5 times the minimum wage (Carbonnier et al., 2022), but tax credits do not appear in the measure of statutory payroll tax rates. The tax credit has been turned into a cut in payroll tax rates in 2019.

[19] In Appendix C, I also study the effects of a large payroll tax cut in an origin country (Slovenia) on exports of posting services, and find estimates in the same ballpark, that also range from -1.5 to -3.

is that that reform is broad enough to generate general equilibrium effects that affect the demand for foreign services through other channels than the effects on labor cost differentials. Figure A.10 repeats the analysis using imports as a fraction of GDP as an alternative outcome variable, which should capture any simultaneous changes in Belgium aggregate demand relative to France. Posting imports (measured in percent of GDP) follow parallel trends until 2015 and start to diverge right after that Belgium lowered its payroll taxes. Figure A.9 investigates the effects on trade in goods; which should be less sensitives to taxes on labor (because more capital intensive). I find no discernable responses to the change in Belgian payroll taxes when focusing on trade in manufacturing goods.[20]

5.2.2 The EU Regulation for Destination-Based Payroll Taxation

I next study a EU reform that induced a sharp variation in the wage cost for firms exporting labor services *within* a given exporting country. A EU regulation was implemented in May 2010 to restrict the payroll tax exemptions granted to foreign firms engaged in the posting program, in contexts that could be interpreted as (legal) tax avoidance. Before the reform, temporary employment agencies located in the lower-tax side of the border region (e.g Luxembourg) could register French workers under Luxembourgish contracts and immediately send them back to France as posted workers; which allowed them to avoid French labor market regulations and taxes. Such behavior was akin to "profit-shifting" but affected the (administrative) location of labor instead of capital.

To end those practices, the new regulation required that firms located in border regions (*"regions transfrontalieres"*) pay payroll taxes in the destination country when supplying their temporary services abroad. More specifically, those firms must pay destination-specific payroll taxes if they (i) post a worker that has not been affiliated to the home country social security system for at least a month or (ii) post a worker to its own country of residence (e.g French worker posted to France). Such practices were mostly documented between France and Luxembourg before the reform, and occured almost exclu-

[20]Figure A.11 shows robustness of the analysis combining the EU-wide dataset to measure imports of posting contracts and the Abadie et al. (2010) method to build an alternative control group using all alternative importing countries. The effects are qualitatively similar; the elasticity is 0.6(.22) instead of 1.45(.32) in the main figure.

sively through temporary employment agencies (Belkacem and Pigeron-Piroth, 2016).[21] Truckers employed in Luxembourg and driving outside the country could also be affected by the reform (transportation is the second highest posting export category in Luxembourg after temporary employment agency services). However, due to the highly mobile nature of international transportation and the difficulty in determining in which country international drivers "work", a 10-year exemption was granted by the EU to firms operating in the sector. [22] The 2010 change in EU regulation thus introduced an exceptionally narrow but sharp increase in labor taxes for some exporters, but not others, keeping other determinants of foreign and domestic supply of labor services constant.

To study the effects of this reform, I use administrative matched employer-employee data for all firms located in Luxembourg merged with information on all posting exports since 2006. Using this dataset, I can measure the number of (unique) workers employed in Luxembourg each month, with information on whether those workers are "posted" or not in that given month. The dataset also has 5-digit sector codes for each establishment. Hence I can measure the employment stock (in full time equivalent) for services supplied at home and abroad, in each sector.

Figure 6 shows graphically the differences-in-difference setting provided by the reform. The top panel plots the yearly number of temporary employment contracts in Luxembourg from 2006 to 2017 (normalized to one in 2009 just before the reform implementation) supplied abroad through posting (treatment) and domestically (control). I also show the sharp variation in payroll tax rates induced by the reform (dashed line, right y-axis). Statutory payroll tax rates for temporary employment agencies increased from 15 to 44 percent for services exported through posting (due to destination-level taxes being

[21] 82% of temporary employment agency workers in Luxembourg were French residents (ULEDI); this number is 20% when focusing on total private employment in Luxembourg. Just after the publication of the EU regulation, the Luxembourgish social security sent an official letter to all temporary employment agencies in the country to remind employers that they should affiliate their workers in the destination country when posting them abroad after May 2010 ("CCSS/notedetachement"), which shows this sector was the most targeted by the new rule. In French data, the majority of French workers posted workers are sent from Luxemboug and through temporary employment agencies.

[22] Those exemptions ended in April 2021 and sparked a wave of protests amongst workers and employers organizations in the international road transportation transport (see Parliament answers and debate 2021n3932/3966 for instance).

higher), but stayed constant for contracts performed in Luxembourg.[23] The identifying assumption is that services performed at home or abroad should be exposed to similar demand and supply shocks and should follow similar trends absent the reform.

The two series followed parallel trends before the reform, suggesting that services supplied domestically provide a credible counterfactual for exports of temporary employment services from Luxembourg. The series start to diverge immediately after the 2010 reform. The year after that the EU regulation imposes destination-based payroll taxes for posted workers, the number of temporary employment services supplied abroad through posting decreased by 40% compared to the pre-reform level. In comparison, the number of temporary employment contracts performed domestically increased during the same period. To confirm that the reform caused the change in service exports patterns, Figure A.13 shows the equivalent of Figure 6 using monthly frequency instead. The drop in postings occurred in the exact month following the new EU regulation, while both series were following parallel trends in months preceding it. This is evidence that the policy-driven change in payroll tax rates is driving the change in posting exports from Luxembourg. The high-frequency data confirms the lack of anticipation of the reform, which contrasts with usual findings on tariffs (**?**).

I estimate the corresponding elasticity with respect to the change in wage costs. I obtain this elasticity from the 2SLS model $\log S_{LUjt} = e \log c_{LUjt} + \gamma_t + \gamma_j + \varepsilon_{jt}$, where S_{LUjt} is the total number of temporary employment services produced by firms in Luxembourg that are supplied domestically (e.g to $j = LU$, control) or abroad (e.g to $j =$ abroad, treated). To exploit the exogeneous shift triggered by the reform, the wage cost is instrumented with the reform interaction $\mathbb{1} \cdot (j = \text{abroad}) \times \mathbb{1} \cdot (t \geq 2010)$. Because the reform introduces within-sector variations in labor taxes over time, the inclusion of year fixed-effects in this specification filters-out all general equilibrium effects in Luxembourg– e.g any i-specific time-varying term in Equation (5)– that affect similarly domestic and foreign

[23] I use the yearly observed decomposition of posting exports from Luxembourg by destination countries in the EU-wide A1 dataset to compute the implied change in payroll tax rate following the reform. The Luxembourgish micro dataset does not record the destination country for each posting contract. This captures potential changes in the composition of destination countries after the reform. I assume that all postings in temporary employment agency sector are affected by the reform, which gives me an upper bound for the implicit change in payroll tax rates.

demand for temporary employment services.

The reduced-form elasticity of posting flows with respect to the change in statutory payroll tax rates reported in the figure is large and significant, with a point estimate of -1.3(.13). This is very similar to the point estimate obtained exploiting the change in payroll tax rate in Belgium.[24] Using (instrumented) total wage cost in the regression yields a much larger elasticity of -5.3(1.9) three years after the reform (a similar time-window than in the Belgian reform), and an elasticity of -8.5(1.39) eight years after the reform. In contexts that make "payroll shifting" easier for firms, for instance in border regions or in the temporary employment sector where workers can be hired very flexibly, exports of labor-intensive tasks thus appear to be very responsive to labor market regulations differentials.

Figure 6, Panel A, shows that imposing domestic payroll taxes to exporting firms located in Luxembourg led to an immediate collapse of their exports, relative to domestic activity in the same sector. Despite the absence of differential trends before the reform, the drop in posting exports in 2010 could be caused by a simultaneous shock affecting the demand for services abroad. To test this assumption, I next move to a triple differences design, looking at the differential evolution of foreign and domestic activity in the international transportation sector that was mostly sheltered from the reform. Figure 6, Panel B plots the yearly number of contracts in the transportation sector in Luxembourg from 2006 to 2020 (normalized to one in 2009 just before the reform implementation) posted abroad (placebo treatment) and supplied domestically (control). In this sector where posting is also prevalent, but that was not targeted by the EU regulation, posting contracts did not decline after 2010 compared to domestic activity. The implied (placebo) elasticity is zero and is statistically different from the elasticity estimated in the treated sector.[25]

Using the placebo sector allows me to directly relax the parallel trends assumption required for identification in Figure 6, Panel A, by controlling for potential differences in pre-trends. Specifically, I can compare services exported versus supplied domestically

[24] I also find no evidence of wage responses in the Luxembourgish context. This is plausibly because most workers with posted from Luxembourg in the temporary employment sector are paid at the minimum wage; for instance 90% of workers posted from Luxembourg to France earn wage between 1 and 1.2 times the Luxembourgish minimum wage.

[25] I follow Kleven et al. (2013) and compute the placebo elasticity using the same tax differential as for eligible sectors in panel A of Figure 6.

in the temporary employment sector versus the transportation sector, before and after that payroll taxes increase for exports of temporary employment services. Formally, I estimate the reduced-form elasticity from $\log S_{LUjst} = e \log c_{LUjst} + \gamma_{jt} + \gamma_{st} + \varepsilon_{jst}$, instrumented with the three-way reform interaction $\mathbb{1} \cdot (j = \text{abroad}) \times \mathbb{1} \cdot (t \geq 2010) \times \mathbb{1} \cdot (s = \text{temp. agency contract})$. The estimated elasticity with respect to the payroll tax rate is large and statistically significant at the one percent level even after controlling for those additional fixed effects, with a point estimate of -1.37(.08).

Another way to relax the parallel trends assumption used in Figure 6, Panel A, is to investigate the effects of the reform on *imports* of posting services from Luxembourg in importing countries. Specifically, comparing imports of posting services by origin country within a given destination allows to filter-out any unobserved foreign demand shock that could drive the decline in Luxembourgish exports of labor-intensive services. Figure A.14 shows this alternative comparison in France, the main importer of Luxembourgish labor services before the reform.[26] It plots French imports of labor services from Luxembourg (red, treated) and a synthetic country (blue, control), before and after the reform. After the reform, France cut by half its imports of posting services from Luxembourg. At the same time, French posting imports from other countries did not deviate from their pre-2010 trend. This confirms that the drop in imports of labor-intensive services from Luxembourg is driven by the EU regulation rather then negative shocks affecting the demand of French customers.

Overall, the graphical evidence presented in this section shows large causal effects of labor taxes on exports of labor-intensive tasks. Clearly, Luxembourgish temporary employment agencies were mostly competitive because of their lower tax rates. After this tax advantage was neutralized by the EU reform, their exports dropped dramatically.

5.2.3 The Change in Payroll Tax Exemption Duration Threshold

Exploiting variations in tax rates across countries over time and within-country over time, I showed that labor tax rates shape trade competitiveness in labor-intensive services. I

[26] France imported 71% of all posting services exported by Luxembourg in 2009, the year before the reform.

now turn to variations in payroll taxes caused by duration thresholds set by the EU regulation. For the same importing-exporting-firm cell, payroll taxes vary from origin-based to destination-based if the contract lasts more than a given duration. In the presence of trade responses to labor taxes, the duration of posting contracts should exhibit discontinuities around the regulatory threshold associated with a change in tax rates, especially for services supplied in high-tax countries.

To test this assumption, I use the exhaustive micro dataset on all workers posted to France from 2017 to 2021. For each posting contract, I observe the exact duration of the service contract performed in France each year.[27] Furthermore, France has the top level of payroll tax rates in the EU (Figure 1, Panel C), meaning that all exporting firms, regardless of their origin country, should have incentives to avoid paying French taxes by not crossing the duration threshold. In practice, we expect to see an excess of posting contracts that stop exactly at the duration threshold to avoid the corresponding change in wage costs.

Figure 7 plots the distribution of posting contracts' duration, each line corresponds to the year when the contracts started. In 2017, the distribution exhibits a spike just below the 24-month threshold, which corresponds to the tax-related threshold for that year (e.g the "notch" in the average payroll tax rate faced by foreign firms).[28] One issue to interprete this "bunching" as behavioral responses to discontinuities in tax rates is that distortions around local thresholds can be driven by other unobserved factors than the underlying discontinuity in tax incentives itself (Kleven, 2016). For instance, the 24-month threshold could coincide with a reference point for exporting firms and workers. In that case, the observed distortion is not driven by the change in average tax rate at the threshold, but by other confounding discontinuities located at the same threshold.

To rule-out this explanation, I exploit the fact that the threshold was moved to 18 months by a new EU regulation introduced in July 2020.[29] The EU posting trade program

[27] In this dataset, a contract can be identified as the combination between a unique posted worker, a unique French client, a unique exporting firm, and a unique start and end date for the posting assignment.

[28] Note that only 10% of posting contracts last more than a year, meaning that this threshold does not affect most firms.

[29] The new regulatory threshold was first introduced in a EU Directive voted in 2018, but member states had until July 2020 to adopt it in their national law. I thus focus on 2017 as the "pre-reform" distribution, since in that year the 18-month threshold was not associated with any change in perceived or actual regulation.

thus not only creates sharp discontinuities in the level of payroll tax rates applying to exporting firms with different duration of activity abroad, it also creates exogeneous changes in those discontinuities over time. I can thus verify that bunching follows the change in the tax threshold. The red dotted line in Figure 7 plots the distribution of contracts' length starting in 2020. A substantial bunching in the distribution appears at the new regulatory threshold while the excess mass at the old threshold decreases substantially. This confirms that the prime driver of bunching responses at the regulatory threshold comes from the corresponding notch in payroll tax rates. Overall, the bunching evidence presented in Figure 7 confirms the presence of substantial responses to origin-destination payroll tax differentials which is consistent with the difference-in-differences analysis.

5.2.4 The German Minimum Wage Reform

Using three quasi-natural experiments, I showed evidence of large and persistent posting responses to higher employers' payroll taxes, with elasticities above one. Next, I investigate how increasing exporting firms' wage costs through minimum wages, rather than payroll taxes, affect international competition for labor-intensive services in the EU.

The country case study focuses on Germany where no nationwide minimum legal wage was in place until 2015. In Germany, only construction-related industries were entitled to a minimum legal wage regulation at the sectoral level since 1996.[30] Other sectors had wage floors for their domestic workers agreed at the firm or branch level: around 55% of German domestic workers were covered before 2015 (Dustmann et al., 2022). However, those standards were legally not "generally applicable" and therefore did not apply to posted workers employed by foreign firms. For instance, firms located in Romania were allowed to employ workers paid at 2 euros per hour (the minimum legal wage in Romania) while supplying services on Germany's territory. One salient example is given by

[30]The destination-based minimum wage regulation for posted workers was implemented by a European Directive in 1996 and was 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 thus been implemented through the addition of branches in the AEntG scope. This anecdote shows that "social standards" in the posting policy led to the introduction of sectoral minimum legal wages for domestic workers as a way to protect domestic labor markets from foreign competition; in countries that previously had no nationwide wage floors.

the meat processing industry, that had no industry-level collective agreements to set minimum legal wage standards before 2015 (Erol and Schulten, 2021). In this sector, posted workers' average wages were extremely low, around 3 euros per hour against 16.2 euros per hour for workers employed by German firms (Doelfs, 2012).[31] Before 2015, posted workers represented 50% of the worforce in the German meat processing industry (Wagner and Hassel, 2016; Wagner, 2018). This situation led to vivid tensions at the EU level. In 2013, Belgium filed a complaint at the EU court of justice, arguing that Germany was gaining "unfair competitive advantage" in the food-processing sector by using the absence of a minimum legal wage as a way to import cheap labor services from low-wage countries. This episode laid the ground for the project of a minimum legal wage in Germany. [32]

In August 2014, following pressures from the German government and the EU, the meat processing industry implemented a minimum legal wage (7.75 euros per hour) in the sector. In January 2015, a national minimum legal wage of 8.5 euros per hour was then introduced and applied to all sectors in Germany. When it was introduced, about 15 percent of German employees earned less than that amount (Dustmann et al., 2022). One important consequence of this nation-wide reform was the large change in rules for foreign firms operating in non construction-related sectors. Those firms had to increase their workers' wages in order to reach 8.5 euros per hour. The reform was only binding for foreign firms previously paying their workers less than 8.5 euros per hour. Furthermore, foreign firms supplying construction services were only marginally affected because they were already constrained by the German sectoral minimum wage in construction that was above 8.5 euros per hour in 2015.

To study this reform, I use data on bilateral *sectoral* posting exports that are only available for a subset of six sending countries: Poland, Luxembourg, Hungary, Czech Republic, Lithuania, and Romania. I observe posting services exported by firms located in those countries in both manufacturing and construction sectors, to all destination countries. Panel A of Figure 8 shows the difference-in-differences setting provided by the reform.

[31] Wages of posted workers could be as low as 1.50 euros per hour (Hassel, Steen Knudsen and Wagner, 2016).

[32] Wagner (2018) provides an in-depth historical perspective on the German meat processing industry and the role of exploitative labor conditions, in particular of posted workers, in its economic development.

It plots the yearly number of posting services exported to Germany by those countries (normalized to one in 2013 the year before the reform) in the construction sector (blue line, control) and manufacturing industries (red line, treated), before and after the minimum wage reform depicted by the vertical red line. The identifying assumption is that postings in construction and manufacturing should be exposed to similar yearly shocks and should follow similar trends in the absence of the reform that distorts the minimum wage regulation for foreign firms in the non-construction sector only. The figure shows that postings to Germany in construction and manufacturing were similar in 2012, but the two series started to diverge in 2014 when the minimum legal wage was implemented in the meat industry. Postings to the German manufacturing industries decreased further in 2015 when all manufacturing industries became treated by the minimum wage reform. At the same time, imports of posting services in construction stayed stable and close to their pre-reform level. The corresponding estimates indicate that imports of services in Germany differentially decreased by 60% in sectors treated by the reform.[33]

The implied reduced-form elasticity can be obtained from the 2SLS regression $\log(S_{st}) = \alpha + e\log(c_{st}) + \gamma_t + \gamma_s + u_{st}$ where S_{st} denotes aggregate exports of posting services to Germany in sector s and c_{st} is the average wage cost in exporting countries. To exploit the exogeneous shift introduced by the policy change, I instrument wage cost of exporting firms by the reform interaction $\mathbb{1}(s = \text{manufacturing services}) \cdot \mathbb{1}(t \geq 2014)$. Like in Figure 6, year fixed-effects control for nationwide demand and supply shocks in Germany. The estimated coefficient, reported in the figure, is again large and statistically significant with a point estimate of -1.34(.43).[34]

To verify that the the drop in German imports of manufacturing services is not driven by sector-specific shocks that would affect the demand for those services even in the absence of the reform, Panel B plots the same differential evolution in another major importing country. France, a neighboring country with similar size and exposure to posting inflows, kept importing construction and manufacturing labor services at the same rate

[33]This is obtained from a regression of (log) German imports of posting services in each of the two sectors on the reform interaction term (equals to one in manufacturing services after 2014).

[34]Figure A.15 shows the same analysis but excluding imports from Romania; because German nationwide restrictions to postings and migration were lifted in 2014 for Romanian citizens (see Table B.3). The graphical patterns and estimated reduced-form elasticity are similar.

during the same period. It is only in Germany that imports of manufacturing labor services decreased relative to imports of construction services.

A remaining concern is that the minimum wage reform affects the demand for posted workers in manufacturing sectors through other channels than through the direct change in wage costs for foreign firms. To make progress on this issue, I take advantage of exogenous variations *within* the treated industry across sending countries. The identifying variation comes from the *kinked* relationship between the wage cost shock caused by the reform and the pre-reform wage level in sending countries, illustrated in Panel A of Figure 9. The change in German regulation makes exports more costly in exporting countries where the new minimum wage is binding compared to countries where it is not. One identification strategy is thus to compare how *within* the treated sector (manufacturing services) posting flows from exposed versus non-exposed countries evolved differentially in Germany, relative to the non-exposed sector, before and after the reform. In spirit, this is similar to comparing the employment responses of German workers earning more or less than the new minimum wage before the reform as in Dustmann et al. (2022).

To do so, I estimate separately for each sending country an equation of the form $\log(S_{ist}) = \alpha + \gamma \cdot \mathbb{1}(s = \text{manufacturing}) \times \mathbb{1}(t \geq 2013) + \mathbb{1}(s = \text{manufacturing}) + \mathbb{1}(t \geq 2013) + u_{ist}$ where S_{ist} denotes exports of country i to Germany in sector s. The coefficient γ captures the effect of the reform on country i's exports of labor services to Germany in the treated sector (relative to the control sector). Panel B of Figure 9 shows the estimates of γ in the y-axis and the change in wage cost caused by the reform (in the treated sector) for each exporting country on the x-axis. Estimated posting responses to the minimum wage reform increase monotically with bindingness of the reform, capturing well heterogeneous exposure to the change in minimum wage. Exporting countries that faced the largest change in wage costs due to their (low) pre-reform level of wages at home (countries on the left of the x-axis) reduced more their exports to Germany in the exposed sector. In contrast, the treatment effect for the exporting country where the new German minimum wage was not binding (Luxembourg), plotted in light blue, is not statistically different from zero. This confirms that the change in wage costs for exporters located in low-wage countries are the prime driver of the aggregate effect showed in Figure 8.

As a falsification test, I finally repeat the same analysis focusing on "placebo" importing countries that did not change minimum wage requirements during the same period. The placebo trade responses, for each exporting country, in Germany's neighboring countries (France, Netherlands and Austria) are plotted in Figure A.16. Those responses are not statistically different from zero. The estimated coefficients are not decreasing by origin-specific wages when focusing on the placebo importing countries, confirming that Figure 9 captures the differential effects of the German reform on posting exports, rather than a mechanical pattern that would be observed even without the reform.

It is worth emphasing that Dustmann et al. (2022) find very limited effects of the same reform on *German* employment (recall that posted workers do not appear in German employment statistics), which is consistent with a monopsony power model of the labor market where firms face un upward-sloping labor supply curve. The effects presented in Figure 8 and Figure 9 are not necessarily inconsistent with their findings. First, the implied change in wage costs was much larger for foreign than domestic workers. The reform caused an average 6% increase in wages for German workers previously earning less than 8.5 euros per hour, the increase was 10% for the most affected domestic workers (Dustmann et al., 2022). Although I do not observe wages paid to posted workers in Germany, the reform (if perfectly enforced) should have mechanical increased posted workers' labor costs by 40% on average; and more than doubled wage costs for foreign firms located in the poorest countries.[35] Alfaro-Ureña et al. (2021) emphasize that with monopsonistic labor markets, imposing higher standards to exporting firms increases their employment as long as the implied wage increase is moderate. Second, that the reform shrinked foreign firms' competitiveness in supplying services through posting (as showed in Figure 8 and 9) does not automatically imply that their workers did not reallocate to more productive firms (at home or in Germany) as showed by Dustmann et al. (2022) for German workers. For instance, Mense-Petermann et al. (2022) document that the main German meat producer employs some previously posted workers under German employment contracts since the 2014 reform. In this case, enforcing domestic standards could also push labor

[35]This is a conservative estimate (e.g lower bound) by assuming that posted workers were paid at origin-specific average wages instead of minimum wages before 2014.

markets closer to the efficiency level by reducing the monopsony power of foreign firms over their workers in exporting countries.

6 Gravity Estimation and Policy Counterfactuals

This section presents results based on a theory-consistent estimation of the gravity model for cross-border labor service trade, exploiting all sources of variation in wages, payroll taxes and minimum wages in 25 member states over the period 2009-2018. The model indicates that posting flows are described by the following expression:

$$S_{ijt} = \exp\left\{-\theta \log\left(c_{ijt}\right) - \theta \log(m_{ijt}) - \log\left(\Phi_{jt} S_{jt}\right) + \theta \ln T_i\right\} \tag{6}$$

where c_{ijt} is the total hourly wage cost employers must pay to export physical services from i to j in year t, m_{ijt} are bilateral trade costs that can vary over time or not, and $\Phi_{jt} S_{jt}$ is the multilateral resistance term described previously. Taking this equation to the data means that I will estimate a specification of the form:

$$S_{ijt} = \exp\left\{-\theta \log c_{ijt} + \gamma_{ij} + \gamma_{it} + \gamma_{jt} + \varepsilon_{ijt}\right\} \tag{7}$$

where γ_{ij}, γ_{jt} and γ_{it} are fixed-effects defined respectively at the origin-destination, destination-year and origin-year level. The structural parameter θ is primarly identified by two types of variations. First, *origin-specific* payroll tax reforms *within* receiving countries: services posted from different countries are subject to different taxes in the same receiving country and those taxes vary over time. Second, *origin-destination* minimum wage variations: workers posted from different countries are affected differentially by destination-level changes in minimum wages because of different initial level of wages.[36]

I estimate Equation (6) at the country-level (one observation by destination-origin-year cell): hence I do not adjust c_{ijt} for the sector$\times$year preferential schemes studied in the country-specific case studies. For instance, destination-based payroll tax rates specific

[36]For instance, consider three firms located in three different countries supplying services to clients in j. The first firm pays $\bar{w}_{jt} + \tau_{1t} w_{1t}$, the second pays $\bar{w}_{jt} + \tau_{2t} w_{2t}$ and the third pays $w_{3t} + \tau_{3t} w_{3t}$ (because $w_{3t} > \bar{w}_{jt}$). Any change (reform) in $\bar{w}_{jt}$ affects the total wage cost of those three firms differentially.

to temporary employment agencies in border regions is not reflected in the nationwide measure of τ_{it} in Luxembourg. Similarly, the German minimum wage reform in 2015 will be reflected in my nationwide measure of $\bar{w}_{jt}$ but not the sectoral-level minimum wages for construction in place before that year.

This has two implications for interpreting the theory-based estimates of θ. First, due to measurement error, the elasticities from Equation (7) will be biased towards zero and will be lower bounds for the reduced-form estimates presented in Table 1. Second, the gravity estimation acts as an "out of sample" and generalization test for the country case-studies. While exploiting different variations, and different measures of bilateral posting flows, I should obtain estimates of θ that enable me to predict posting responses to the country-specific reforms studied in the previous section.

I present my estimates in Table 2. All specifications include destination-origin fixed effects (filtering-out bilateral migration costs m_{ij}) and a free posting agreement dummy to account for variations in posting regulations over time.[37] As demonstrated by Anderson and Van Wincoop (2003), failure to account for the multilateral resistance term can lead to severe biases in the estimates of the gravity coefficients. Therefore, all specifications include destination-year fixed effects (filtering-out $\Phi_{jt}S_{jt}$) that account for a country "remoteness" in terms of service trade. I cluster standard errors at the destination-year level to account for potential autocorrelation of error terms within a given destination country and time period (but I will show robustness to alternative inference procedures).

Column (1) presents the basic specification with pair fixed-effects and destination-year fixed effects, exploiting variations *within* destination country and year in the labor cost of different exporting countries. The control for unobserved time-varying destination characteristics filters-out all destination-specific shocks that would be correlated with demand for posting services in country j. 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 (6) should reflect the differential use of domestic versus foreign in-person services. The specification presented in column (1) thus also includes services supplied domestically (S_{jjt}) in the estimation sample. The estimated

[37] Those variations are summarized in Table **??**.

elasticity is substantial but below unity, with a point estimate of -.75(.19). This elasticity is a bit larger than the steady-state correlation presented in Figure 4 but lower than reduced-form estimates presented in Table 1.

Column (2) repeats the specification from Column (1) but removing internal flows from the estimation sample. The estimates remain stable with a coefficient of -.80(.24). The estimates do not appear to be sensitive to the inclusion of domestic in-person services.

Column (3) repeats the specification from Column (2) now using a Poisson pseudo-maximum likelihood (PPML) estimator. This is because the log-linearization of the multiplicative gravity equation can be biased by zero flows and heteroskedastic error terms (Silva and Tenreyro, 2006). Estimates with log-linear OLS and PPML are close. This is unsurprising because there are limited zero flows in the dataset due to the absence of a reporting threshold for posting contracts. The estimated elasticity is -.1.2(.15)

Next, I estimate a Poisson regression using trade shares λ_{ijt} instead of levels S_{ijt} as the outcome variable, following Eaton, Kortum and Sotelo (2012).[38] The intuition is that estimating gravity models using shares (while including destination fixed effects) avoids biasing the structural parameters estimates towards large countries. This estimator is the one validated by Monte-Carlo simulations as showed in Head and Mayer (2014). The implied trade elasticity displayed in column (4) is -2.1(.47) and is now closer to the reduced-form estimates presented in Table 1.

So far, the identification has used exogenous variations in origin-specific wage costs affecting differentially workers sent to the same destination country, controlling for all changes in demand and supply in the importing country.[39] One potential sources of endogeneity lies in unobserved shocks occuring the same year than a tax reform in the origin country. For instance, a payroll tax reform could be implemented jointly with other policies that boost exporting firms' productivity and make them more competitive, leading my estimates to be biased upwards. The specification in Column (5) introduces a

[38] Those shares sum to one at the importing country level and are defined in the theoretical section.

[39] In their survey of the literature, Kleven et al. (2020) emphasize that this is usually considered to be the best available source of variation to study how international movements of labor respond to tax reforms. For instance, Kleven et al. (2014) exploit within-destination differences in tax rates applied to foreigners and domestics. Thanks to my setting, I can exploit an additional dimension: labor costs do not only vary by destination, but also by origin (because of different tax basis and different bindingness of destination minimum wages).

origin-year fixed effect and is thus comparable to estimates reported in Figure 5 and Figure 9. This control ensures that even if nationwide reforms were endogenous, this does not necessarily pose a threat to identification.[40] In this specification, the only source of variation left comes from nationwide destination-level minimum wage reforms that affect each exporting country differentially (because of different previous gross wage levels). The estimated coefficient becomes smaller than the coefficient in column (4), suggesting that general equilibrium effects do occur and may bias the estimates upwards. But the estimated elasticity remains large and statistically significant, with a point estimate of -1.2 (.20), which is extremely close to the reduced-form estimate in Figure 8 exploiting similar bilateral variation from minimum wage reforms and including the same set of controls and fixed-effects.[41] Adding internal flows to the preferred specification in column (6) yields a similar a point estimate of -1.3(.22).[42]

I perform additional tests to gauge the robustness of the results. Column (1) of Table A.1 shows the estimates when clustering standard errors at the origin-destination level, while column (2) accounts for twoway clustering at the origin-year and destination-year level. The elasticity remains precisely estimated and is statistically significant at the one percent level. Column (3) investigates potential heterogeneities by restricting the estimation to the Eurozone only, and find again similar results.

Overall, the estimates presented in Table 2 confirm the large causal effects of labor market regulations on trade in physical services within EU countries. The estimates from the "structural gravity" estimation are above the steady-state correlations and at the lower end of reduced-form elasticities. Using the more conservative coefficient in column (5) means that a 1% increase in the labor cost to export physical services from i to j decreases posting flows from i to j by 1.2%.

[40] This also automatically controls for changes in the duration of posting contracts that varies at the origin-year level in my dataset.

[41] Re-estimating the specification presented in column (8) but omitting posting flows to Germany yields a similar estimated coefficient of -1.1(.37). Hence the baseline elasticity in Table 2 is not a "duplicate" of the analysis presented in Figure 8 and 9 with different data. Rather, it shows that exploiting conceptually similar bilateral variations in wage costs gives similar estimates of θ in the case-study or in the gravity pooling all country-pairs.

[42] Note however than including domestic services, which are much larger than posting flows, poses some non-convergence challenges when performing the PPML estimation that uses a regressor in level, not in log.

Because my gravity estimation is an empirical application of widely used trade models (e.g Eaton and Kortum, 2002) and relies on similar estimators and fixed effects than most other applications (Head and Mayer, 2014), I can benchmark my estimates to those obtained in different contexts. Even though non-tariffs trade barriers represent more than 70% of all trade barriers in the world (Looi Kee et al., 2009; Niu et al., 2018), it is usually hard to compare trade elasticities estimated using non-monetary changes in regulations to trade elasticities identified through ad-valorem tariffs variations. I can directly infer the change in wage costs associated with changes in labor regulations within the posting program. The estimated trade elasticities for physical services presented in Table 2 are smaller than that of the trade elasticity for goods, that is usually estimated around 5 (Head and Mayer, 2014).[43] Given the weight of services in modern economies but the lack of estimates for the trade elasticity in those sectors (Francois and Hoekman, 2010), those numbers can be useful to calibrate quantitative models of service trade.

The estimation structure provided by the gravity model also enables me to test for other potential margins of responses to posting-specific labor regulations. In Table A.2, I repeat the baseline estimation presented in Table 2 but I replace bilateral trade in physical services (postings) with bilateral trade in goods, using data from Head and Mayer (2014).[44] This is not a "placebo" test, because countries could substitute imports of posting services with imports of goods, although many posting services are not "tradable". But for some activities, for instance meat processing, it is plausible that countries could import more goods (e.g meat in my example) if the cost to import posting services increases due to posting-specific regulations. Posting-specific wage cost has an opposite sign effect on bilateral trade in goods. This is evidence that the baseline estimates do not only capture responses to unobserved shocks that would affect less labor-intensive exports similarly. Rather, the positive sign suggests a small substitution effect between exports of physical services and exports of goods in response to a tightening in posting-specific labor regula-

[43] The R-squared is 0.96, thus a simple trade model performs well in explaining the geography of trade in physical services.

[44] Only firms exporting posting services must match the minimum legal wage in the importing country; manufacturing exporters are not affected by this prevailing wage rule. Origin-specific payroll tax reforms affect both exporters of posting services and goods, although firms exporting labor-intensive services should be more exposed to those reforms if labor costs account for a larger share of their total unit cost.

tions.

Another key advantage of my setting is that I can compare short- and long-run elasticities obtained within the same estimation framework. My difference-in-differences analysis showed clear evidence of dynamic trade flows adjustment to changes in labor regulations, with responses growing over time. In contrast, the year-to-year (short-run) posting responses to changes in wage costs is smaller. Those heterogeneities are very similar to those recently documented by Boehm, Levchenko and Pandalai-Nayar (2023) for trade in goods, suggesting that it also takes several years for the cross-border supply of physical services to adjust to payroll tax and minimum wage reforms. The difference-in-differences design thus usefully complement standard gravity approaches, not only because they provide credible tests for identification (e.g inspection of pre-trends) but also because they transparently show the dynamic adjustment of trade flows to permanent changes in labor market regulations. This finding is also consistent with the public finance literature that shows dynamic employment responses to payroll tax cuts (e.g in Saez, Schoefer and Seim, 2019; Guo, 2023) and goes against the belief that fiscal devaluations may only boost exports in the short-run (Farhi, Gopinath and Itskhoki, 2014).

Effects of EU Policy Proposals I use my estimates to performs back of the envelope computations of the effects of several policy proposals of "social convergence" in the EU on posting flows, tax revenues and posted workers' wages. I predict changes in cross-border supply of physical services trigerred by predicted changes in labor costs $\hat{c_{ij}}$ using my estimates of θ and the relationship in Equation (6).[45] I use as a lower bound elasticity estimate the gravity coefficient in column (5) of Table 2 and my upper bound elasticity is the average of this gravity estimate and the three reduced-form elasticities presented in Table 1. The results are presented in Table 3.

I start by considering a EU policy discussed in 2005 that proposed to lift destination-level minimum wages requirements for foreign firms supplying posting services abroad. This "Bolkestein directive" would have implied a massive drop in labor costs for firms located in low-wage countries supplying services in high-wage countries. As a result, ex-

[45]Formally, I predict $\hat{S_{ij}} = S_{ij} \exp[-\theta(\log \hat{c_{ij}} - \log c_{ij})]$. This only captures first-order effects of changes in labor costs on bilateral posting flows and ignores general equilibrium or reallocation effects.

ports of labor services (and the corresponding tax revenues collected by origin countries) would habe doubled in Eastern European countries.[46] The counterpart of this boost in exports is a 16% average decrease for posted workers' wages, since they would not receive the posting allowance anymore.[47] In contrast, the impact would have been minimal for firms located in older member states that are mostly not constrained by the minimum wage rule (except for firms located in Southern Europe). I come back to the political implications of the Bolkestein proposal in the conclusion of the paper.

Panel B investigates an alternative scenario that focuses on payroll taxes instead. To neutralize the tax differentials allowed by posting, some political leaders in old member states have advocated to shift to a destination-based taxation system. The basic proposal enables foreign countries to keep collecting labor taxes on posted workers but by (i) applying destination-specific payroll tax rates and (ii) by including the posting allowance in the tax base.[48] This policy would decrease postings from Eastern European countries that had lower payroll tax rates and a narrower tax base with the origin-based tax system. The reform would also slightly decrease exports from older member states because tax rates differ even when countries have similar level of wages (e.g Luxembourg and France in Figure 6). While destination-based taxation would decrease the net volume of postings in the EU, total taxes collected on posted workers would nevertheless increase, even when considering the upper bound elasticity of ≈ -3.7.[49]

7 Concluding Remarks: the "Polish Plumber" Parable

In a book written in the late 1990s, Has globalization gone too far?, Dani Rodrik illustrated the importance of social standards considerations in the process of trade liberaliza-

[46] Because the posting allowance is exempted from the tax basis in the baseline, the Bolkestein directive does not decrease tax revenues by decreasing the tax basis for exporting firms.

[47] Of course, if the average equilibrium wage (without the posting allowance) for posted workers is different than the equilibrium wage in the origin country, then the expansion of posting exports after the Bolkestein directive would increase the wages for newly posted workers, and the net effect is thus unclear.

[48] Some policymakers have also sometimes proposed that destination countries could collect taxes on posted workers that work within their territory, see Rocca (2020) for a detailed proposal.

[49] This is because a 1% increase in payroll tax rates on average implies much less than 1% increase in total wage cost. Of course, with sufficiently large θ (for instance the maximum reduced-form estimate in Table 1), the reform is predicted to decrease overall tax revenues on posted workers.

tion with a simple "parable". In the first scenario, Honduran workers produce clothing in Honduras, following the labor laws and standards of their home country (including child labor). In the second scenario, Honduran workers temporarily travel to the United States to work in the clothing industry but are still governed by Honduras' labor laws and standards. From an economic standpoint, these two configurations are equivalent: the well-being of displaced US workers, Honduran workers and firms' shareholders are exactly the same. Hence, anyone basing its view on pure economic outcomes should support both policies. But, as Rodrik puts it, "*the vast majority of economists who have no difficulty with the outsourcing example would also accept that it is not good public policy to relax labor standards for migrant workers.*".

While Rodrik's parable was initially conceived as an extreme thought experiment to highlight the complex political considerations in the trade liberalization process, the EU posting policy has effectively brought this example to life in the real world. European firms can trade services by temporarily send their employees abroad, and those employees keep their origin country employment contract. Like in Rodrik's story, both foreign workers and foreign labor institutions are effectively traded through posting. In anticipation of potential resistance from EU citizens against competition from workers subject to different labor laws, the EU commission granted member states the right to apply some of their domestic standards to foreign firms providing physical services within their borders. But many economic stakeholders shared Rodrik's view that a commitment to free trade within the single market contradicted the enforcement of domestic standards on foreign firms in the posting policy. Concerns of protectionism became more salient following the accession of 10 Eastern European countries, which felt disproportionately penalized by the regulatory framework of the posting policy. In the aftermath of the 2004 EU enlargement, the EC thus introduced a proposal aimed at lowering the social standards requirements in posting.

The Bolkestein Directive, officially known as the "Directive on services in the internal market", was named after Frits Bolkestein, the European Polish Commissioner for the Internal Market who proposed it in 2005. The proposal was to enforce the "country of origin principle", which would have allowed firms to fully operate under the laws and

regulations of their home country when providing services in other EU countries, instead of having to comply with the home country's minimum wage.

The Bolkestein Directive became a highly controversial topic in Europe, and sparked a wave of protests right after the introduction of the proposal at the EU Parliament in March 2005. Critics of the directive, including trade unions and left-wing political parties, argued that it would lead to a "social dumping", as service providers from countries with lower standards would be able to offer their services without having to comply with the host country's regulations. The protests against the Bolkestein directive represented one of the first instances of coordinated action and demonstrations across multiple EU countries, using the fear of social dumping as a common motivation. Seizing upon the concerns of unfair competition generated by the law, Philippe de Villiers, a French politician with strong anti EU views, popularized the term "Polish plumber" on March 15, 2005, in an op-ed that gained widespread attention in France and Europe.

In France, the polemic intervened just in the middle of a the campaign for the adoption of a European constitutional treaty, that aimed to deepen European integration. Figure 10, Panel A, shows that the French public debate interest for the Bolkestein Directive peaked right after the introduction of the proposal at the EU Parliamen and De Villiers's op-ed. The controversy sparked by the directive became so central and controversial in the French public debate on the referendum that the president Jacques Chirac had to call for an immediate withdrawal of a proposal deemed "unacceptable" by France.

Panel B next shows the evolution of voting polls to adopt the EU constitution in France. The support for EU integration dropped dramatically in the days following the introduction of the Bolkestein Directive at the EU Parliament, and the start of the "polish plumber" polemic about social dumping in services. This figure suggests that the fears of foreign competition based on different labor norms that were trigerred by the Bolkestein Directive played a key role in the rejection of the EU project by French voters, a conjecture that has previously been made by political scientists (Perrineau, 2005). Similar to Rodrik (1998)'s allegory of Honduran migrants, the "Polish plumber" episode illustrates why the question of trade liberalization is hard to adress separately from that of social convergence.

Trade economists often view the option to impose domestic standards to foreign firm

as disguised protectionism. But allowing EU countries to impose their domestic standards to foreign firms also led to higher incentives to regulate national labor markets in Europe. The first sectoral minimum legal wage in Germany was introduced in 1996 so that some exposed sectors could impose their standards to foreign suppliers of services. The 2010 EU regulation reform was the first instance of destination-based taxation for labor in the EU. The 2017 fierce debate to impose "equal pay" between posted and domestic workers led to the first proposal of a EU-wide minimum legal wage. Understanding to what extend international trade could lead to social convergence through "standards escalation" provides a fruitful avenue for future research.

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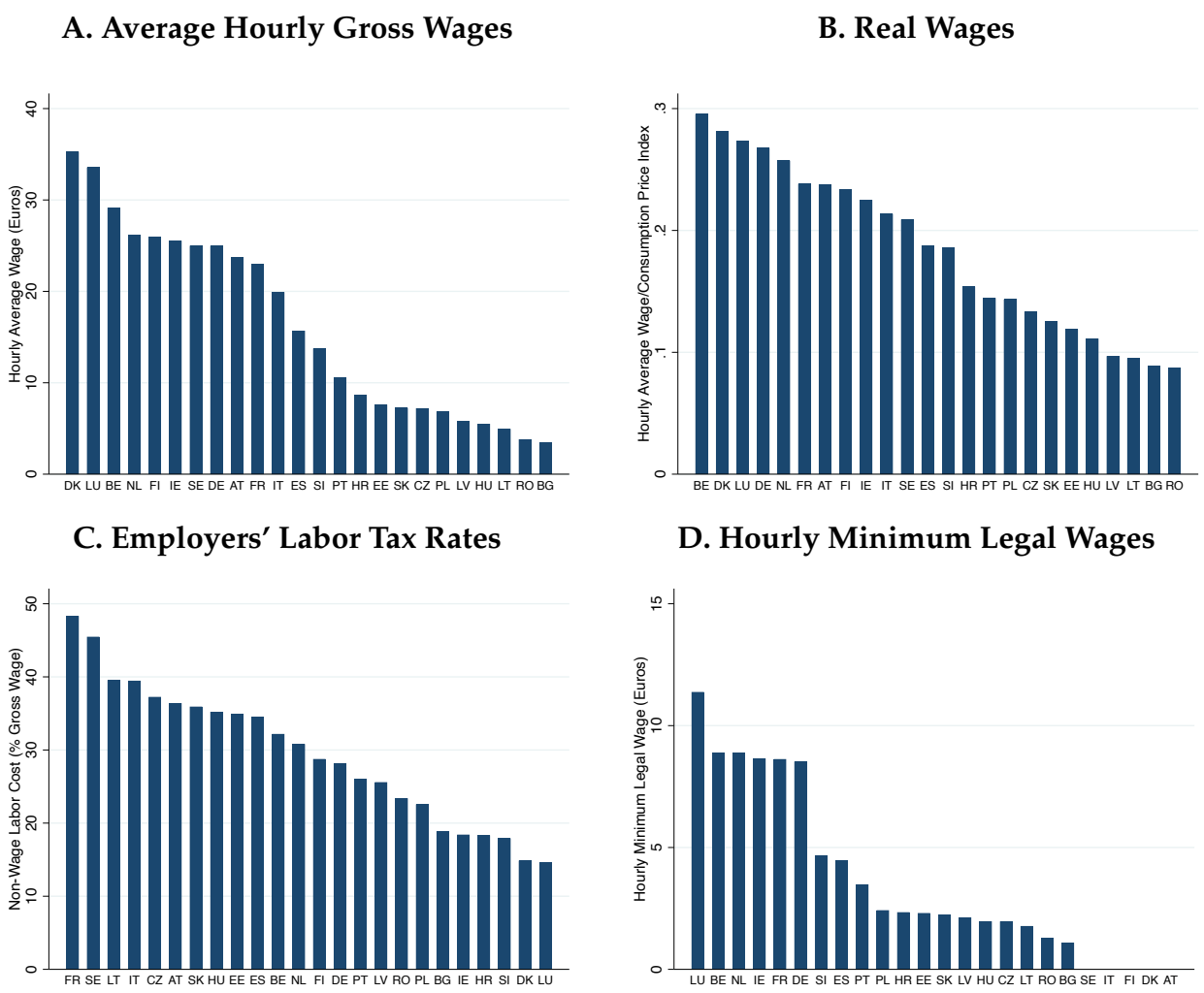
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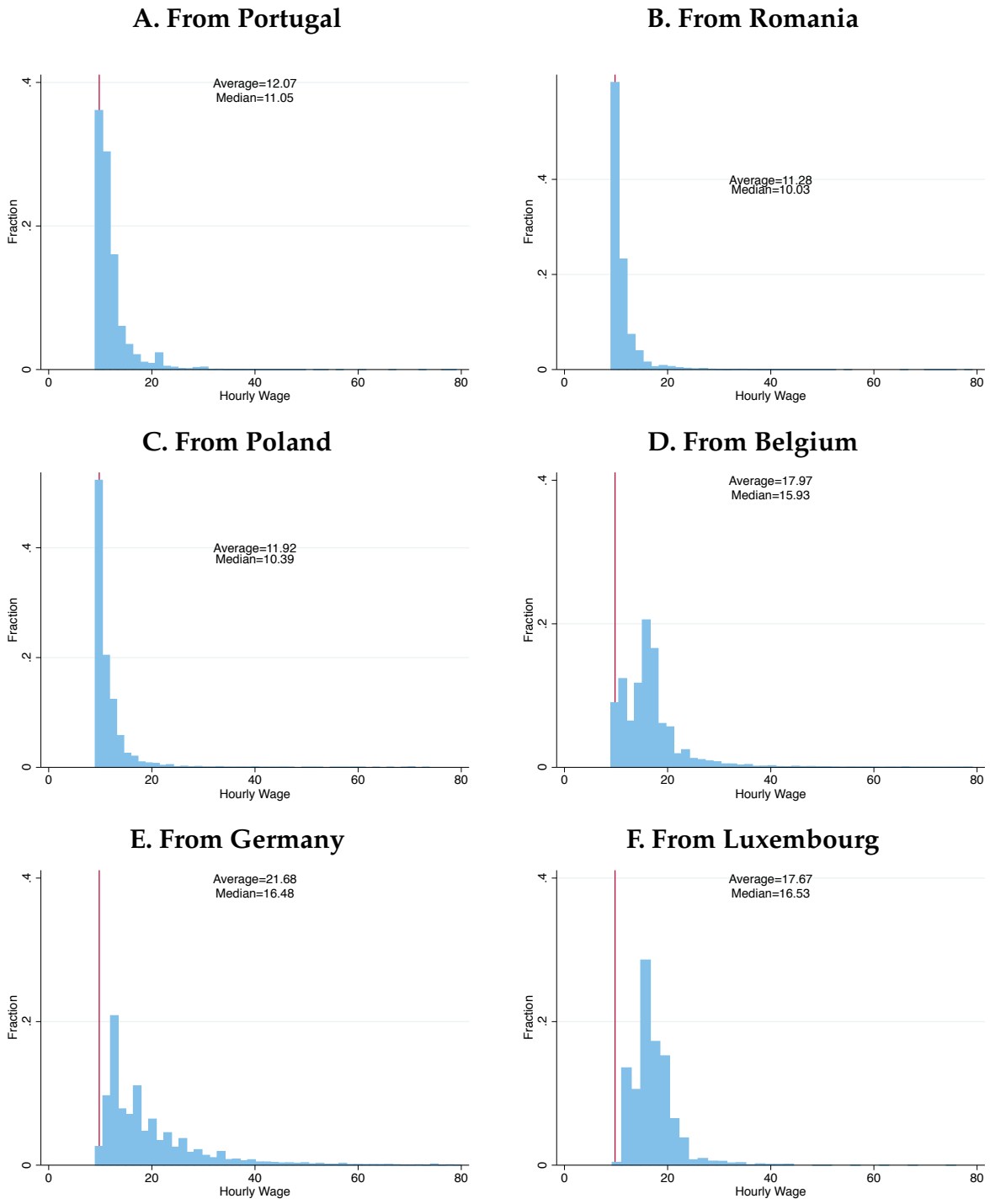
8 Figures And Tables

Figure 1: **Wages, Payroll Taxes and Minimum Wages in the European Union**



Notes: This figure shows different components of hourly labor costs in Europe in 2015, using data collected from Eurostat. Panel A plots average nominal hourly gross wages paid in the country. Panel B divides gross hourly wages by an harmonized consumption price index to account for differences in prices across EU countries. Panel C plots employers' effective payroll tax rates, computed as social security contributions and other labor taxes net of subsidies, in percent of gross wages paid to employees. Panel D plots nationwide statutory minimum legal wages.

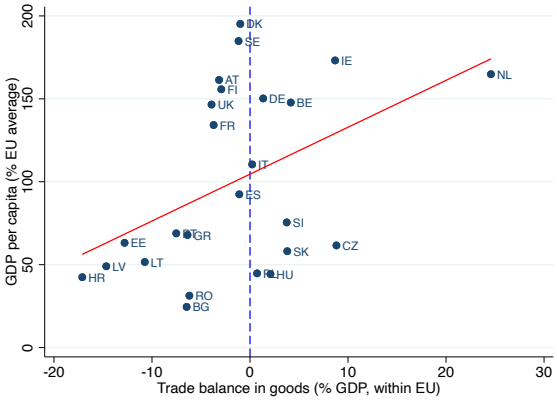
Figure 2: **Bindingness of Importing Country Wage Floor by Origin of Exporting Firms**



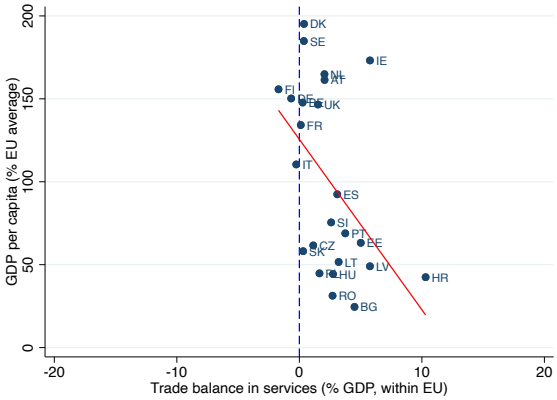
Notes: This figure illustrates the bindingness of an importing country (France) domestic minimum legal wage for exporting firms located in different origin countries. Each panel plots the distribution of hourly wages paid to workers employed by exporting firms in each of those countries and supplying physical services within France territory in 2018. Per EU law, exporting firms must comply with the French minimum legal wage during the posting contract. The French minimum legal wage that year is depicted by the vertical red line. Each figure displays the median and average nominal hourly wage paid by firms located in each of those countries when supplying services in France.

Figure 3: **Comparative Advantage in Services and Taxes on Labor**

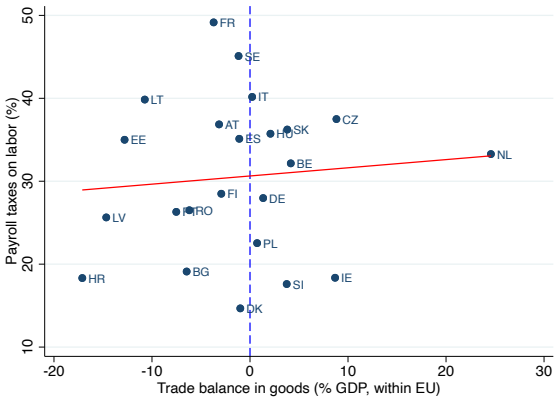
A. Trade Balance in Goods and GDP/Capita



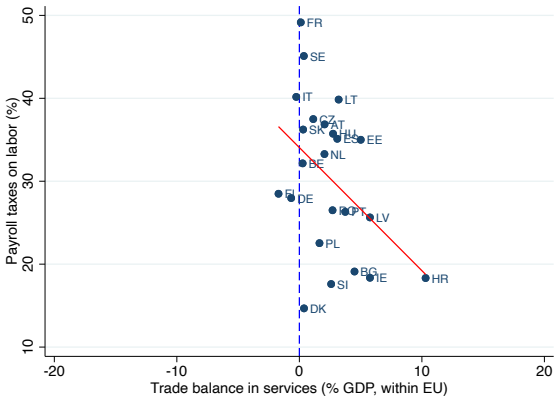
B. Trade Balance in Services and GDP/Capita



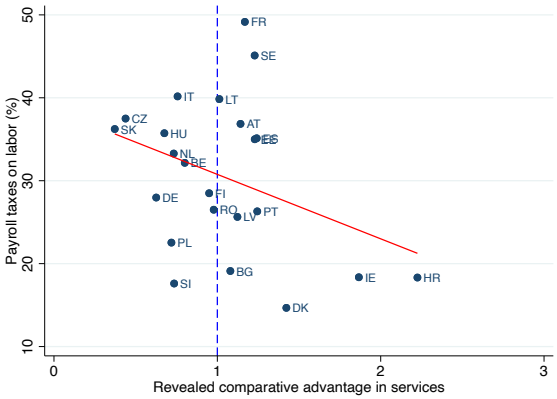
C. Trade Balance in Goods and Labor Taxes



D. Trade Balance in Services and Labor Taxes



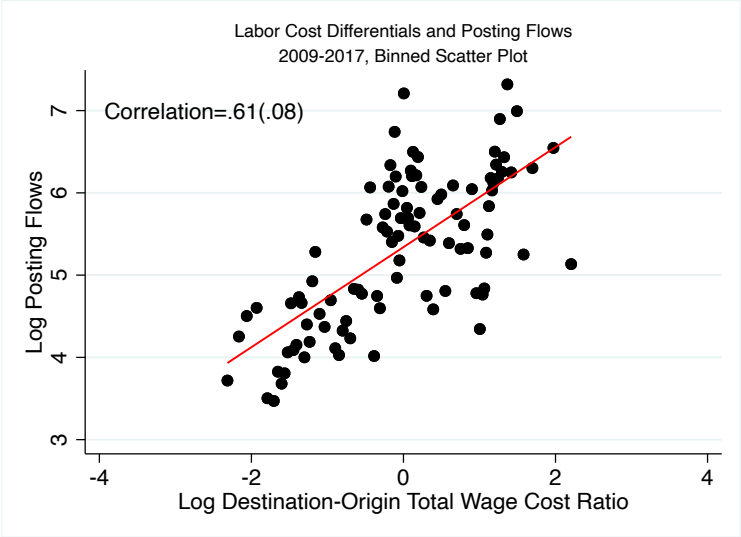
E. RCA in Services and Labor Taxes



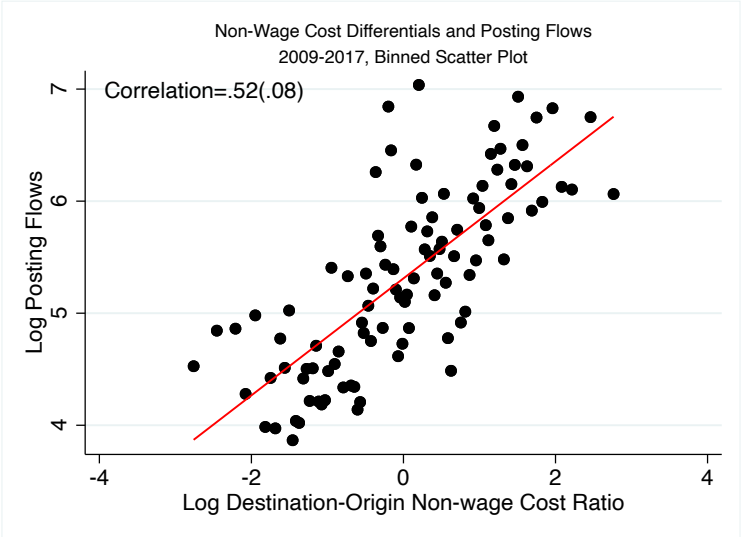
Notes: This figure illustrates correlations between a country measure of competitiveness in goods and services (trade balance) and measures of income and labor taxes. Trade balances are computed for within-EU trade only in year 2014, using data from Eurostat. Panel A and B relate trade balances to GDP per capita (relative to the EU average). Panel C and D relate trade balance to employers' based payroll tax rates. Panel E relates a country relative advantage in services ("RCA") ratio to payroll taxes on labor. Small EU economies with extremely large trade balances (Luxembourg, Malta and Cyprus) have been excluded from the figure.

Figure 4: **Steady-State Correlation between Trade in Physical Services and Labor Cost Differentials**

A. Total Labor Cost Differentials

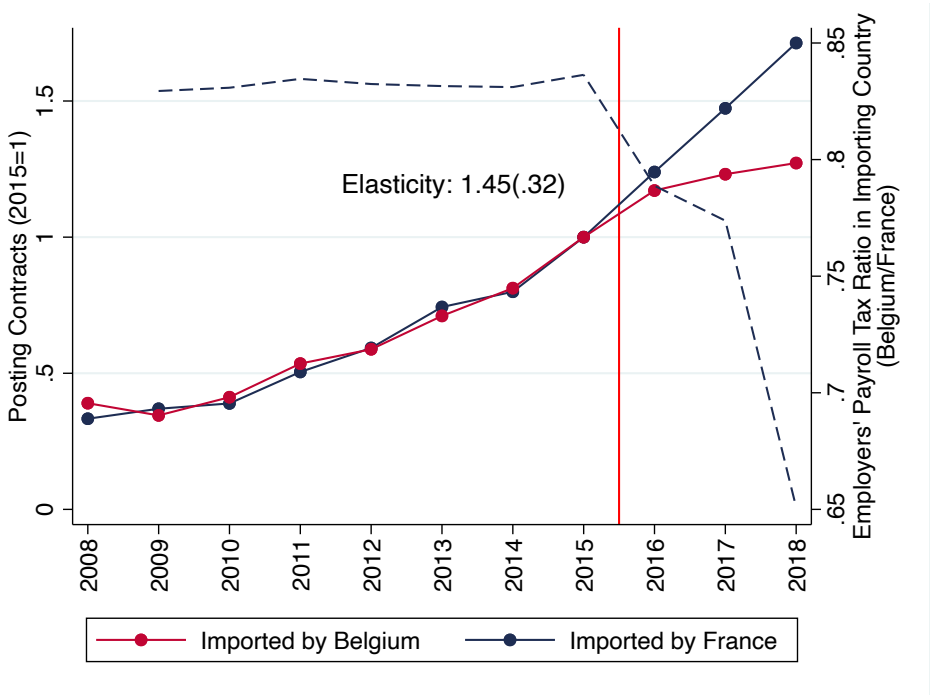


B. Payroll Tax Burden Differentials



Notes: This figure depicts the relationship between the log of bilateral posting flows (trade in physical services) and the log of labor cost differentials, for a given country-pair during the 2009-2018 period. The top panel uses employers' hourly labor cost differentials between domestic and posted workers, after accounting for the specific payroll tax rates and minimum wages that apply to foreign firms. The bottom panel focuses on differences in payroll tax burden, that is to say the amount paid for social security contributions and other labor taxes when hiring one hour of labor. The red line depicts the best linear fit using a univariate regression. The correlation between log bilateral posting flows and the log labor cost differentials is displayed in each figure with standard errors in parentheses.

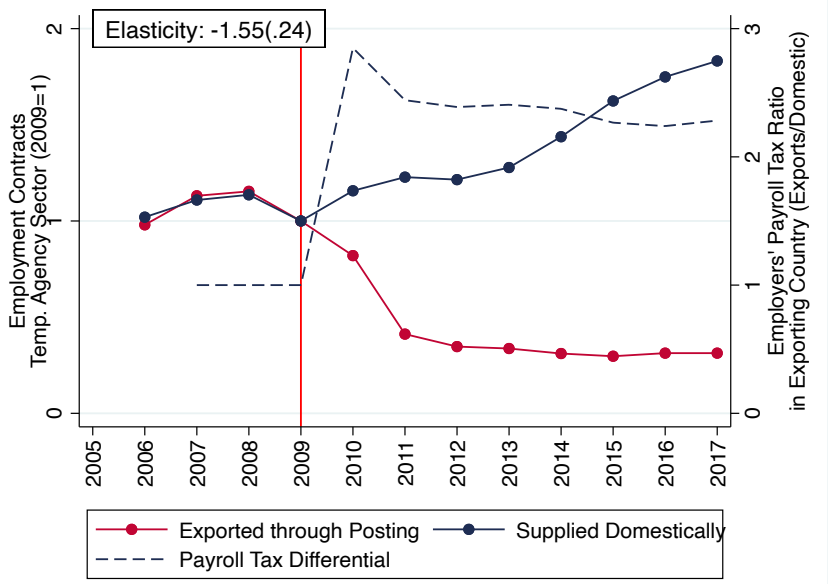
Figure 5: **Effect of a Payroll Tax Cut in Belgium on Posting Imports**



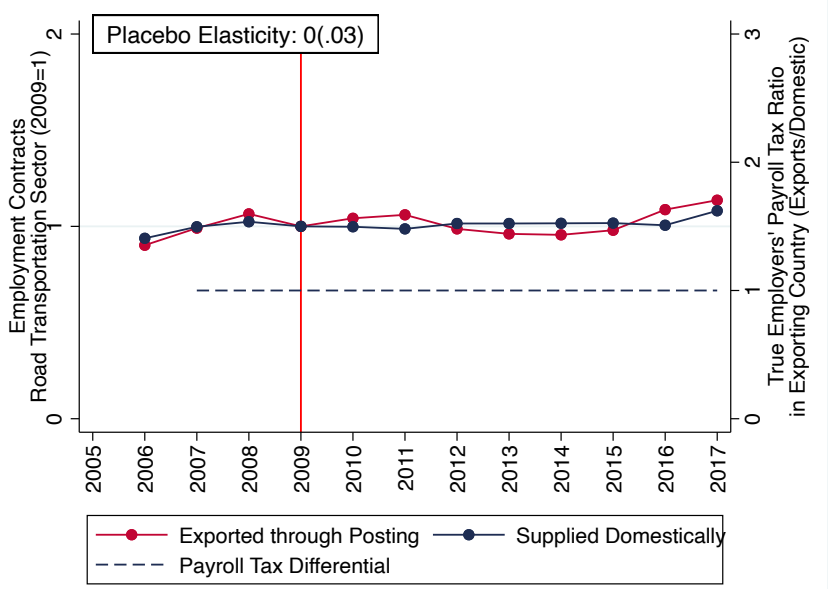
Notes: This figure shows the effects of a 2015 reform that decreased Belgian employers' social security contributions by 8 percentage points on imports of labor services. The dashed line (and left y-axis) shows the evolution of the payroll tax rate ratio in Belgium (treatment) versus France (control), before and after the reform. The figure shows how imports of posting services in Belgium (treated, red series) evolved compared to imports of posting services in France (control, blue series) before and after the policy-induced change in domestic labor cost in Belgium. All series are normalized to one the year before the implementation of the labor tax cut. The conceptual framework presented in Section 2.2 predicts a positive effects; since higher payroll tax rates should increase imports of labor services and decrease exports of labor services. The effects of the same reform on Belgian exports of posting services is showed in Figure A.8. The elasticity reported in the figure is computed with respect to the change in the statutory payroll tax rate using the 2SLS procedure described in the main text. The estimates of the elasticity with respect to the implied (instrumented) total wage cost is showed in Table 1.

Figure 6: **Effect of Imposing Destination-Based Taxation to Luxembourgish Exporters**

A. Exports of Posting Services Dropped in the Exposed Sector

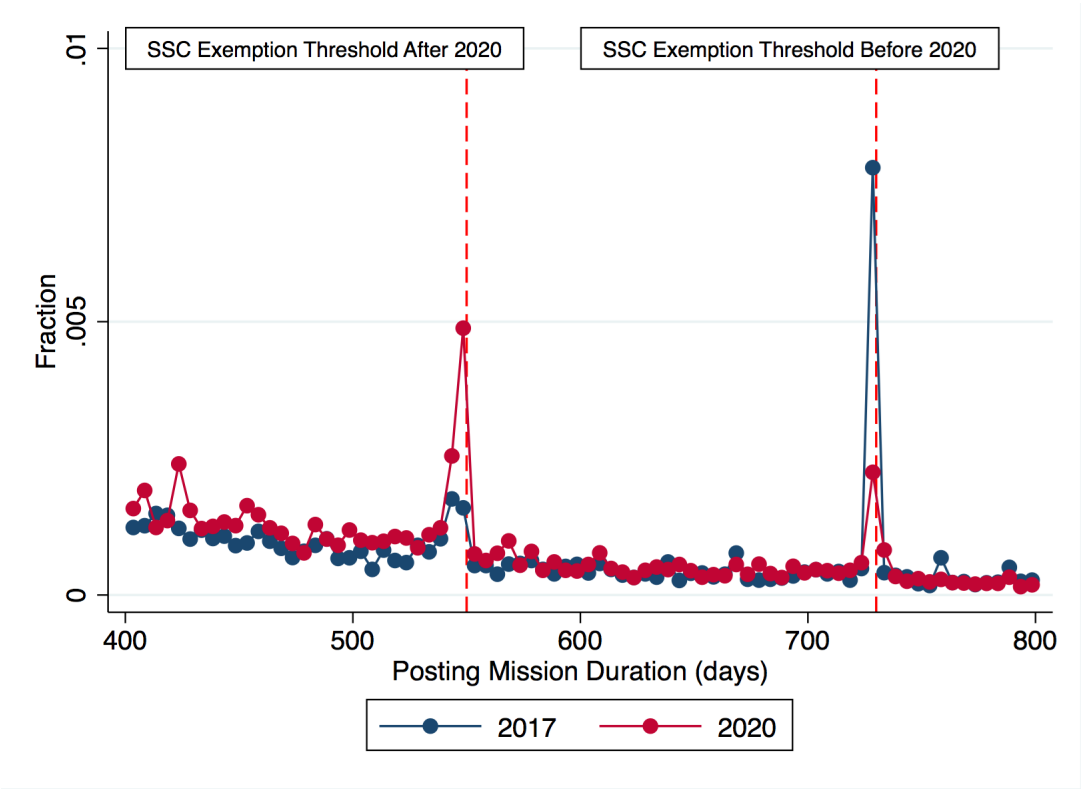


B. No Differential Evolution in the Sheltered Sector



Notes: This figure shows the effects of a EU regulation implemented in May 2010 that imposed destination-based payroll taxation to temporary employment agencies located in border regions posting workers in neighboring countries. The dashed line (and y-axis) shows the evolution of the payroll tax rate ratio between firms that export (treated) and firms that sell domestically (control). The top panel shows exports (treated, red series) versus domestic (control, blue series) contracts (measured in unit of labor) of temporary employment agencies in Luxembourg, before and after the reform (vertical red line). The bottom shows the same differential evolution for the road trasnportation sector, that was sheltered from the reform for 10 years due to a "transitory" sector-specific exemptions. All series are normalized to one in pre-reform year. The elasticity reported in the figure is computed with respect to the change in statutory payroll tax rate.

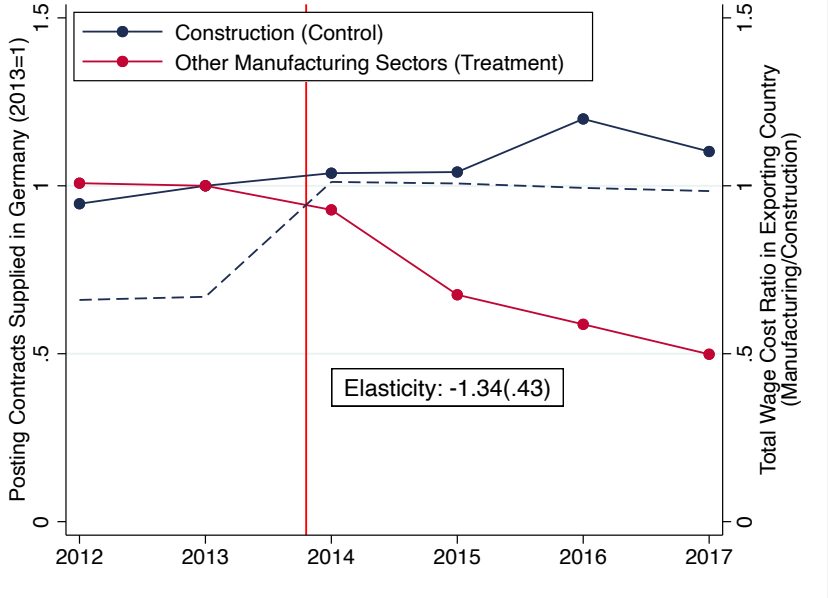
Figure 7: **Bunching at the Destination-Based Taxation Duration Threshold**



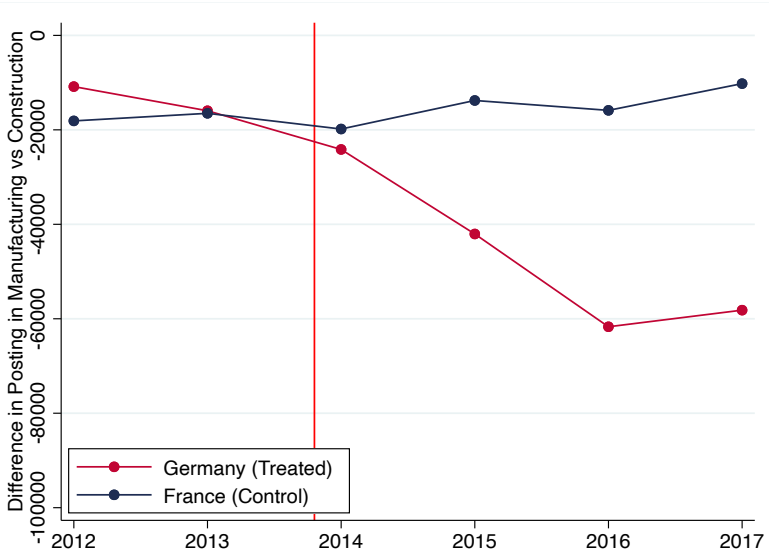
Notes: This figure shows the distribution of the duration of posting contracts (in days) performed in France, the country with the higher effective payroll tax rate in the EU. The vertical dashed red lines depict the regulatory thresholds for destination-based taxation set by the EU. This threshold was 24 months since 2010 and was moved to 18 months in 2020, with a transitory period between in 2018-2019. When firms send their workers in France for one more day than the regulatory threshold, they become subject to the French payroll tax rate (for the ful posting contract). The destination-based tax threshold thus creates a notch in the average tax rate faced by exporting firms exporting physical services to France.

Figure 8: **Effect of Imposing German Minimum Wage to Foreign Exporting Firms**

A. Exports of Posting Services to Germany Dropped in the Treated Sector



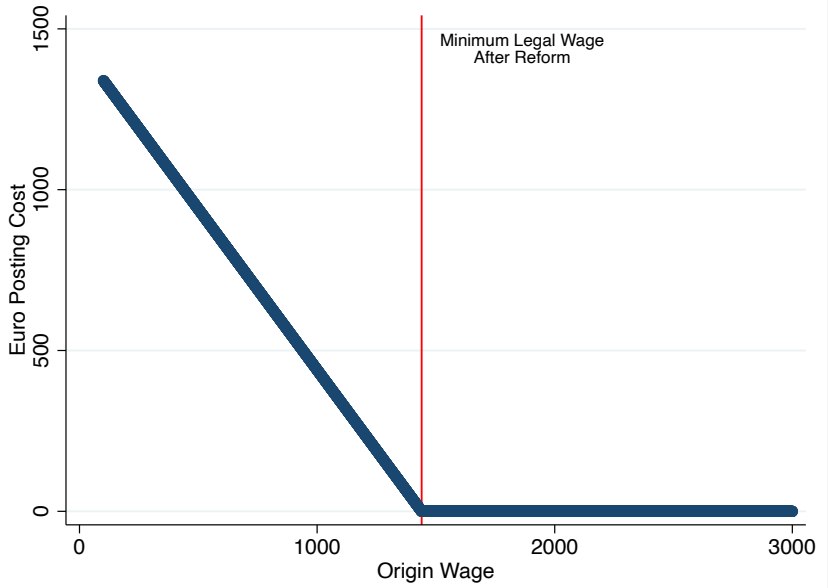
B. No Differential Evolution in a Neighboring Country



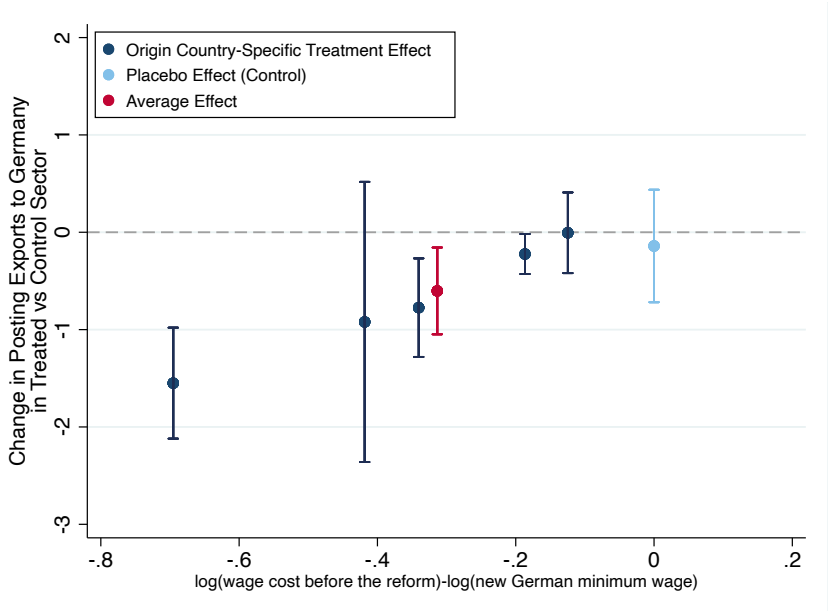
Notes: This figure shows posting responses to a minimum wage reform in Germany. Before 2014, only foreign firms operating in the construction sector were subject to German (sectoral) minimum wage.s Other foreign firms became liable to the German minimum wage in August 2014 (when operating in meat processing industry) or 2015 (in all other manufacturing services). The dashed line (y-axis) shows the evolution of labor costs for firms supplying manufacturing services (treatment) versus construction services (control) in Germany. The top panel shows the evolution of exports of manufacturing services (treatment, red series) and construction services (control, blue series) to Germany, before and after foreign firms become liable to the German minimum wage in the treated sector. The top panel shows the same differential evolution in the neighboring country, France, where minimum wage requirements for foreign firms do not vary across sectors and stayed constant during the period. All series are normalized to one in the pre-reform year 2013.

Figure 9: **Heterogeneous Effects by Bindingness of German New Minimum Wage**

A. Firms in Low-Wage Exporting Countries Face Larger Additional Costs



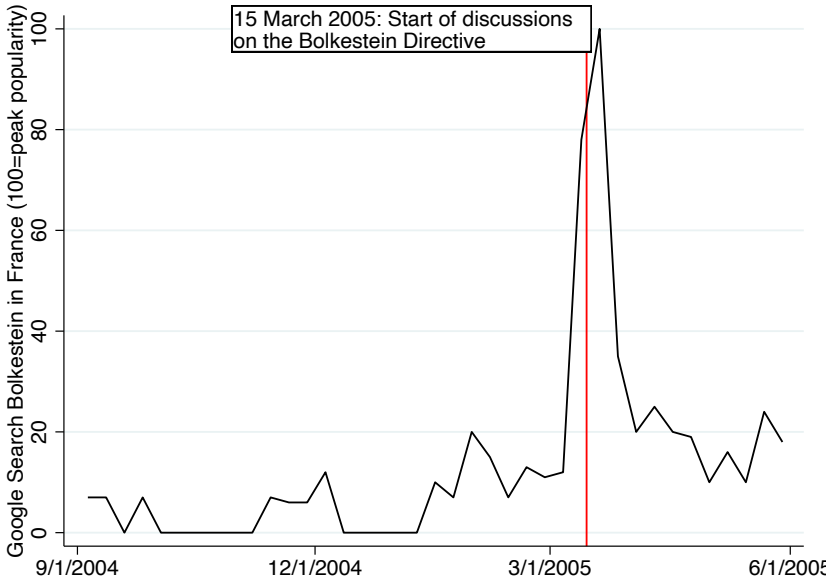
B. Posting Responses by Bindingness of the Reform



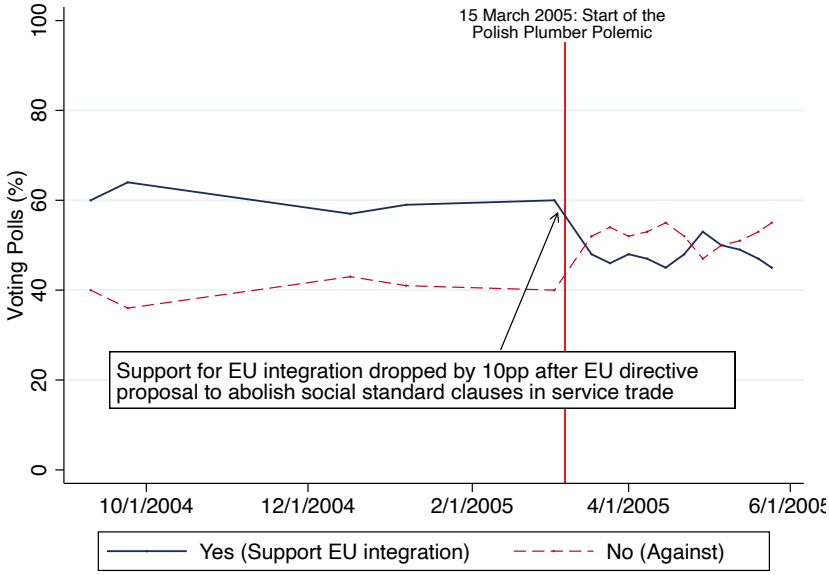
Notes: Panel A shows the kinked relationship between the exporting country's wage and the additional cost that foreign firms must pay to supply services in Germany in the treated sectorsd after the reform. Panel B shows the treatment effect (and 95% confidence intervals) of the minimum wage reform estimated for each exporting country as described in the text. The blue coefficient plots the estimated treatment effect for the exporting country with zero direct exposure to the reform, Luxembourg (minimum wage above novel German minimum wage). The pink coefficient is the average treatment effect (for all exporting countries).

Figure 10: **Threats of Social Dumping and Political Support for EU Integration**

A. Salience of the "Bolkestein Directive" in French Public Debate



B. Support for EU Integration in France after "Polish Plumber" Polemic



Notes: The Figure describes the effects of the "bolkestein directive", that aimed to lower social standards applied to foreign firms engaged in the cross-border supply of services in the EU, on support for EU integration in France. The top panel shows google searches for the bolkestein directive in France. The bottom panel shows the evolution of voting polls for the French referendum regarding the adoption of the EU constitution in 2005. The vertical red line refers to the introduction of the Bolkestein directive at the EU parliament.

Table 1: **Reduced-Form Estimates of Posting Responses to Payroll Tax and Minimum Wage Reforms**

Description		Elasticity w.r.t labor tax rate (1)	Elasticity w.r.t labor cost (2)
Panel A. Labor cost reform in importing countries	A1. Belgian Tax Shift (2016)		
Employers' social security contributions rate on all employees hired in Belgium was decreased from 33% to 25% starting at the beginning of 2016. DD estimation comparing imports of posting services in Belgium versus France.	Imports	1.44***	3.78***
		(.32)	(.74)
	Exports	-2.83***	-7.1***
		(1.3)	(2.1)
Panel B. Labor cost reform for exporting countries			
	B1. EU Regulation (2010)		
A new regulation required that Luxembourgish firms pay payroll taxes in the destination country when posting temporary employment agency workers abroad after May 2010. DD estimation comparing services supplied abroad vs at home for firms located in Luxembourg. Placebo estimation for a sector sheltered from the reform.	Exports	-1.54***	-8.51***
		(.24)	(1.39)
	Placebo Sector	-.00	-.02
		(.02)	(.15)
	B3. German minimum wage reform (2014-15)		
A minimum legal wage for foreign firms supplying physical services in Germany was introduced in the meat processing industry in August 2014, followed by a nationwide minimum legal wage for all sectors in 2015. Foreign firms supplying services in the construction sector were always subject to a German sectoral wage floor. DD estimation comparing exports of labor services to Germany in manufacturing vs construction sectors. Placebo estimation for an exporting country not binded by the new German minimum wage requirement.	Exports	-	-1.34***
			(.43)
	Placebo Origin	-	-.18
			(.11)

Notes: *p<0.10, **p<0.05, ***p<0.01. This table summarizes the reduced-form estimates of the service trade elasticity with respect to payroll cost of posted workers, using different quasi-natural experiments detailed in the text.

Table 2: **Elasticity of Trade in Physical Services to Policy-Induced Labor Cost Changes**

Regressor: $\log(c_{ijt})$	(1)	(2)	(3)	(4)	(5)	(6)
Elasticity $(-\theta)$	-.759***	-.80***	-1.2***	-2.1***	-1.2***	-1.3***
	(.20)	(.21)	(.12)	(.38)	(.20)	(.22)
Observations	5,539	5,291	5,532	5,532	5,532	5,767
Origin-Destination FE	Yes	Yes	Yes	Yes	Yes	Yes
Destination $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Origin $\times$ Year FE	No	No	No	No	Yes	Yes
Estimator	OLS	OLS	PPML	MPPML	MPPML	MPPML
Internal Flows	Yes	No	No	No	No	Yes

Notes: *p<0.10, **p<0.05, ***p<0.01. This table summarizes coefficents estimated from Equation (6) on the full matrix of bilateral posting flows within the EU merged with data on employers' labor cost for each country pair for 2009-2018. 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 (6) (OLS estimation); in levels for specifications relying on the multiplicative form of Equation (6) following Silva and Tenreyro (2006) ("PPML" Poisson pseudo maximum likelihood estimator); and in shares λ_{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 posting regulations between country i and j changes at time t, and a destination-year fixed effect to control for the multilateral resistance term (Φ_{ijt}). Weighted regressions use total population in sending countries to weight observations. Robust standard errors clustered at destination-year level are displayed in parentheses.

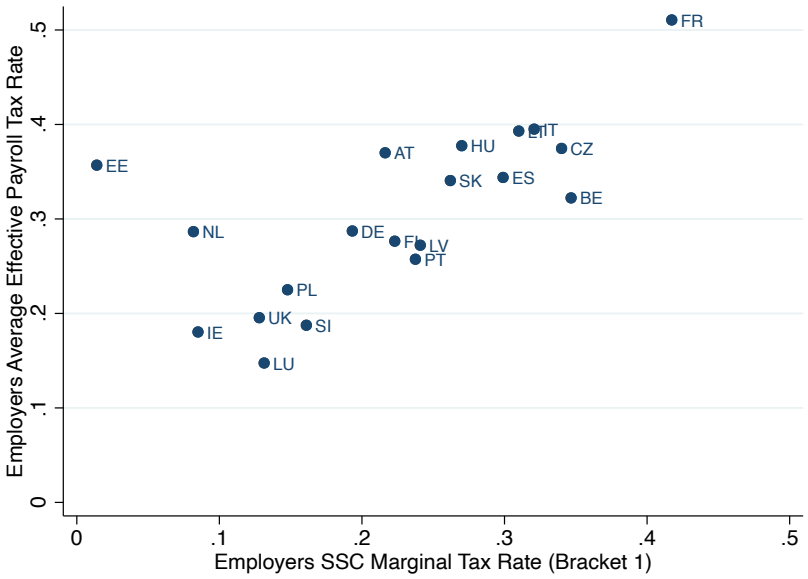
Table 3: **Predicted Effects of EU Policy Proposals**

	Exports of Labor Services		Taxes Collected on Posting Exports		Posted Workers' Average Wages	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
A. Bolkestein Directive						
Eastern Europe	+23%	+108%	+23%	+108%		-16%
Old Member States	+.3%	+1.3%	+.3%	+1.3%		-16%
B. Destination-Based Taxation						
Eastern Europe	-10%	-25%	+40%	+14%		
Old Member States	-1.2%	-2.2%	+7%	+6%		

Notes: This table summarizes the predicted effects of several EU policy proposals on the cross-border supply of physical of services in Europe. The lower bound effects are computed using the lower-bound estimate presented in column (8) of Table 2 while the upper bound uses the average of the lower bound and the three reduced-form elasticities presented in Table 1. I compute the implied change in bilateral wage costs that would be trigerred by each of the proposed reform, and compute the implied change in bilateral posting flows. I then compute the corresponding change in tax revenues and posted workers' wages.

A Additional Tables and Figures

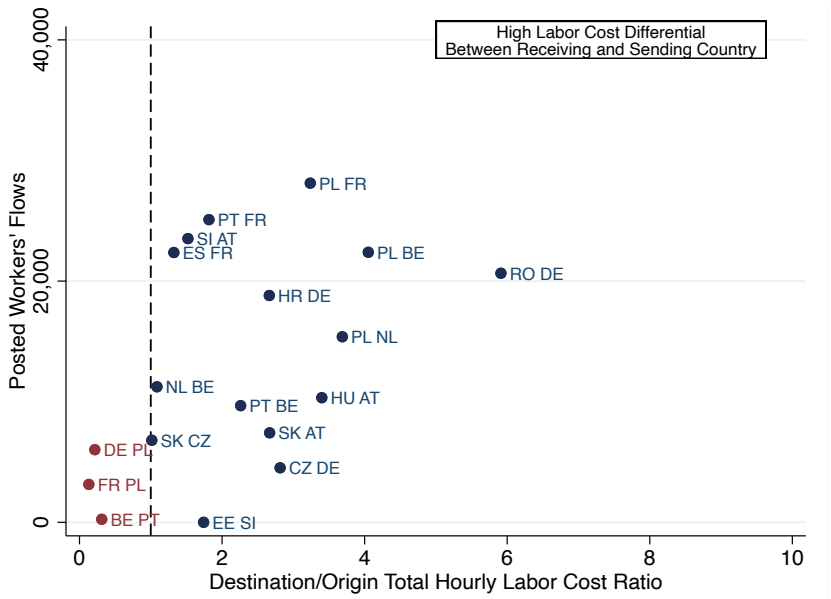
Figure A.1: **Employers' SSC Marginal Tax Rate in 1st Bracket (OECD measure) vs Effective Non-Wage Payroll Tax Rate (Eurostat)**



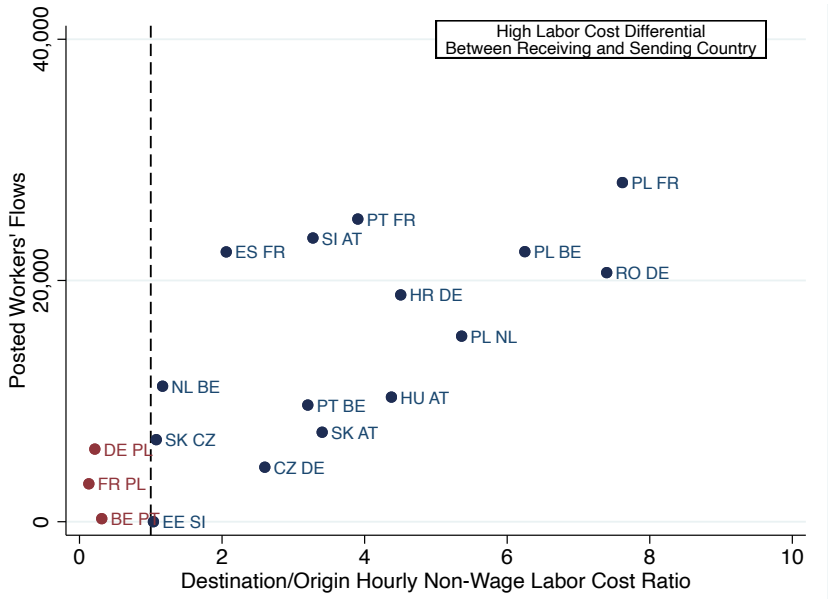
Notes: This figure shows the correlation between measures of the effective payroll tax rate computed by Eurostat (accounting for SSC, other labor taxes paid by employers, and net of subsidies for employers), and the social security contribution marginal tax rate faced by employers provided by the OECD taxing wages database.

Figure A.2: **Postings Flow from Low to High Labor Cost Countries**

A. Bilateral Flows and Total Labor Cost Ratio

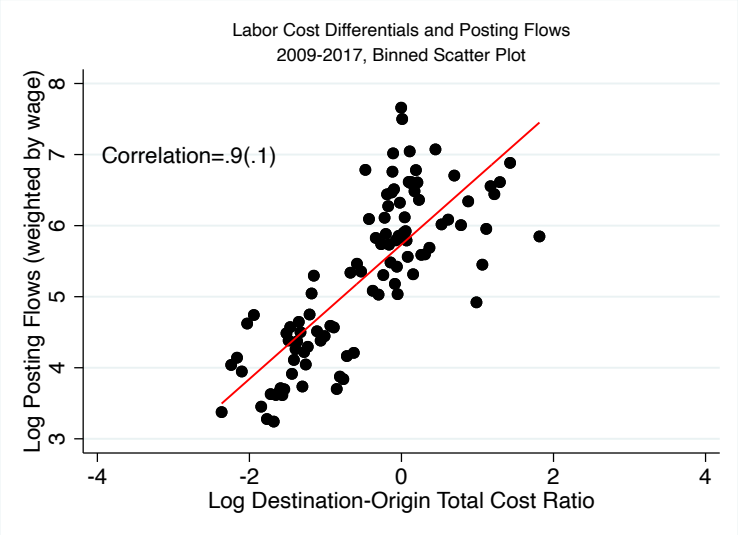


B. Bilateral Flows and Non-Wage Labor Cost Differentials



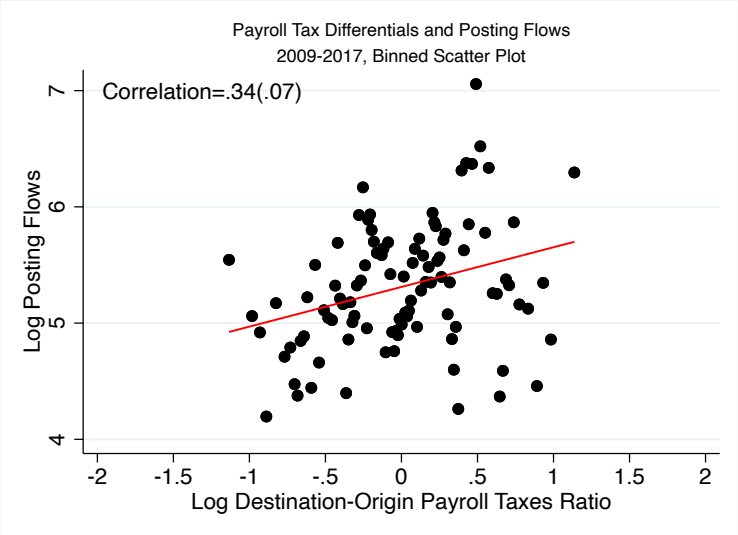
Notes: The figure depicts the steady-state correlation between bilateral posting flows and destination-origin labor cost differentials for the period 2009-2017. The figure is based on the full matrix of bilateral posting flows within the EU merged with data on employers' payroll tax cost for 2009-2017. 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.

Figure A.3: **Weighting Posting Flows by Wages**



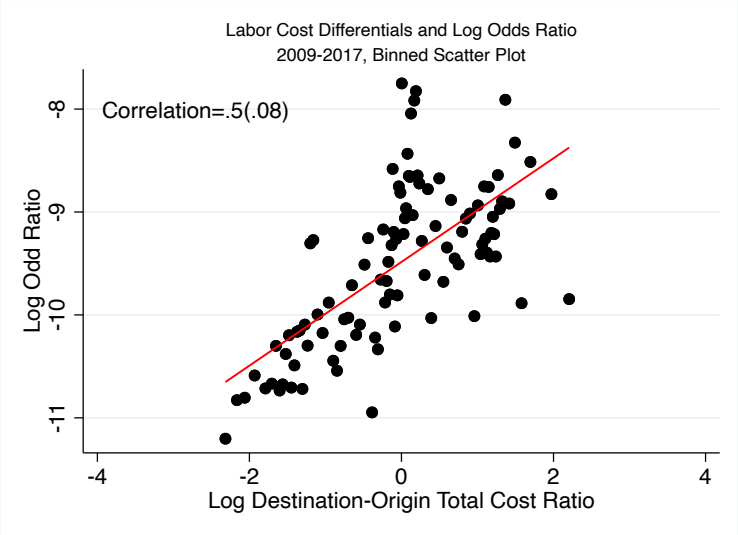
Notes: This figure shows the baseline correlation between log of bilateral posting flows and log of total wage cost differentials, weighting bilateral posting flows by the average wage in the exporting country.

Figure A.4: **Payroll Tax Rates Differentials**



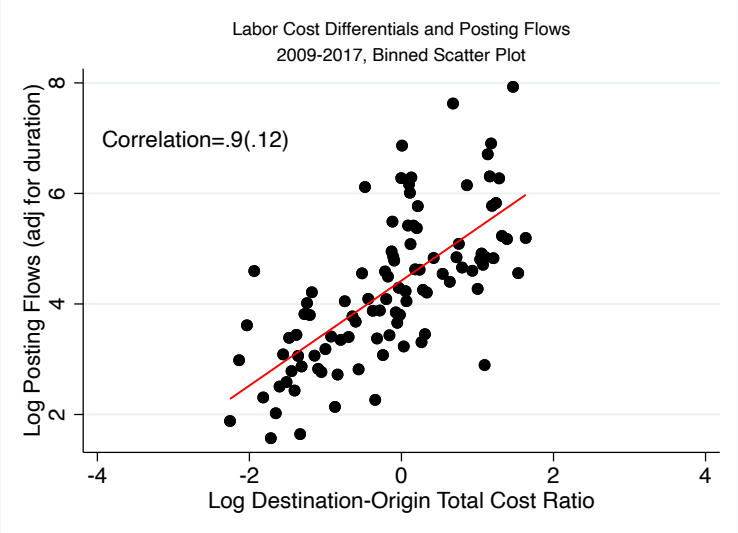
Notes: This figure shows the correlation between log of bilateral posting flows and log of the payroll tax rate ratio as a measure of differences in labor cost between two countries.

Figure A.5: **Log-Odd Ratios**



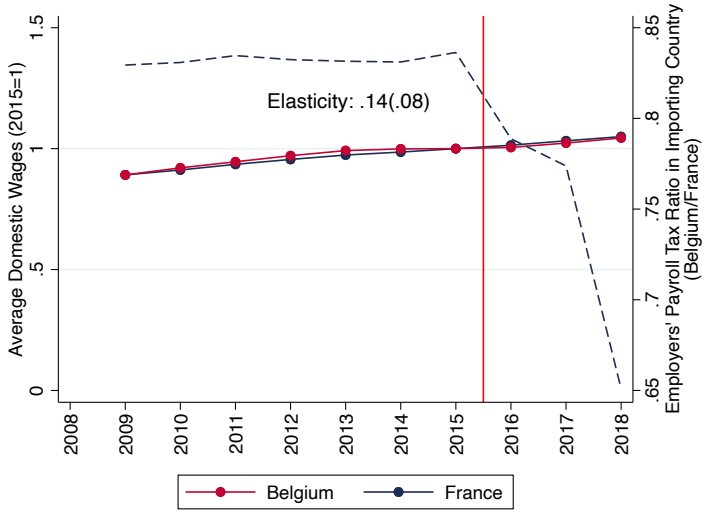
Notes: This figure shows the correlation between log of odd ratios and log of the payroll tax rate.

Figure A.6: **Weighting Posting Flows by Duration**



Notes: This figure shows the correlation between log of bilateral posting flows and log of total wage cost differentials, weighting observations by the average duration of posting assignments.

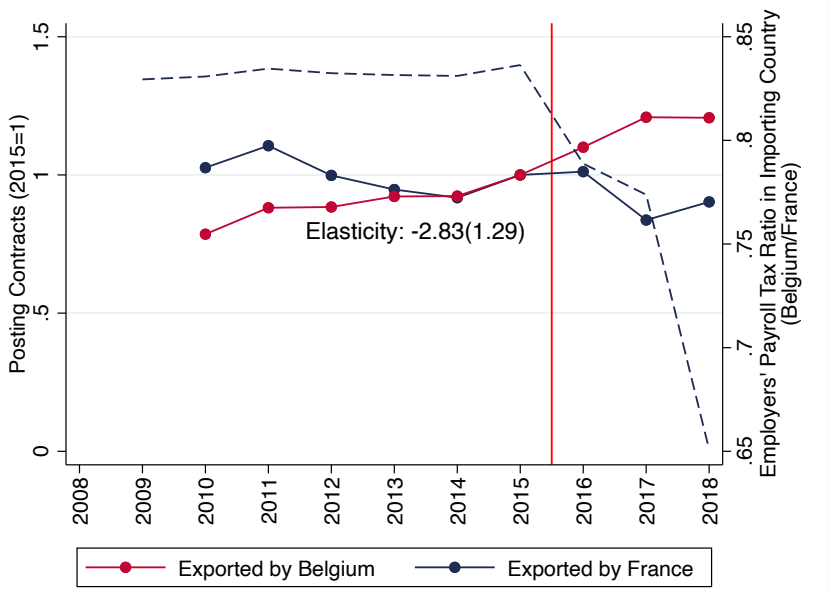
Figure A.7: **Effect of a Payroll Tax Cut in Belgium on Gross Wages**



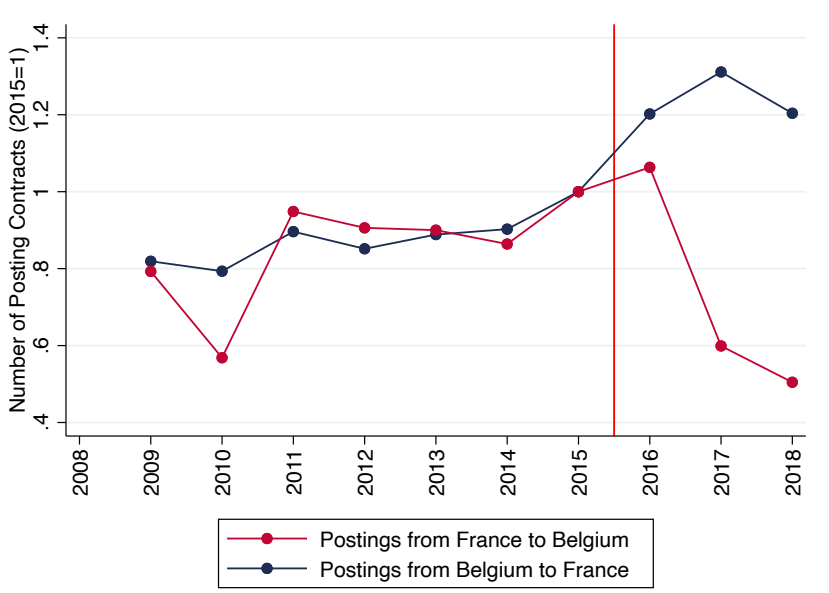
Notes: This Figure repeats the difference-in-differences analysis of the Belgian tax shift reform, using average gross wages instead of posting flows, in Belgium and France.

Figure A.8: **Effect of a Payroll Tax Cut in Belgium on Exports of Posting Services**

A. Exports of Posting Services from Belgium vs France

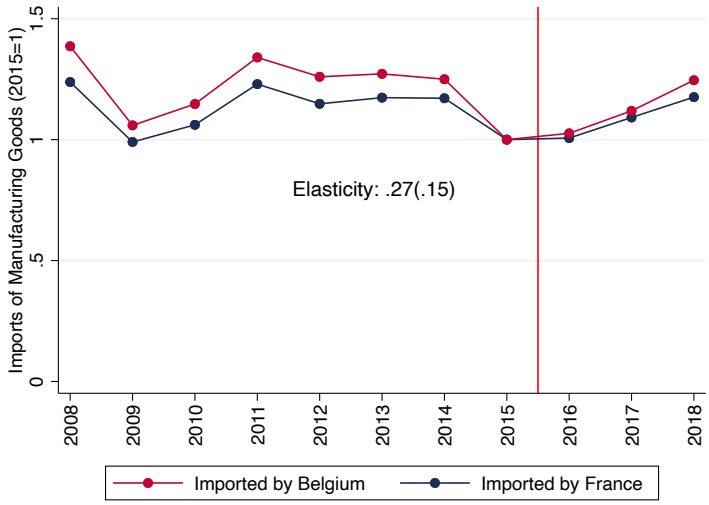


B. Bilateral Trade in Posting Services Between France and Belgium



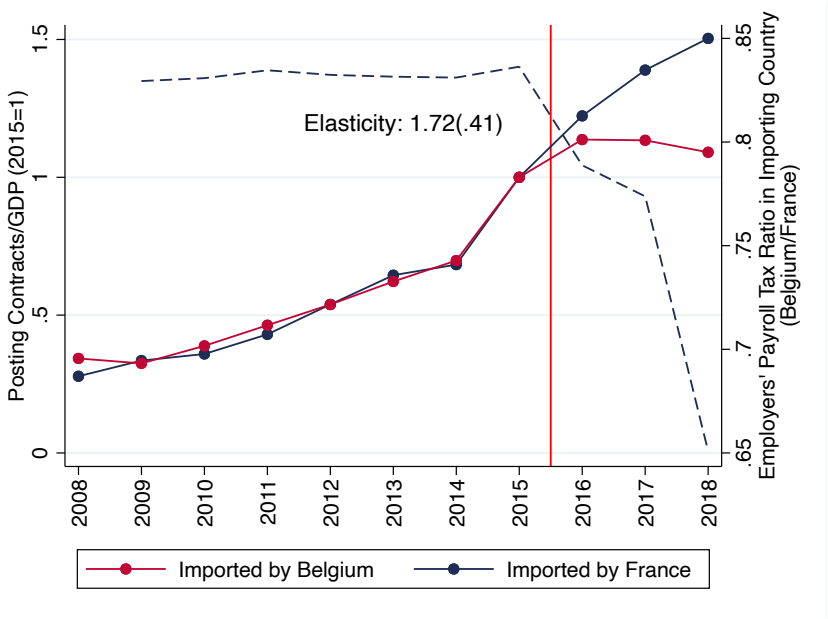
Notes: This Figure repeats the differencce-in-differences analysis of the Belgian tax shift reform, using exports of posting services from Belgium and France.

Figure A.9: **Effect of a Payroll Tax Cut in Belgium on Imports of Goods**



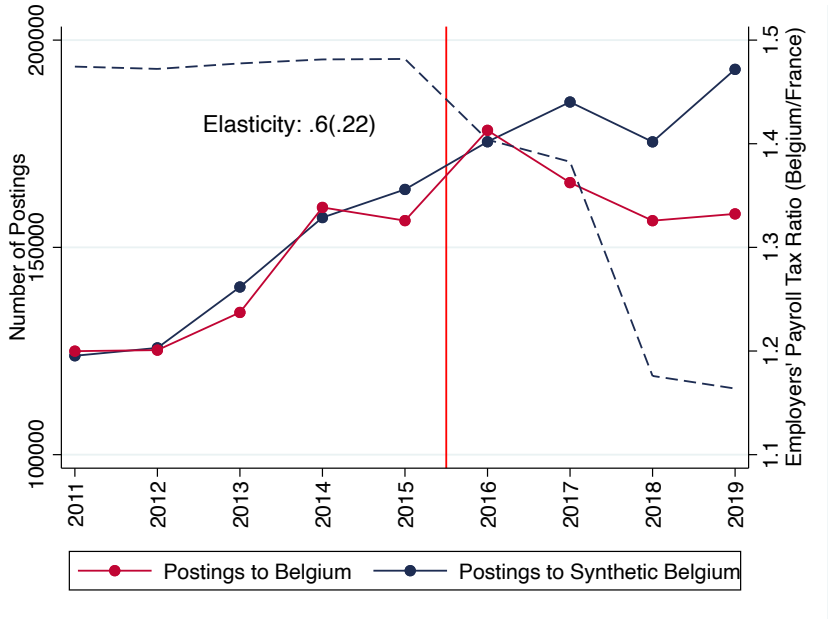
Notes: This Figure repeats the differencce-in-differences analysis of the Belgian tax shift reform, using imports of manufacturing goods instead of posting flows, to Belgium and France.

Figure A.10: **Adjusting for Change in Aggregate Demand After the Reform**



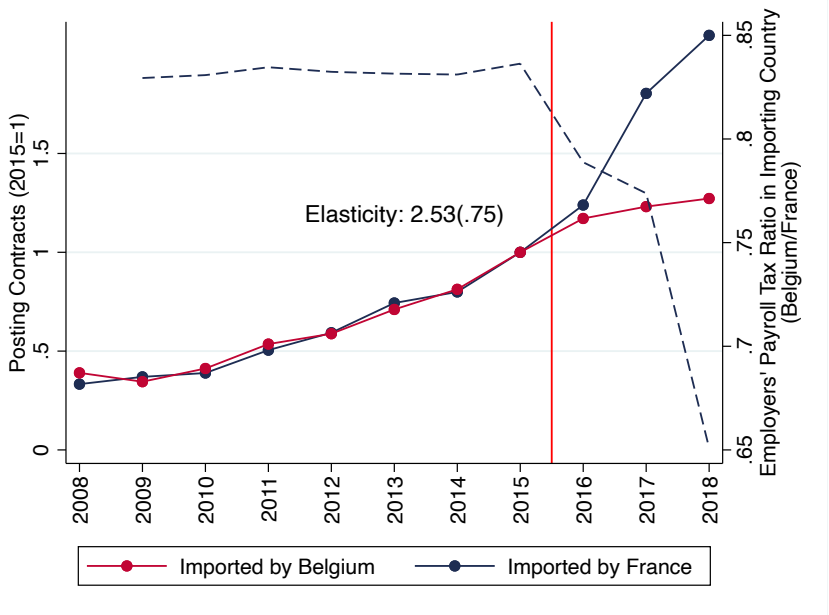
Notes: This Figure repeats the differencce-in-differences analysis of the Belgian tax shift reform, using posting imports over nationwide GDP, in Belgium and France.

Figure A.11: **Effect of a Payroll Tax Cut in Belgium: Synthetic Control Method**



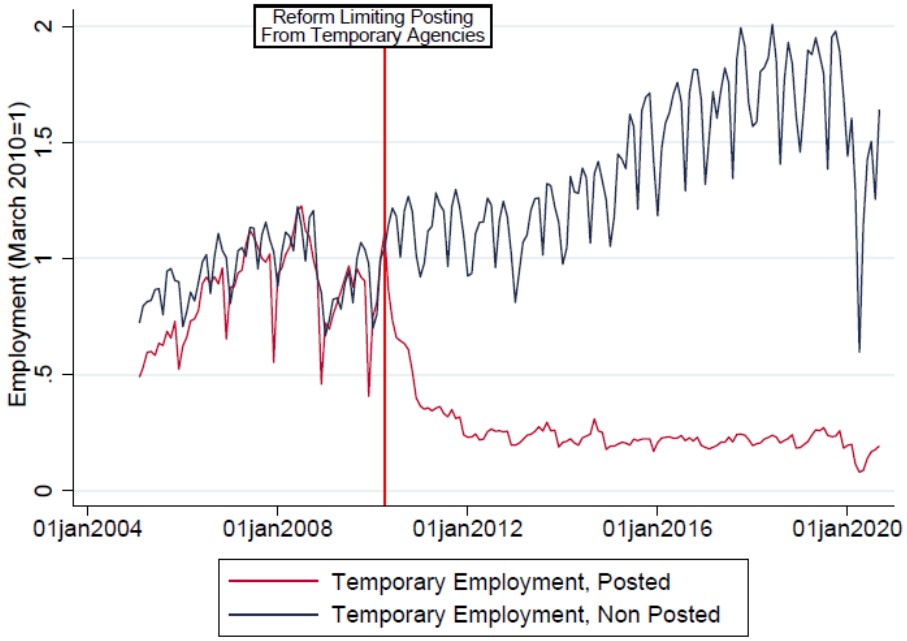
Notes: This graph reproduces the analysis of the tax shift method using a synthetic control country instead. The elasticity reported in the figure is computed with respect to the change in payroll tax rate.

Figure A.12: **Effect of a Payroll Tax Cut in Belgium on Posting Imports: Raw Series**



Notes: This Figure uses posting notifications collected in Belgium and France, plotting raw series non corrected for a potential break in series in 2017 due to a change in reporting system in France. More details can be found in the main text.

Figure A.13: **Effects of Imposing Domestic Payroll Taxes to Exporting Firms**



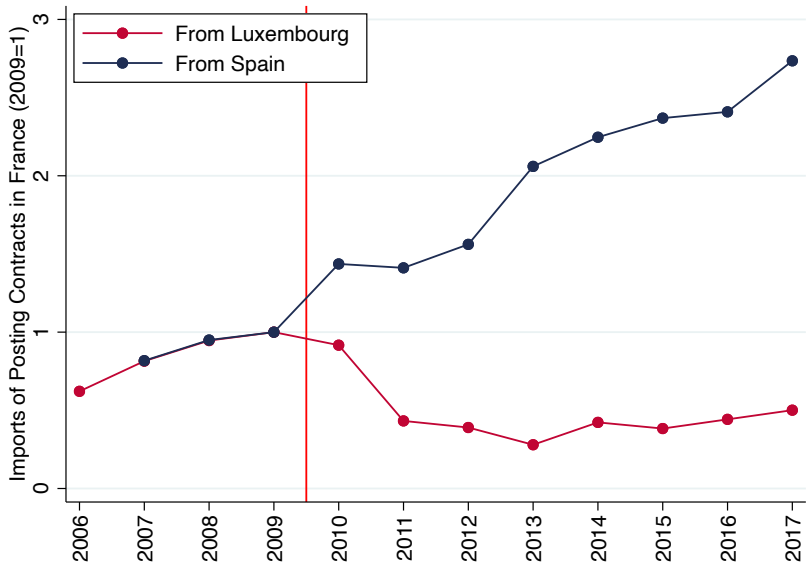
Notes: This Figure shows the effects of restricting posting-specific payroll tax exemptions, using monthly data on employment in the temporary employment sector in Luxembourg. The reform is depicted by the vertical red line., and was introduced in May 2010.

Figure A.14: **Effect of the 2010 Reform on French Imports**

A. French Imports of Posting Services from Luxembourg Dropped

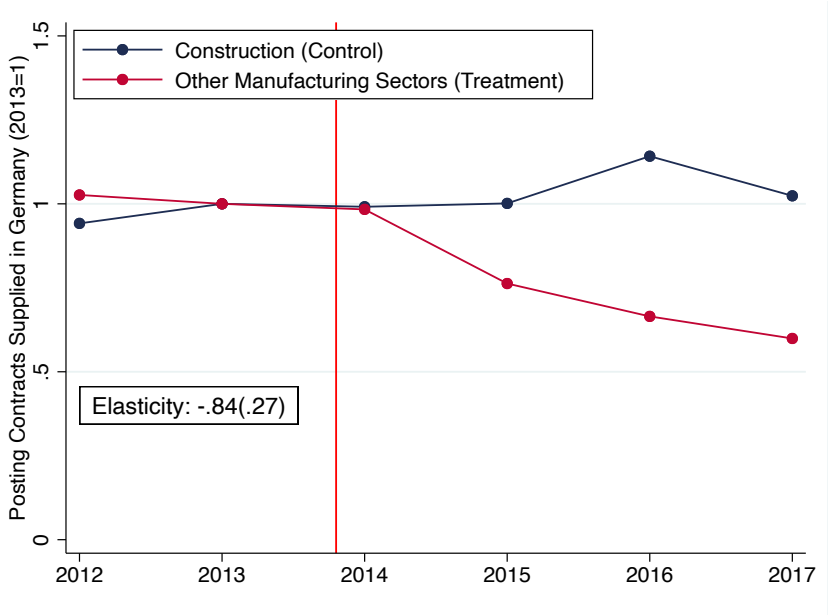


B. Compared to Imports from Control Exporting Countries



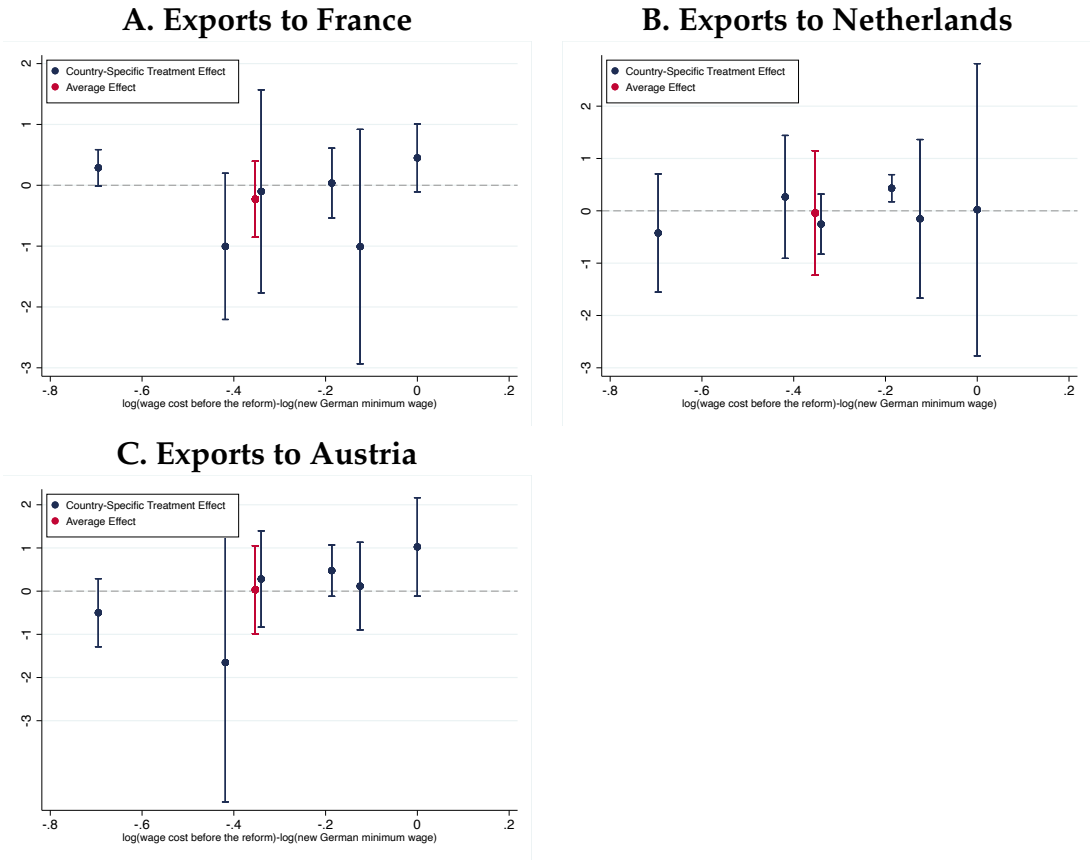
Notes: This Figure shows the effects of the 2010 reform described in the main text of section 4.2.2 on imports of posting services from Luxembourg in France.

Figure A.15: **Effects of the German Reforms: Excluding Romania**



Notes: This Figure shows the effects of the German 2014-2015 reforms excluding exports of Romania.

Figure A.16: **German Reform: Placebo Destination Estimates**



Notes: This Figure repeats the analysis of trade responses to the German minimum wage reform in treated vs control sector; but replacing Germany with its neighboring countries that did not change minimum wage requirements for exporting firms.

Table A.1: **Additional Gravity Specifications**

	(1)	(2)	(3)
Elasticity ($-\theta$)	-1.1***	-1.1***	-1.1***
	(.197)	(.236)	(.256)
Observations	4,677	4,677	3,997
Alternative:	Pair Clustering	Destination×Year, Origin×Year cluster	Zone Euro only

Notes: *p<0.10, **p<0.05, ***p<0.01. This table shows additional specifications for the baseline gravity estimation presented in the main text. The specification is the same than in column (4) of Table 2 but with different inference procedures in column (1)-(2); and excluding countries outside the euro zone in (3).

Table A.2: **Elasticity of Trade in Goods to Posting-Specific Labor Cost Changes**

Regressor: $\log(c_{ijt})$	(1)	(2)	(3)	(4)
Trade in Goods Elasticity				
	.49***	.47***	.35***	. 11
	(.07)	(.06)	(.06)	(.10)
Observations	5,400	5,400	5,400	5,400
Origin-Destination FE	Yes	Yes	Yes	Yes
Destination $\times$ Year FE	Yes	Yes	Yes	Yes
Origin $\times$ Year FE	No	No	No	Yes
Estimator	OLS	PPML	MPPML	MPPML
Internal Flows	No	No	No	No

Notes: *p<0.10, **p<0.05, ***p<0.01. This table repeats the estimation strategy presented in Table 2 and described in the main text, replacing the outcome variable by a measure of bilateral trade in goods. Robust standard errors clustered at destination-year level are in parentheses.

B Additional Institutional Details

The European posting policy is a legal framework within the European Union (EU) that regulates the temporary cross-border movement of workers. This policy allows employees from one EU member state to be temporarily posted to another member state while still being subject to the social security and labor laws of their home country. The primary goal of this directive is to facilitate the provision of services across borders while ensuring fair working conditions for posted workers.

The history of the European posting policy dates back to the 1960s when the EU began working towards creating a single market for services. Freedom to supply services is one of the four pillars of the EU single market and was thus adopted as part of the Rome Treaty. The original legal framework underwent major changes. The first Posting of Workers Directive was adopted in 1996 as a response to concerns that the differences in labor standards and wages across EU member states could lead to unfair competition and exploitation of workers in lower-wage countries. This was in the context of EU enlargement to Spain and Portugal, in particular, where wages and taxes were much lower than in the core of the EU. The primary objective of the directive was to ensure that posted workers benefit from the same core labor rights and working conditions as local workers in the host country. This was however restricted to areas such as maximum working hours, minimum rest periods, minimum paid annual leave, and minimum rates of pay.

The 2004 enlargement of the European Union (EU) marked a significant expansion of the single market. Ten new member states from Central and Eastern Europe joining the EU; which represented roughly 20% of the total EU population at the time. This enlargement brought changes in various EU rules, including those related to the posting of workers. Following the enlargement, workers from the new member states gained the right to post their workers to other EU countries under the framework of the Posting of Workers Directive. This meant that companies from the new member states could send their employees to provide services in other EU countries on a temporary basis; without having to request employment or work authorization in the country of destination.

The EU enlargement also trigerred the liberalization of migration (free movement of workers) for citizens of new member states. However, transitional arrangements were implemented by several existing EU member states, primarily in Western Europe. These arrangements allowed these countries to restrict the free movement of workers from the new member states for a limited period (up to seven years) after the 2004 enlargement. The idea behind these restrictions was to gradually open up their labor markets to prevent sudden disruptions in local labor markets and to mitigate potential downward pressure on wages. Those so-called "safeguard" clauses were only implemented for traditional migrants, not posted workers, with the exception of Austria and Germany that were allowed to impose transitional measures for the cross-border supply of services too. The timing of the safeguard clauses and of free movement and free posting liberalizations for new member states of 2004 and 2007 is summarized in Table B.3.

In the aftermath of the EU enlargement, a proposal for a new directive for services was introduced. The Bolkestein Directive, formally known as the Services in the Internal Market Directive, was a proposed piece of legislation by the European Commission in 2004. The directive was named after Frits Bolkestein, the European Commissioner for

Table B.3: Liberalization of posting and free movement for Eastern European Countries

	NMS of 2004		NMS of 2007	
Country	posting	free movement	posting	free movement
Belgium	2004	2009	2007	2014
Denmark	2004	2009	2007	2009
Germany	2011	2011	2014	2014
Ireland	2004	2004	2007	2011
Greece	2004	2006	2007	2009
Spain	2004	2006	2007	2009
France	2004	2008	2007	2014
Italy	2004	2006	2007	2011
Luxembourg	2004	2007	2007	2014
Netherlands	2004	2007	2007	2014
Austria	2011	2011	2014	2014
Portugal	2004	2006	2007	2009
Finland	2004	2006	2007	2007
Sweden	2004	2004	2007	2007
United Kingdom	2004	2004	2007	2014

Notes: NMS 2004: Poland, Latvia, Lithuania, Slovakia, Slovenia, Hungary, Czech Republic, Estonia; NMS 2007: Romania, Bulgaria.

Internal Market and Services at the time. The proposal aimed to address barriers that hindered the free movement of services across the EU, such as varying regulations and administrative burdens faced by service providers operating in different member states. One of the most controversial aspects of the directive was the "country of origin principle." This principle suggested that service providers should adhere to the regulations and laws of their home country, even when providing services in another EU member state. This approach was intended to simplify the regulatory environment for service providers, but critics argued that it could lead to "social dumping," where companies take advantage of lower standards in their home country to provide services in other member states. In fact, the country of origin principle in the Bolkestein proposal was opposite to the restrictions set by the 1996 directive; and were essentially reverting the minimum wage requirements for sending companies.

The Bolkestein Directive sparked significant controversy and debate across the EU. Critics argued that the country of origin principle could undermine labor standards, workers' rights, and consumer protection in some member states. They expressed concerns that service providers might establish themselves in countries with less stringent regulations to take advantage of lower costs and then provide services in other member states with higher standards. Due to the intense controversy and opposition from several EU member states, the Bolkestein Directive was significantly amended and its scope was narrowed. Essentially, the country of origin principle was removed from the final version of the directive.

The EU Regulation 883/2004, which came into effect in May 2010, introduced changes that impacted posted workers, including those in border regions. This regulation aimed to streamline and clarify the rules regarding social security coordination for individuals moving within the European Union (EU) and the European Economic Area (EEA). It sets new restrictions for payroll taxation for firms engaged in the posting program. Specifically, the authorization to maintain a posted worker under the social security system of their employer's country can only be granted if the posted worker has been affiliated with the social security agency of the sending country for a minimum of one month prior to the posting. Furthermore, a break of two months between two posting contracts is required before the same worker can be posted to the same country. If a worker is posted to its own country of residence, the payroll taxes must also be paid in the country of destination. Furthermore, the principle whereby employees employed by a company operating across a common border of two States had to be subject to the legislation of the Member State in which the company had its registered office is changed by the new regulation (Regulation EC No. 1408/71, June 14, 1971, Article 14b(3), Official Journal of the European Communities, July 5, No. L 149, p. 2). After 2010, the Regulation No. 883/2004 indicates that the common law applies, and thus the law of the place where the employment contract is executed prevails. Furthermore, some exceptions were granted to some sectors. For instance, international transportation has traditionally been excluded from general social security regulations because of the highly mobile nature of the activity (regulation no.1072/2009). This was also true for the 2010 EU regulation: firms operating in the road transportation sector that were potentially exposed to the change in rules were granted a 10-year transitory exemption period.

The 2017 directive concerning posted workers is known as the "Directive (EU) 2017/159 of the European Parliament and of the Council of 19 December 2016 amending Directive 96/71/EC concerning the posting of workers in the framework of the provision of services." This directive amended the original 1996 Posted Workers Directive (Directive 96/71/EC) and aimed to establish more equal working conditions for posted workers compared to domestic workers in the host country. The directive was introduced against the backdrop of growing concerns about social dumping within the EU. The proposal aimed to strike a balance between facilitating the free movement of services and ensuring fair working conditions. The main proposed change was the "equal pay" principle where posted workers should be entitled to equal pay for equal work in the same location. This means that posted workers had to receive the same salary and benefits as local workers for performing the same job. In practice, this means that the destination-specific minimum legal wage requirement is replaced by the destination-specific *prevailing wage*.

Emmanuel Macron, the President of France, played a prominent role in advocating for changes to the Posted Workers Directive within the European Union (EU). His role and actions were part of France's broader efforts to address concerns related to social dumping and the rights of workers in the EU. France, under Macron's leadership, was one of the countries pushing for stricter regulations and a more comprehensive reform of the directive. The French government sought to limit the duration of postings, increase the application of host-country labor laws, and ensure equal pay for posted workers.

C Additional Evidence: Slovenian Posted Bonus

I additionally 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 end of 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 after the reform, introducing a large labor cost cut for workers posted by Slovenian suppliers.[50] The reform introduces a sharp decrease in the social security contribution rate paid by Slovenian employers, of about 40% for workers paid at the average wage level (Figure C.17). According to the theoretical framework, this payroll tax cut should increase trade-migration flows from Slovenia ($dS_{ijt}/d\tau_{it}$<0).

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.

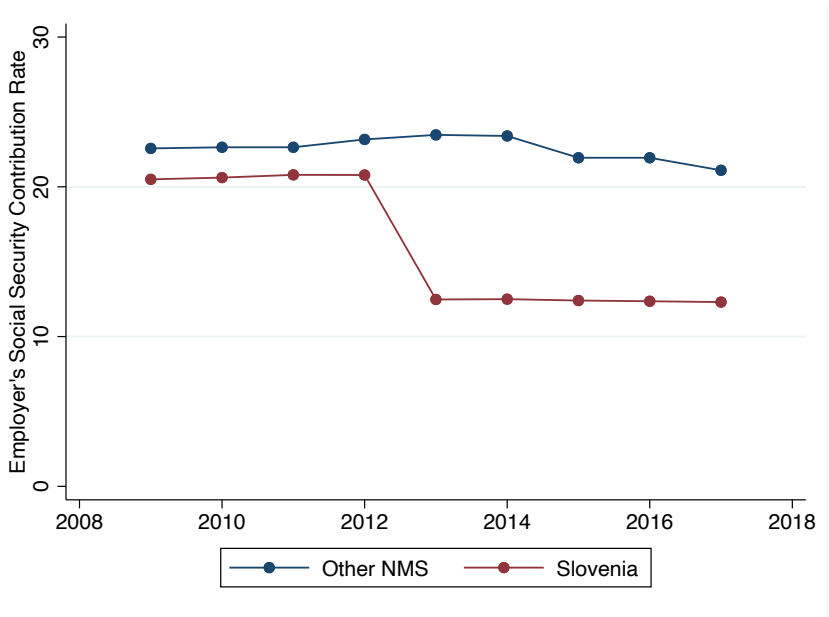
Figure 5 shows graphically the differences-in-difference setting provided by the reform. The top panel plots the number of posted workers from 2008 to 2017 (normalized to one in 2012 just before the reform implementation) sent by Slovenia (treatment) and by other NMS (control) to Austria, the main receiving country for workers posted from Slovenia. 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 Φ_{jt} that should affect demand for workers posted from Slovenia and other NMS 2004 countries similarly. 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 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 the origin-based payroll tax rate given by this country-level experiment is large and significant, with a point estimate of -2.3 (0.35) in Austria, -2.2 (0.35) in Germany, and -1.62 (0.24) for all receiving countries, controlling for destination-year fixed effects.[51] Next, Panel B repeats the difference-in-differences setting using the synthetic control method a la

[50] The effect of this payroll tax cut "posted bonus" has been documented by a worker union (EFBHWW) 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.

[51] The corresponding reduced form estimates for the elasticity of trade-migration flows with respect to origin-specific non-wage labor cost component are respectively -1.77 (.23), -1.70(.24) and -1.3(.18), while the elasticity with respect to total wage cost is larger, with a point estimate of -5.5(.72).

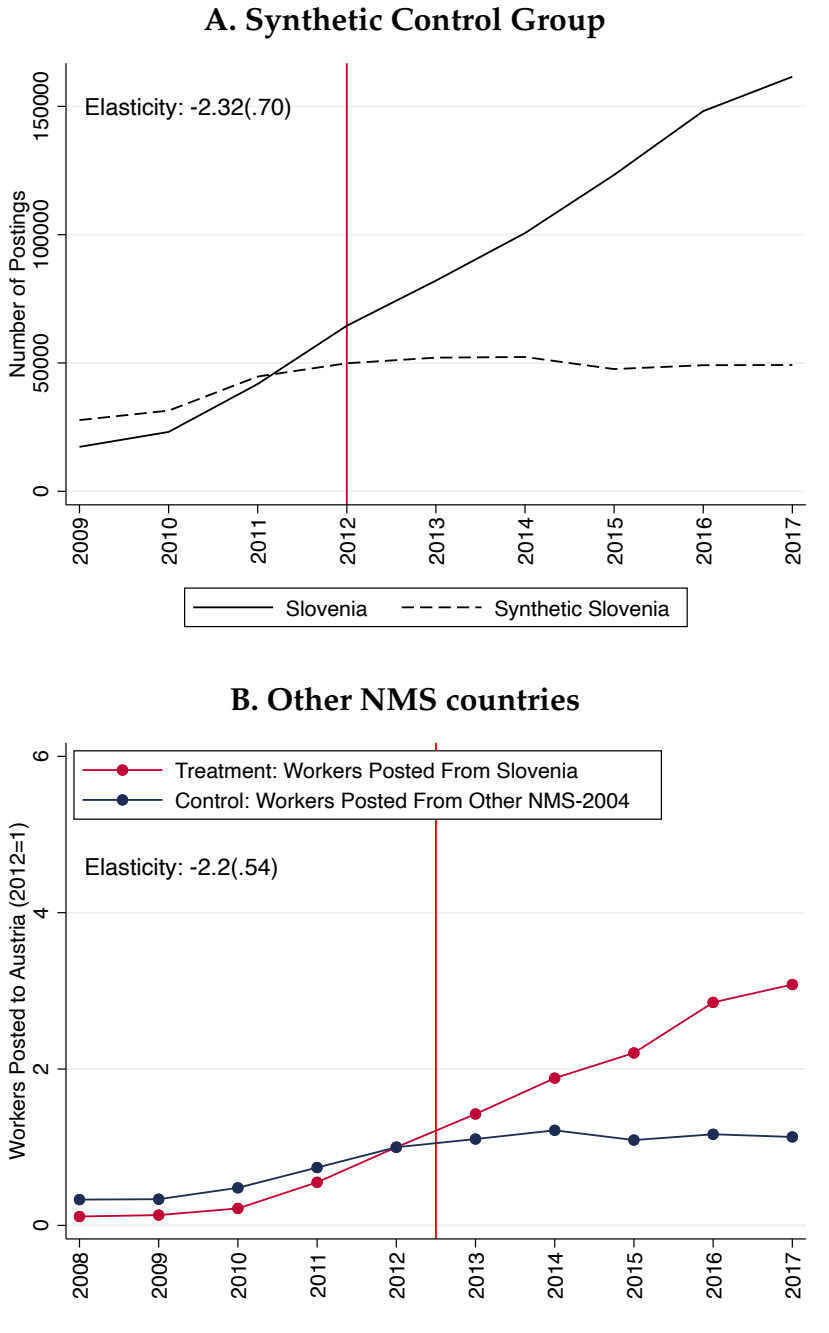
Abadie et al. (2010) to build an alternative control country, matching on pre-reform trade-migration flows .The figure compares all workers sent from Slovenia to all destination countries, to the number of workers posted from the synthetic country to all destination countries. The results are extremely similar, with an implied reduced form trade elasticity with respect to payroll tax rate in the origin country of -2.3(.71).

Figure C.17: **Slovenian Posted Bonus and Payroll Tax Rate**



Notes: This Figure shows the evolution of payroll tax rates paid by firms located in Slovenia and other NMS before and after the new social security regulation of 2012.

Figure C.18: **Trade Responses to Slovenian Posted Bonus**



Notes: This Figure shows the effects of a payroll tax cut for workers posted from Slovenia, on exports of posting services from Slovenia.