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DISCUSSION PAPER SERIES

IZA DP No. 16770

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ABSTRACT

Propagation of Immigration Shocks through Firm-to-Firm Trade Networks*

This paper investigates the degree to which immigration shock to a region propagates through supply chains. Using the unexpected arrival of Syrian refugees densely concentrated in border regions of Turkey, we estimate how firms throughout the country are affected in terms of their sales, employment, and wages. We also estimate the effect of the shock on interprovincial trade, focusing on trade volume and network formation. The results point to positive spillover effects of immigration for firms with pre-existing links to Syrian refugee-hosting regions through upstream and downstream linkages. We further find evidence for increased trade volume and network expansion through new trade linkages.

JEL Classification: D22, J61, L14

Keywords: immigration, propagation, firm-to-firm trade, employment, production networks

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1 Introduction

A large literature examines the impact of migrant flows on labor market outcomes and firm performance. Since migrant flows typically affect certain parts of a country more than others, many of these studies use geographical comparisons over time in a difference-in-difference framework.[1] However, the regions where migrants do not settle are also affected by the migrant shock when the migrant impact on firms in treated regions propagates to firms in untreated regions via supplier-customer links. This paper examines the indirect impact of migrant flows via production networks in the context of the massive Syrian refugee influx into Turkey—the largest current refugee stock worldwide. In particular, it examines how this massive refugee influx affects the buyer-supplier relationships among firms and how this change in production networks affects firm performance.

A large and growing literature examines economic networks.[2] This literature mostly studies the spillover effects of shocks across sectors. In contrast, relatively little work exists about the propagation of shocks across firms and the importance of production networks on firm performance.[3] The few studies on the propagation of shocks across firms use natural disasters, such as earthquakes, or infrastructure development, such as railways, as a source of an exogenous change in production networks.[4] Even less is known about the creation and destruction of firm-to-firm linkages due to these shocks. To the best of our knowledge, only Bernard et al. (2019) have examined this issue so far. Our study differs from this literature in that it focuses on the propagation of labor supply shocks across firms.

Since the start of the Syrian conflict in 2011, nearly six million Syrians have fled the country and sought refuge in nearby countries. Turkey hosts the highest number of Syrian

[1] See, e.g., Card (1990), Hunt (1992), Friedberg (2001), Mansour (2010), Cohen-Goldner and Paserman (2011), Glitz (2012), Foged and Peri (2016), Dustmann et al. (2017), and Aydemir and Kırdar (2017).

[2] See, e.g., Long and Plosser (1987), Jovanovic (1987), Durlauf (1993), Horvath (2000), Di Giovanni and Levchenko (2010), Acemoglu et al. (2012), Atalay (2017), and Dhyne et al. (2021).

[3] There are exceptions, see for example Barrot and Sauvagnat (2016), Di Giovanni et al. (2014), Todo et al. (2015), Boehm et al. (2019), Bernard et al. (2019) and Carvalho et al. (2021).

[4] Barrot and Sauvagnat (2016), Boehm et al. (2019) and Carvalho et al. (2021) use the 2011 earthquake in Japan, and Bernard et al. (2019) use the opening of a high-speed train line in Japan.

refugees, currently at 3.7 million. The overwhelming majority (98.7 percent) of the Syrian refugees in Turkey live outside of camps (Turkey Presidency of Migration Management (TPMM), 2021). Geographically, Syrians are concentrated in provinces close to the Syrian border. Syrians have joined the Turkish labor market in high numbers;[5] however, most Syrians work in the informal sector (98 percent), where wages are lower, which has lowered the production costs of firms employing them. In fact, evidence exists that Syrian refugees have significantly impacted firm performance and market structure; for instance, Akgündüz et al. (2023) report that existing firms expand and new firms are established.

The existing literature shows that the arrival of refugees in Turkey has improved firm performance in refugee-dense regions (Altındağ et al., 2020; Akgündüz et al., 2023), but does the arrival of refugees also affect the performance of firms that are farther away? For this purpose, we first examine how much the effects of the refugee shock, concentrated in certain regions, propagate to other regions via firm-to-firm linkages. We also analyze how far propagation goes in terms of distance and how long it takes until these effects are realized. In addition, we investigate the key drivers and obstacles to propagation. In particular, we examine the roles of existing trade links, the importance of trading in intermediate goods, geographical distance, production technology, and firm size.

The propagation of the refugee shock can take place through not only the existing links but also the establishment of new links. The formation of new links depends on firms' ability to alter their production mix, switch to new suppliers, and find new customers, which depend on information about the potential suppliers and transportation costs.[6] Barrot and Sauvagnat (2016) and Carvalho et al. (2021) find high switching costs in the short run after the disruption in the supply chains caused by natural disasters. Significant switching costs are also reported in banking networks in the diffusion of financial shocks (Khwaja and Mian, 2008). To understand the role of switching costs in our context, we also examine the Turkish

[5]Based on the 2018 Turkey Demographic and Health Survey, a nationally representative dataset of natives and refugees, Demirci and Kırdar (2023) report that 61.8 percent of 18–59-year-old refugee men were in paid employment compared to 68.9 percent of native men of the same age group

[6]Bernard et al. (2019) use a model of production networks where firms actively search for suppliers.

firms' ability to establish new links in response to the arrival of Syrian refugees.

Our empirical analysis draws on a rich administrative dataset of the entire population of Turkish manufacturing firms. This dataset provides a comprehensive overview of firms' activities, including sales and employment. Most importantly, it includes information about all firm-to-firm trade—not only the binary links but also the trade values. Using this information on firms' pre-shock networks, as well as the distribution of the migrant shock across provinces, we generate measures of firm-level migrant shocks—that are more precise than those in the previous literature.

To understand the propagation of the migrant shock across firms, we estimate how various firm performance indicators change with the migrant shock to upstream and downstream links. In doing so, we control for province-sector-year fixed effects; hence, we compare two firms in the same province, sector, and year to account for local demand shocks and use the variation in their pre-shock network differences. Our key identification assumption is that—for a given province and sector pair—outcome variables have similar time trends across firms that trade with the refugee-intensive regions and that do not. We use an event study analysis to check that this identification assumption holds.

Our results indicate that firm sales and employment increase in the migrant shocks received by both upstream suppliers and downstream customers. The estimated positive downstream exposure impact is consistent with a market expansion as refugees expand the consumer base. The estimated positive upstream exposure impact on sales and employment might result from the fact that refugees—mostly working for lower wages in the informal sector–lower the production costs of upstream suppliers and, hence, the costs of downstream purchasing firms. Examining this potential channel, we find that firms' costs-to-sales ratios decline in upstream exposure. This cost advantage accrued from the employment of refugees by upstream supplier firms is transferred to downstream purchasing firms.

We find significant heterogeneity in the upstream and downstream exposure impacts by firm characteristics. Sales of firms producing low-technology goods rise in both upstream

and downstream exposure to migrants. Sales of firms producing high-technology items also increase in downstream exposure; however, there is no evidence that sales of firms producing high-technology items change with the expansion of the production base in their upstream links—which is expected as Syrians work in low-technology sectors. In terms of firm size, large firms are more sensitive to upstream exposure than small and medium firms—suggesting that large firms buy more from firms located in the migrant-dense regions. In contrast, all firms, regardless of size, increase their sales as their downstream exposure rises, although the employment impact is limited to large firms. Finally, distance is not a significant impediment to the propagation of the refugee shock across firms. We find that firms farther away from migrant-dense regions are equally likely to be affected.

We support these firm-level findings by presenting evidence that inter-province trade increases in the migrant shock received by each of the destination and origin provinces. Neither geographical distance nor weak pre-shock inter-provincial trade levels reduce the positive impact of the migrant shock on interprovincial trade. In addition, the number of firm-to-firm links between provinces increases when the buyer province receives a large refugee shock, implying that firms can find new buyers in the refugee-dense regions. In contrast, there is no evidence of a change in the number of firm-to-firm links when the seller province receives a large shock, suggesting that finding new suppliers is much harder. Moreover, production networks appear to be particularly strengthened between provinces that had little trade before the refugee shock.

Finally, we also assess the relative magnitudes of the propagation effect and the direct impact of the refugee shock on native employment. We find that the propagation effect amounts to about 20 percent of the direct positive impact of the refugee shock on native formal employment. In other words, the indirect effects of migration emerging in regions far away from the refugee-dense regions are quantitatively significant.

The first contribution of this study is to the literature about the effects of migrant shocks on the economy. This study provides the first evidence of the role of migrant shocks on firm

performance that results from the impact of the migrant shock on supply chains. In most quasi-experimental studies that seek to measure the migrant impact on household or firm outcomes, the migrant shock is concentrated in certain parts of the country.[7] To measure the short-run migrant impact, these studies compare the impact in migrant-dense regions with that in other regions. This literature also acknowledges that these short-run impacts might dissipate in the long run due to equilibrating labor and capital flows.

The arrival of migrants leads to labor supply shocks in regions not directly affected by the migrants, as natives in the directly affected regions respond by migrating to other regions (see, e.g., Card and DiNardo (2000), Card (2001), Borjas (2006)). In this way, the local labor supply shock due to migrants spread to the national market. Monras (2020) finds that although the initial impact of migrants on low-skilled natives is substantial in the US,[8] this negative effect disappears over time due to internal migration; in fact, low-skilled natives' wages are only slightly lower five years after the shock.[9] Our study provides empirical evidence for a novel channel that influences the long-run impacts of migration: customer-buyer links across firms. Moreover, the propagation effect in our setting is also equilibrating regarding the migrant impact on formal employment, as in the equilibrating effect of internal migration. In addition, our event-study analysis reveals that both the upstream and downstream impacts of the refugee shocks on firms' sales and employment are

[7]See, e.g., Altonji and Card (1991), Borjas (2006) and Card (1990) for the US; Aydemir and Borjas (2011) for Canada; Dustmann et al. (2016) and Pischke and Velling (1997) for Germany; Hunt (1992) for France; Dustmann et al. (2005) for the UK; Aydemir and Kırdar (2017) for refugees from Bulgaria, Aksu et al. (2022) and Aracı et al. (2022) for Syrian refugees in Turkey.

[8]One percent rise in the labor supply due to the migrant shock reduces low-skilled natives' wages by 0.7 percent.

[9]There are several other channels through which the labor market effects of immigrants equilibrate over time. We would also expect capital to flow into regions that become more labor-abundant after the migrant shock. In fact, in the context of the Syrian refugee shock into Turkey, Aksu et al. (2022) and Akgündüz et al. (2023) report an increase in new firm openings. Another way of adjustment to the immigrant labor supply shock for firms is changing the production technique of a given product. Lewis (2011) finds that manufacturing plants in high migrant-intensity regions in the US invested less in automation machinery than firms in other regions, which reduced the impact of immigration on less-skilled natives' wages. A further channel of adjustment could be a change in the product mix firms produce. An increase in the amount of unskilled labor will lead to an increase in the share of the goods that use unskilled labor intensively, as in Rybczynski (1955).

statistically detectable about two years after the peak of the refugee inflows.[10]

The second contribution of this study is to the literature studying the role of production networks in the propagation and amplification of shocks, using data on firm-to-firm linkages. Barrot and Sauvagnat (2016), Boehm et al. (2019), and Carvalho et al. (2021) exploit natural disasters as shocks to production networks, Couttenier et al. (2022) examine the propagation of the impact of a localized conflict to other regions via production networks, and Bernard et al. (2019) examine the effect of an opening of a new rail line in Japan on production networks. Unlike these studies, we utilize a massive migrant labor supply shock to production networks. Our finding about the improvements in firm performance is in line with that of Bernard et al. (2019). Similarly, Barrot and Sauvagnat (2016) and Carvalho et al. (2021) find that shocks to supply chains affect firm performance. Our study differs from Bernard et al. (2019) and Barrot and Sauvagnat (2016) in that we examine both upstream and downstream effects, but it is similar to Carvalho et al. (2021) in this sense. While the firm-to-firm linkages are binary in these studies, our key variable of interest also utilizes the values of firm-to-firm sales. Hence, we can construct a more precise measure of the importance of links. Another key aspect of our study is that we examine how the shock alters production networks, whereas production networks are fixed in Barrot and Sauvagnat (2016) and Carvalho et al. (2021). In this sense, our study is similar to Bernard et al. (2019), who report the creation of new buyer-seller links.[11] Our setting is particularly interesting in studying the creation of new buyer-seller links because the shock also led to the generation of new firms (i.e., new potential nodes in the production network), as the previous literature shows.

[10] Earlier studies on the labor market impact of the refugee shock in our setting find that the direct impact on labor market outcomes is realized even before the peak of the refugee inflow (see, e.g., Ceritoglu et al. (2017) and Aksu et al. (2022)).

[11] However, Bernard et al. (2019) face the limitation that the number of suppliers per firm is capped at 24 in their data, whereas we can observe all links in our data.

2 Background Information

After the Syrian civil war started, refugees started arriving in Turkey in 2011. Turkey adopted an open-door policy toward Syrian refugees. The Turkish government gave "temporary protection" status to the Syrian refugees in October 2011. Most of the refugees stated that they left Syria for security reasons and chose Turkey as their destination due to the ease of transportation (Ferris and Kirişci, 2016).

At first, the number of refugees was relatively low; there were about 8,000 Syrians at the end of 2011 and 170,912 Syrians at the end of 2012. However, the pace of their arrival accelerated after 2013 as the war intensified. The number of Syrian refugees in Turkey reached 560,129 at the end of 2013, 1,622,839 at the end of 2014, and 2,503,549 at the end of 2015. After 2015, while the pace slowed, Syrian refugees kept coming in. The number of Syrian refugees in Turkey was about 2.8 million at the end of 2016, 3.4 million at the end of 2017, and 3.6 million at the end of 2018. In the initial years of the crisis, Syrian refugees were placed in refugee camps in Turkey. However, they settled in urban areas over time. Only about 10% of Syrians in Turkey lived in refugee camps at the end of 2015 (PMM, 2016).

Syrians are, on average, younger and less educated than natives. According to the 2018 Turkey Demographic and Health Survey, which includes a representative sample of the Syrian refugees and natives, among the working-age population (15+), 36.8% of Syrians but 20.8% of natives are 15- to 24-year-old, and 80.9% of Syrians but 57.1% of natives are 15- to 44-year-old. In terms of education, among the 20- to 59-year-old population, 17.3% of Syrians have a high school or a higher degree compared to 41.1% of natives.

Syrian refugees have had limited access to formal employment. Until 2016, they did not have access to formal employment, except for special circumstances such as starting a business.[12] In January 2016, with new legislation (Law No: 8375), Syrian refugees became eligible to hold work permits with certain restrictions. However, the number of work permits

[12]Only 7,351 work permits were issued for Syrian refugees until 2016 (Turkish Ministry of Labor and Social Security, 2019).

remained low. Therefore, many Syrian refugees work informally to sustain their lives. In fact, based on the 2018 Turkey Demographic and Health Survey, Demirci and Kırdar (2023) report that the employment rate of Syrian refugee men does not lag much behind that of native men. For a sample of 18- to 59-year-olds, they find that 61.8% of refugee men have paid jobs compared to 68.9% of native men, although the gap is wider among women (6.5% vs. 24.8%). In addition, refugees are much more likely to be informally employed. Demirci and Kırdar (2023) find that 97.9% of 18- to 59-year-old married refugee men are informally employed compared to 19.1% of native married men of the same age group. They also report that the fraction employed in manufacturing is higher for refugee men than for native men.

The previous literature studying the local effects of the Syrian refugee influx into Turkey finds that this influx has made a substantial impact on firm performance and market structure in the refugee-dense regions. Akgündüz et al. (2023), using the same data sources as in this study and a similar difference-in-differences IV methodology, conduct a comprehensive analysis of the refugee shock on firm behavior, including exporting. They find that Turkish firms significantly benefit from the arrival of refugees in terms of sales. Moreover, the rise in sales is more pronounced in manufacturing—the sector our study focuses on— where many Syrian refugees work informally, but smaller in the services sector, where the language barrier makes it harder for the refugees to secure jobs. They also report an increase in the establishment of new firms. In addition, the authors uncover a fall in the prices of exported products, resulting from the cost advantages of employing Syrian refugees. Furthermore, they find that exports and the product variety of exports to the MENA region, with which the refugees have cultural and business ties, rise substantially.

Several papers have examined the impact of Syrian refugees on natives' labor market outcomes using the Turkey Household Labor Force Surveys, which we also do in this study (for formal employment) using firm-level data. The findings of the previous literature are mixed. Ceritoglu et al. (2017) find negative effects of the refugee shock: falling informal employment, increasing unemployment, falling labor force participation rate, and job-finding

rates among natives. In contrast, Cengiz and Tekgüç (2022) do not find a negative impact on natives' employment. Del Carpio and Wagner (2015), Aksu et al. (2022), and Aracı et al. (2022) report an adverse effect on men's informal employment. However, they also find a positive impact on men's formal employment, resulting in a null overall impact on men's employment. At the same time, they find a negative impact on women's employment. Aksu et al. (2022) also uncover a positive impact on wages in the formal sector and show that not accounting for the pre-existing trends in this variable—as done in the other papers—hides this fact, as the formal wage growth in the pre-shock period was much higher in the control regions.

The improvement in output and firm performance, as shown in Akgündüz et al. (2023), is consistent with the limited adverse effects of Syrians on native employment reported by the studies above. Essentially, firms use more of the production factor (unskilled workers) that becomes more abundant after the arrival of refugees. The sectors that can benefit most from this—such as construction and manufacturing—see the highest rise in sales. This is consistent with the findings in Aksu et al. (2022) and Aracı et al. (2022), which report a substantial replacement of informally-employed native workers with refugees in both of these sectors as well as a significant rise in formally-employed native workers in manufacturing.

3 Methodology

We designed empirical approaches to analyze two issues: the propagation of Syrian refugee shocks across provinces through firm-to-firm trade and the changes in the trade network in response to the arrival of Syrian refugees. To estimate the propagation across provinces through firm-to-firm trade, we compare firms with varying regional supply chains within Turkey in the following difference-in-differences specification.

$$y_{ijst} = \alpha_0 + \alpha_1 R^U_{ijt} + \alpha_2 R^D_{ijt} + \gamma_i + \phi_{jst} + \frac{C^o_i}{C_i}\tau_t + \frac{S^o_i}{S_i}\tau_t + \epsilon_{ijst} \tag{1}$$

In equation (1), y_{ijst} is the outcome variable (sales, employment, wages) for firm i in province j, sector s, and year t, and R^U_{ijt} and R^D_{ijt} are upstream and downstream supply chain exposures to the arrival of Syrian refugees (defined precisely below). The equation includes firm fixed effects, γ_i, to control for firm-level heterogeneity. We further include sector-province-year fixed effects, ϕ_{jst}, to control for sector-region-specific effects, including the arrival of Syrian refugees in a given province. The sector-province-year fixed effects allow us to isolate the effect of Syrian refugees through regional propagation by eliminating the potentially heterogeneous effects of the arrival of Syrian refugees across sectors. Essentially, the inclusion of ϕ_{jst} allows us to compare two firms in the same province, sector, and time with varying levels of downstream and upstream exposures resulting from their different trade links.

Equation (1) also controls for the dependency level of each firm on regional trade. In particular, we include a full set of interactions between the 2010-2011 pre-exposure period share of the out-of-the-home-province purchases in total costs and year fixed effects, $\frac{C^o_i}{C_i}\tau_t$. A similar set of interactions is included between the share of the out-of-the-home-province sales in total sales and year fixed effects, $\frac{S^o_i}{S_i}\tau_t$. These controls allow for different time patterns in the outcome variable between firms that are more reliant on inter-province trade and those that are not. We estimate equation (1) using an OLS regression. Since the treatment variables vary at the firm level, standard errors are heteroskedasticity robust and clustered at the firm level.

The key to the analysis is defining the upstream and downstream exposure to the arrival of Syrian refugees. These variables depend on three factors: i) the distribution of Syrian refugees across provinces (as in Figure 1), ii) the provincial distribution of each firm's trade links (as in Figure 3), and iii) the share of out-of-province purchases (sales) in total costs (sales) (as in Figure 2). Specifically, we define the upstream exposure as

$$R^U_{ijt} = \frac{C^o_i}{C_i} \sum_{k \neq j}^{N} w^p_{ik} R_{kt}. \tag{2}$$

Upstream exposure, R^U_{ijt}, is a weighted average of the Syrian-native ratios across provinces at time t, R_{kt}. As weights, w^p_{ik}, we use the share of province k in total out-of-province purchases of firm i in 2010 and 2011.[13] This weighted average is then multiplied by the ratio of the firm's out-of-province purchases, C^o_i, to total costs, C_i, in 2010-2011 to account for each firm's domestic out-of-province trade exposure. Costs include all firm-to-firm purchases, labor costs, and imports.

Similarly, downstream exposure, R^D_{ijt}, is defined as

$$R^D_{ijt} = \frac{S^o_i}{S_i} \sum_{k \neq j}^{N} w^s_{ik} R_{kt}. \tag{3}$$

The definition of downward exposure differs from that of upstream exposure in two ways. First, the weight, w^s_{ik}, is now the share of province k in all out-of-province sales of firm i in 2010-2011. Second, we multiply the weighted average of the Syrian-native ratios across provinces by the share of out-of-province sales, S^o_i, in all sales of the firm, S_i.

The immigration literature using the regional variation in migrant density for identification, including the literature on the effects of Syrian refugees in Turkey, often uses an instrumental-variable approach due to the potential self-selection of immigrants to regions with better economic prospects. Similarly, to account for the potential endogeneity of R_{kt}, we use the instrument in Aksu et al. (2022),[14] which distributes the total number of Syrian refugees in neighboring countries—including Turkey, Lebanon, Jordan, and Iraq—in each year across Turkish provinces according to i) the distance of each Turkish province from each Syrian province, ii) the prewar population shares of Syrian provinces, and iii) the distance of Syrian provinces to the four bordering countries in the following way.

$$I_{p,t} = \sum_{s=1}^{13} \frac{(\frac{1}{d_{s,T}})\pi_s}{(\frac{1}{d_{s,T}} + \frac{1}{d_{s,L}} + \frac{1}{d_{s,J}} + \frac{1}{d_{s,I}})} \frac{T_t}{d_{p,s}}. \tag{4}$$

[13] We used two years to smooth out year-specific noise.

[14] This instrument has also been used in Aygün et al. (2021) and Akgündüz et al. (2023).

We replace R_{kt} with $I_{p,t}$ in equations (2) and (3) in defining the instruments for R^U_{ijt} and R^D_{ijt}, respectively. Above, $I_{p,t}$ denotes the expected number of refugees in Turkish province p at time t, $d_{s,X}$ for $X = T, L, J, I$ stands for the minimum distance of Syrian province s to any entry point in the border of Turkey, Lebanon, Jordan, and Iraq, respectively.[15] In equation (4), π_s stands for the prewar population share of Syrian province s, and T_t denotes the total number of Syrian refugees in the four neighboring countries, which is roughly equal to the total number of refugees exiting Syria given the low numbers in other countries until 2015. Finally, $d_{p,s}$ is the distance of Turkish province p to Syrian province s.

This instrument distributes the total number of refugees in the four neighboring countries rather than that only in Turkey across Turkish provinces because the relative economic conditions and treatment of refugees in these countries, as well as the change in these over time, could influence the timing and size of the refugee inflow to Turkey. [16] Therefore, this instrument also aims to account for the potential endogeneity of the size and timing of the refugee inflow to Turkey. Mechanically, this instrument reweights the prewar population shares of Syrian provinces according to their distances from the four neighboring countries. For instance, the prewar population share of the Aleppo province in Syria, 21.6%, rises to 42.3% with this formulation because Aleppo is much closer to Turkey than to the other three neighboring countries. In fact, the Syrian sample of the 2018 Turkey Demographic and Health Survey shows that 57.5% of refugee households originate from this province.

Next, we discuss why distance is a highly relevant instrument. First, refugee camps were set up in the border regions in the early phases of refugees' arrival. Although most refugees moved out of these camps over time, they settled in the neighboring regions. Second, refugees are expected to use the health and educational facilities in the province they are registered. Although this has not been strictly enforced, it created some inertia to move out of the border regions. Third, residing close to the border makes visiting family back in Syria

[15]There are six entry points on the Turkish border, three at the Iraqi border, two at the Jordanian border, and four at the Lebanese border.

[16]In fact, the data show that the arrival of refugees in Turkey compared to the other three countries gained momentum over time.

convenient.

The second question of interest is whether the arrival of Syrian refugees led to a change in the trade network within Turkey. Our empirical approach is similar to that in the literature regarding the effects of immigration on internal migration between regions (Hatton and Tani, 2005; Mocetti and Porello, 2010), and our analysis is at the destination-origin province pair level. We use the following specification,

$$y_{sjt} = \beta_0 + \beta_1 R_{jt} + \beta_2 R_{st} + \omega_{sj} + \tau_t + e_{sjt}, \tag{5}$$

where y_{sjt} is the firm-to-firm trade outcome (the logarithmic values of sales and the number of links) for origin province s and destination province j at time t. The primary variables of interest are the ratios of refugees to the native population in the destination province, R_{jt}, and the origin province R_{st}.[17] To account for multilateral resistance to trade at the origin-destination pair level, we further control for destination-origin province pair fixed effects, ω_{sj}, and time fixed effects τ_t. We also use more demanding, alternative specifications that control for regional trade shocks by including the interactions of year fixed effects with NUTS-1 level destination and origin fixed effects. We estimate the models using both OLS and 2SLS. In 2SLS estimations, we account for the selection of refugees into provinces with greater economic prospects by instrumenting both the origin and destination province Syrian refugee-to-native ratios using the instrument introduced by equation 4. All standard errors are clustered at the destination-origin province pair level.

[17] Following the aforementioned studies, the treatment variable of interest could be defined as the difference between the Syrian to population ratios of destination (purchasing) and origin (selling) provinces. However, there is no reason to expect that refugee-to-population ratios of destination and origin provinces would have symmetric effects. Destination provinces can be treated as the downstream of the inter-province supply chain while the origin provinces would be the upstream. The effects will, therefore, be necessarily different.

4 Data

We use the Entrepreneurship Information System (EIS) made available by the Turkish Ministry of Industry and Technology. The EIS consists of several modules of administrative data at the firm level. Specifically, we used the firm registry, annual firm financial statements, customs data on imports, the Social Security Institute (SSI) records on employment, and firm-to-firm trade data for the 2008–2018 period. The firm registry consists of the universe of firms in Turkey and includes the classification of firm provinces based on their headquarters and sectors at the 4-digit industry level. We execute separate approaches to cleaning the data for the firm-level and province-pair-level analyses.

For the firm-level analysis, we restrict the sample to manufacturing firms with employment registered to the SSI and complete balance sheets. Since upstream and downstream exposure are defined using 2010-2011 linkages, the final firm-level sample consists of firms that existed in one of these two years and reported sales and purchases with other firms.[18] From 2008 to 2018, our final sample consists of around 50,000 firms on average each year, with the highest number in 2011 at 66,425.

Firm registry data provides us with information on the sector and province of firms. Firms' balance sheets give us the data on firms' sales, which we adjust for the CPI. The SSI data consist of all formally employed individuals, their wages, and their place of employment. While the SSI data are quarterly, we use the fourth quarter of each year to calculate the firm-level annual employment, mean wages, and the standard deviation of wages. Firm-level average wages are adjusted for the CPI, and all three variables are log-transformed and used as outcomes in the analysis.

The SSI data further provides us with firm-level labor costs for 2010 and 2011, which we use in estimating the firms' total costs. The data about another element of firms' total costs, imports, come from the customs data. We draw imports from firm-product-destination

[18] We excluded any firms that moved between provinces during the sample period to avoid capturing effects due to capital movements in response to the Syrian refugee inflows. These firms make up less than 0.5% of the sample.

level customs data and aggregate them to the firm level for each year. The customs data report import values in US dollars, which we convert to Turkish Liras using annual average exchange rates. The final element of total costs is purchases from other firms, which come from firm-to-firm trade data.

The firm-to-firm trade data in the EIS makes the analysis of the propagation effects of immigration possible. The firm-to-firm trade data are collected through firms' value-added tax reports for their transactions that are over 5000 TL, which was equivalent to 3200 USD in 2012.[19] We include all purchases and sales of the manufacturing firms in our sample when calculating upstream and downstream exposures.[20] The geographical information on firms in the firm-to-firm trade data allows us to calculate in-province and out-of-province sales and purchases (w_{ik}). In the fraction, S_i^o/S_i, the numerator is the out-of-province sales, and the denominator is the total sales from the balance sheet data.[21] In the fraction C_i^o/C_i, the numerator is out-of-province purchases, and the denominator is total costs, including labor costs, imports, and purchases from other firms.

Table 1 shows summary statistics for variables used in equation (1). Panel (A) provides them for the dependent variables, and panel (B) gives them for the key variables of interest. As seen in panel (B), firms in the sample make significant sales to and purchases from firms outside their province. The ratio of out-of-home-province purchases to total costs is 26.7%, and the share of out-of-home-province sales to total sales is 22%.

The data on the distribution of Syrian refugees across Turkish provinces comes from Turkey's Presidency of Migration Management (TPMM). This data on Syrians' cross-provincial distribution are end-of-year values. However, since the monthly numbers of Syrians display substantial variation over the year, particularly in 2014 (see Appendix Figure A1), we ad-

[19]The threshold remained unchanged throughout the period of analysis despite inflation. It is, therefore, a smaller value in real terms in later years.

[20]The EIS data show that manufacturing firms make nearly half their firm-to-firm sales to retail and wholesale trade firms, and only a third of their sales are to other manufacturing firms. Given the central position of manufacturing in inter-sectoral trade, we take purchases from and sales to all firms and sectors into account when calculating the exposure variables.

[21]The total sales include both firm-to-firm sales and other sales, including exports

just the cross-provincial numbers to measure the yearly average rather than the end of the year.[22] Since no information is available on the provincial distribution of Syrians for 2012, we distribute the total number of Syrians in Turkey in 2012 (obtained from the UNHCR) across provinces according to their provincial shares in 2013. The migrant-to-native ratios are zero for the pre-shock years (2008–2011).

Figure 1 illustrates the resulting provincial migrant-to-native ratios (R_k) for every two years from 2012 to 2018.[23] Although the density of refugees in developed western provinces, such as Istanbul, Bursa, Ankara, and Izmir, rises over time, their density in the southeastern provinces bordering Syria was still much higher in 2018. Figure 1 also shows why our distance-based instrument works well; distance is a significant determinant of the settlement patterns of refugees.

In the second part of the analysis, we use province-pair-level data on firm-to-firm trade by aggregating the trade between manufacturing firms in each province. Each province pair appears twice in the province-pair-level data, with the selling and purchasing province roles switched. We define two outcome variables when analyzing the impact on inter-province trade. First is the CPI-adjusted, log-transformed sales value from firms in one province to another. Second, we define the number of firm links between province pairs. Specifically, each unique combination of selling and purchasing firms between two provinces is counted as a link and aggregated to the province pair level.

Panel (C) of Table 1 shows summary statistics for the value of sales and the number of links in inter-provincial trade. On average, there are 2.2 firm-to-firm links between the 81 provinces in the time frame of our study. Inter-provincial trade makes up a significant portion of firm sales in Turkey. Figure 2 shows the share of out-of-province sales in total

[22] First, we calculate the average value of the monthly numbers of Syrian migrants for 2014 and 2015 (call this $x[t]$, where t denotes the year) using the UNHCR data. Then, we calculate the total number of Syrian refugees in Turkey according to the provincial data for each year (call this $y[t]$). Finally, we adjust the cross-provincial numbers by multiplying them by $x[t]/y[t]$ to align the sum of provincial numbers for each year with the average monthly value for that year.

[23] Aksu et al. (2022) find no evidence of an effect of the refugee influx on internal migration, suggesting that the native population at the province level is unaffected by the arrival of refugees.

sales by province (where firm-level data are aggregated to the province level). The share of inter-province trade in total firm sales in a province appears to be positively correlated with the level of industrialization but negatively correlated with the size of the domestic market in the province. Industrial provinces, such as Kocaeli and Zonguldak, and provinces with a high share of the manufacturing sector but relatively small populations surrounding Istanbul and Ankara have higher out-of-province sale shares. In contrast, the share is low for Istanbul (due to its large domestic market) and several provinces in eastern Turkey. Figure 3 shows the provincial distribution of out-of-province sales for some provinces that are most affected by the inflow of Syrian refugees. This figure shows that these provinces with a large fraction of refugees have significant trade links with provinces that are far away (mainly industrialized and highly-populated western provinces) and with neighboring provinces.

5 Results

5.1 Firm-level outcomes

We start our firm-level analysis by estimating equation (1) for sales, employment, and wages. Table 2 displays the estimation results for our key parameters of interest, the upstream and the downstream exposures. Panel (A) reports the OLS estimates and panel (B) gives the 2SLS estimates. Panel (B) also reports the F-statistic, indicating the reliability of the 2SLS estimator. These F-statistics in all columns substantially exceed the suggested levels when there is one endogenous regressor (Stock et al. (2002)).

The first column of Table 2 provides the estimates regarding sales. The estimates in both panels show statistically significant positive effects of upstream and downstream exposures on sales. The estimated effects are also economically significant, implying a 1.53% and 2.69% increase in sales, respectively, for one standard deviation (SD) increase in upstream and downstream exposure. Since refugees expand the consumer base, a higher downstream exposure means an expansion of the market for the firm. This contributes to the estimated

downstream exposure effect in Table 2. In addition, as downstream firms in the refugee-dense areas become more likely to export after the arrival of refugees (as shown by Akgündüz et al. (2023)), their demand for intermediate goods would increase—also contributing to the estimated positive effect of downstream exposure.

The estimated upstream exposure coefficient in Table 2 implies that firms' sales increase when they are exposed to a higher level of refugee shock via their suppliers. A higher exposure to the refugee shock may reduce the cost of production and prices of suppliers because refugees mostly work for lower wages in the informal sector. This cost advantage would be transferred to purchasing firms, increasing their sales. Next, we examine this potential channel in the observed positive impact of the upstream refugee exposure on sales.

We estimate equation (1) when the dependent variable is the costs-to-sales ratio for firms as reported in their balance sheets.[24] The results in Table 3 provide strong evidence that firms' costs-to-sales ratios decline in upstream exposure; however, no such evidence exists for downstream exposure. These results support the above channel regarding the refugee shock decreasing the cost of production and output prices of upstream supplier firms—resulting in a fall in the marginal cost and a rise in production for downstream buyer firms.

We next consider whether increased sales due to upstream and downstream exposures translate into employment effects at the firm level. Column 2 of Table 1 reports the results where the dependent variable is log-transformed employment at the firm level. The 2SLS results indicate that both upstream and downstream exposures lead to employment gains. The estimates indicate a 1.09% and 1.31% increase in employment, respectively, for one SD increase in upstream and downstream exposure. The effects for downstream exposure are larger than that for the upstream exposure, consistent with larger sales effects estimated for the former. Thus, these results show that, in addition to the potential spillover effects of immigrant labor supply shocks across labor markets through internal migration, propagation also occurs through trade linkages.

[24]We exclude the bottom and top 1% of the distribution of costs-to-sales ratios.

Column (3) of Table 2 shows the impact of upstream and downstream exposures on wages. As firms increase their sales and employment via their upstream and downstream linkages, this may affect the average wage through various channels. In response to the reduced costs of low-skill intense intermediate goods available from upstream firms, firms can adjust their technology and shift their production towards skill and capital-intensive processes. Moreover, increased sales may also lead firms to make capital investments, resulting in productivity increases. These responses would not only impact existing workers' productivity in a firm but also change the composition of workers in that firm. However, although the 2SLS coefficients in Table 2 are positive, neither upstream exposure nor downstream exposure has a statistically significant effect on mean wages.

The results in Table 2 regarding firm sales and employment provide strong evidence for the propagation of the refugee labor supply shock across firms through firm-to-firm trade. It is important to note that, since we include sector-province-year fixed effects in our specification, this controls for sector-region-specific effects, including the arrival of Syrian refugees in a given province. Thus, our upstream and downstream exposure variables isolate the effect of Syrian refugees through regional propagation by eliminating the potential sector-heterogenous effects of the arrival of Syrian refugees in a province.

In essence, our results indicate significant spillover effects of the refugee supply shock through trade linkages. Hence, effects estimated at the local level using spatial analysis may only be part of the total effect that immigration has at the national level.

5.1.1 Event Study Results

The key identification assumption in our analysis is that when we compare firms within the same province and sector, trends in outcomes for firms that trade with the refugee-intensive regions and firms that do not would have been the same, conditional on the covariates, in the absence of the refugee shock. To check the validity of this identification assumption, we adopt a panel event study design that allows for dynamic lags and leads

of the downstream and upstream exposures. We do this by interacting the instrumented exposure values for 2018 with the year dummies, defining 2011 as the baseline year. The omitted year captures the baseline difference between firms exposed to the refugee shock (via upstream and downstream exposures) and those not. We check whether the estimated coefficients in the pre-shock period are small and not statistically different from zero, meaning that the instrument does not predict an effect in the pre-shock period.

Figure 4 presents the event study graphs for firm-level sales as the outcome variable. Panels (a) and (b) display the coefficients for the upstream and downstream ratios, respectively. Both panels show that the estimated coefficients are small and not statistically different from zero before 2011, supporting our identification assumption that the instrument is not correlated with the pre-shock trends in the outcomes. The event study design also shows that the upstream and downstream effects gradually become larger over the years and gain statistical significance only after 2017. This lag in the realization of the upstream and downstream impacts might be expected as firms and networks adjust to the new environment.

Figure 5 provides the event study graphs for firm-level employment. The patterns are very similar to those in Figure 4. The estimated coefficients for the pre-shock period are not statistically different from zero. The coefficients in the post-shock period gradually increase over time as the number of refugees rises. The upstream exposure coefficient for 2018 is statistically significant at the 5 percent level, and those for the immediately preceding years are marginally statistically insignificant at the 5 percent level. Similarly, the downstream exposure coefficients for 2017 and 2018 are much larger than those in the previous years and marginally statistically insignificant at the 5 percent level.

5.1.2 Heterogeneity in Firm-Level Outcomes

Table 2 reports the average effects of propagation across firms. However, the nature of the refugee supply shock suggests that effects may be heterogeneous across firm characteristics. The fact that almost all refugees are informally employed in low-skill-intensive jobs suggests

that employers of refugees are concentrated in low-tech, manual-skill-intensive sectors. Thus, the response of firms to upstream and downstream exposure through trade linkages may differ by firm characteristics—such as technology, trade links, and distance to refugee-intense regions—that shape relationships with suppliers and downstream potential users.

We first study heterogeneity across firms by production technology and estimate separate effects for low-tech and high-tech firms.[25] Given that refugees are predominantly employed by low-tech employers, a higher technological distance is expected between high-tech firms and upstream suppliers affected by the refugee shock than between low-tech firms and upstream suppliers. In contrast, both low- and high-tech firms may benefit from downstream exposure since rising demand in refugee-intense regions is expected to increase demand for all products. The results of the analysis by production technology, presented in Table 4, corroborate these predictions. The 2SLS results show that low-tech firms benefit from upstream exposure in terms of sales and employment, whereas no such evidence exists for high tech firms. In terms of downstream exposure, both low- and high-tech firms benefit; however, while the evidence for the positive impact is limited to sales for low-tech firms, it exists for sales, employment, and wages for high-tech firms. Moreover, the magnitude of the positive effect on sales is larger for high-tech firms.

Firm size may also matter in this context as larger firms are expected to have a greater number of and stronger trade linkages compared to small firms, which tend to have more localized networks (Huggins and Johnston, 2010). Larger firms also serve markets spanning a wider geographic region, and their ability to respond to changing market conditions may be higher due to stronger organizational capacities (Baumann and Kritikos, 2016). Put differently, switching across suppliers and responding to changes in downstream markets may be less costly for larger firms. Hence, the extent of the propagation of shocks may vary by firm size. We estimate the effects by firm size for small (1 to 9 employees), medium (10 to 49 employees), and larger (50+ employees) and present the results in Table 5. While all are

[25]High and low-tech sectors are defined according to EUROSTAT classifications. High-tech manufacturing sectors are NACE-2 codes 24, 29, 30, 32, 33, 34 and 35.

imprecisely estimated, the coefficients regarding the positive effect of upstream exposure on sales and employment are much higher for larger firms. In terms of downstream exposure, the impact on sales is positive for all firm-size types. (This impact is much more precisely estimated than that for upstream exposure.) However, there is evidence of an effect of downstream exposure on employment only for large firms. Moreover, the positive coefficient is much higher for larger firms.

An interesting result in Table 5 is the rise in large firms' average wages due to the upstream exposure. This result is consistent with the discussion earlier regarding the potential effects on worker productivity via upstream refugee exposure. As a result of the reduced costs of low-skill-intensive intermediate goods in upstream firms, large firms can shift their production toward more skill and capital-intensive processes. Essentially, they can outsource products typically produced by low-skilled (low-wage) workers from upstream firms, shifting the composition of their workforce toward more skilled workers and increasing the average wage they pay.

Previous literature shows that proximity enhances the diffusion of knowledge and technology (Comin et al., 2012; Keller and Yeaple, 2013). Industries and firms that trade inputs intensively tend to agglomerate (Ellison et al., 2010), and geographic proximity plays a key role in the matching of suppliers and customers as most connections cover relatively short distances (Bernard et al., 2022). Moreover, Chaney (2014) find that firms export only into markets where they have contact and use their existing network of contacts to search remotely for new partners. These findings suggest that the geographic distance between a firm and the region hit the most by the refugee shock—southeastern Turkey, bordering Syria—may limit the propagation of the shock. We thus estimate the effects separately for firms that are less than 800 km to Aleppo and more than 800 km to Aleppo to assess the role of distance.[26]

[26]Firms that are more than 800 km to Aleppo are predominantly located in western Turkey, mostly in the Aegean and Marmara regions. The longest distance between Aleppo and any Turkish province is that between Aleppo and Edirne, a province in northwestern Turkey on the Turkish-Greek border, at 1327 km.

The estimates reported in Table 6 for these two groups show that the positive sales and employment impacts of upstream and downstream exposures exist for both groups of firms by distance, except for the employment impact of downstream exposure for firms that are closer in distance. This suggests that distance is not a significant deterrent for connections to suppliers and access to markets in the context of Turkey. In fact, we report some evidence of this in Figure 3 for four provinces in Southeastern Turkey. Figure 3 reports the share of provinces in total out-of-province sales in 2011—the year prior to the shock. Hence, this figure shows the outreach of firms as upstream suppliers in the rest of the country. While neighboring provinces have higher shares, as expected, the figure shows that firms have networks that span the whole country. This indicates that supplier links were not constrained by geography, which facilitated the propagation of shocks to distant firms. Here, it is also important to note that the specifics of Turkish geography—in which the large and industrialized provinces are far away from the provinces dense in refugee intensity— play a role.

The above result is also important for our identification approach. The presence of significant effects for distant firms adds to the credibility of our estimated propagation effects because distant firms are much less likely to be directly affected by the refugee shock due to proximity to the Syrian border (via, e.g., border trading), which could potentially contaminate the results.

Finally, we consider whether the openness of firms, defined as the degree to which firms sell their products outside their provinces, matters for the propagation of shocks. A higher share of out-of-province sales may imply stronger out-of-province networks. These existing links may enable finding new links as suggested by dynamic network formation models (Vázquez, 2003; Jackson and Rogers, 2007; Chaney, 2014) and seize cost advantages that emerge among upstream suppliers and benefit from demand shifts among downstream customers. To assess the importance of openness, we estimate effects separately for firms that have below the median share of out-of-province sales (low openness) and above the median

(high openness). The 2SLS results presented in Table 7 clearly indicate that more open firms benefit significantly from both upstream and downstream exposure. For less open firms, the coefficient estimates are statistically insignificant for both types of exposure.

In sum, while firms with different characteristics benefit from downstream exposure due to market expansion—albeit to different degrees, we uncover significant heterogeneity by firm characteristics in the effects of upstream exposure. High-tech firms that are less likely to use low-tech supplies do not benefit from upstream exposure, consistent with the fact that refugees work in low-tech sectors. The upstream supplier effects also increase with firm size and openness, while distance does not deter these effects. These results provide evidence for strong propagation effects of the refugee labor supply shock across firms through trade linkages—beyond its effects on local firms.

5.2 Province level outcomes

The previous section showed that within the same sector-province pair, firms with high downstream and upstream exposure to refugees increase their sales and employment compared to firms with low downstream and upstream exposure. However, this does not mean that among the provinces that are further away from the core refugee region, provinces with more linkages to the core refugee region benefit in terms of sales and employment. The previous section essentially shows that a textile firm in Istanbul with more connections to the core refugee region benefits more than a textile firm in Istanbul with no connections. In fact, all firms may re-adjust their upstream and downstream supply networks to take advantage of lower-cost suppliers and increased demand in the hosting region. Therefore, this section aims to explore how outcomes at the province level change with the strength of province-level linkages with the core region.

A unique feature of our data is the availability of information about all firm-to-firm trade—not only the binary links but also the trade values—that allows us to estimate the effects of the refugee labor shock on trade between provinces. Our empirical approach,

similar to the literature on the effects of immigration on internal migration between regions, uses trade data at the destination-origin province pair level to estimate specification (5). The treatment variables of interest are the ratios of refugees to the native population in the destination province, R_{jt}, and the origin province R_{st} that capture potentially asymmetric effects of refugee shocks in the origin and destination. The analysis focuses on two aspects of the trade network, trade volume (value) and trade links (number of links), as outcome variables.

Table 8 presents results for four different specifications for each of the outcomes. Columns (2) and (6) correspond to equation (5), whereas columns (1) and (5) replace the destination-origin province pair fixed effects, ω_{sj}, with separate fixed effects for destination and origin provinces. The rest of the columns build on equation (5). Columns (3) and (7) add interactions of year fixed effects with destination NUTS-1 region fixed effects and with origin NUTS-1 region fixed effects. Finally, columns (4) and (8) add the interactions of year fixed effects with origin-destination NUTS-1 region pair fixed effects to equation (5). These interactions aim to capture the effects of unobserved shocks at the region level over time.

The 2SLS results concerning the effect of the migrant shock received by suppliers indicate a significant positive effect on trade volume but no statistical evidence of an effect on trade links. On the other hand, the effects of the migrant shock received by buyer firms are positive and statistically significant for both outcomes. These results indicate that the migrant shock received by supplier firms increases trade with existing suppliers without generating new links. In contrast, the expansion of the customer base with the arrival of refugees results in not only an increase in trade volume but also an expansion in the customer network by generating new links. These results indicate that the propagation of the effects of the refugee supply shock is not limited to firm-level outcomes, such as sales. It also affects network formation within a country.

In the final part of our analysis, we study the importance of geographic distance and the strength of pre-shock trade linkages on interprovincial trade volumes and link formation

due to the refugee shock. We first estimate trade effects separately for province pairs that are within 800 kilometers of each other (near) and those more than 800 kilometers from each other (distant). In Table 9, the first two columns report the results for near provinces, columns (3) and (4) for distant provinces, and columns (5) and (6) for distant provinces excluding İstanbul. The 2SLS results indicate that an upstream impact on trade value exists for both near and distant provinces, as well as distant provinces excluding Istanbul. Moreover, the magnitude of the impact is similar for all three groups of provinces. In contrast, a downstream impact on trade value exists only for distant provinces and distant provinces excluding Istanbul. When we examine the effects on trade links, we observe no evidence of an impact for near provinces. The estimated coefficients for distant provinces are much larger and marginally statistically insignificant. In fact, the downstream impact on trade links for distant provinces excluding Istanbul is statistically significant at the 10 percent level. Essentially, distant provinces drive the overall positive impact of downstream exposure on trade links in Table 8 for all firms.

In Table 10, we group provinces based on the strength of provincial trade links prior to the shock. Province pair links are defined as strong if firms in the selling province make more than 1% of their out-of-province sales to firms in the purchasing province.[27] The results in Table 10 reveal that the percent increases in trade volume and the number of links are more pronounced among provinces with weak initial links. In essence, Tables 9 and 10 show that network effects do not primarily arise among provinces with already strong initial links that are close to the refugee-dense regions; on the contrary, trade improvements are registered among those with weaker initial links. Hence, the propagation of the shock helps establish a tighter-knit network by reinforcing the relationships among less-connected province pairs.

[27] We choose 1% because this is close to the median value.

5.3 Comparing the Direct Migrant and Propagation Effects

In this section, we compare the direct impact of migrants on firms' sales and employment with the propagation effects we estimate so that we can better assess the economic importance of the propagation effects.

First, we estimate the migrant impact on firms' sales and employment using the following equation,

$$y_{ijst} = \alpha + \beta R_{jt} + \gamma_i + \rho_j + \lambda_{st} + \phi_{j't} + e_{ijst}, \tag{6}$$

where y_{ijst} denotes the employment of firm i, in province j, in sector s at time t, and R_{jt} is the ratio of migrants to natives in province j at time t. The key parameter of interest is β, which shows the effect of the migrant-to-native ratio on the firm outcome. In equation (6), γ_i stands for firm fixed effects, ρ_j for province fixed effects.[28] We also include a vector of 2-digit NACE level sector–year fixed effects, λ_{st}, to account for different sectoral compositions and sector-specific technological effects, and region–year fixed effects, $\phi_{j't}$, to account for region-specific shocks (at the level of 12 NUTS-1 regions) at different years.

Table 11 displays the results of estimating equation (6). According to the 2SLS estimates, a 10 percentage point increase in the migrant-to-native ratio raises sales by 8.5 percent and employment by 10.2 percent. The migrant impact on formal employment we estimate is consistent with the findings of Aksu et al. (2022), who use the Turkish Household Labor Force Surveys until 2015 to estimate the impact of the migrant shock on formal and informal employment (by employment type) in different production sectors. They find that a 10 percentage point increase in the migrant-to-native ratio increases men's wage employment in the formal manufacturing sector by 2.2 percentage points (or by about 19 percent) but virtually has a null effect on women's wage employment in the formal manufacturing sector.

Next, we aim to understand the effect of the migrant shock on native employment at the

[28]Province fixed effects are actually absorbed by firm fixed effects as no variation exists in the province of firms. Firms that change provinces in our time frame, which make up 3% of the total sample, are excluded from the sample.

provincial level using the estimates in Table 11. First, using the estimated equation (6), we calculate the predicted firm-level employment levels at the 2017 values of the migrant-to-native shock for each province and in the absence of the migrant shock ($R_{jt} = 0$). Then, we aggregate these employment levels to the province level. The percent changes in formal employment due to migrant shock (in 2017 values) are displayed in panel (A) of Figure 6. By definition, these changes are directly proportional to the level of the migrant shock in each province. Second, using the estimated equation (1), we calculate predicted employment at the 2017 values of the upstream and downstream exposures and in the absence of the migrant shock for each firm. We then aggregate these employment levels to the province level. The changes in province-level employment resulting from the upstream and downstream exposures generated by the migrant shock are displayed in panel (B) of Figure 6.

Figure 6 shows that the direct impact of the refugee shock on natives' formal employment and its propagation effect via firm-to-firm trade are both positive. In addition, at the province level, we see from panel (C) of Figure 6 that the direct and propagation impacts are correlated. Provinces that are directly affected by the migrant shock in terms of formal employment are also the ones that benefit from the firm-to-firm propagation impact of the migrant shock on formal employment.

To understand the relative magnitudes of the direct migrant impact and the propagation effect at the national level, we carry out the following calculation. We weight the provincial-level estimated effect for the direct impact in panel (A) of Figure 6 and the propagation effect in panel (B) of Figure 6 using the shares of employment in each province in 2017. The resulting national-level direct refugee effect on employment is a 3.58 percent rise, and the national-level propagation effect on employment is a 0.73 percent increase. Therefore, the propagation effect amounts to about 20 percent of the direct impact of the refugee shock on formal employment.

As discussed in the Background Section, several earlier studies (Del Carpio and Wagner (2015), Aksu et al. (2022), and Aracı et al. (2022)) report a positive direct impact of the

migrant shock on men's formal employment (although the effect on informal employment is negative). In this study, we find that the indirect propagation effect on formal employment in regions far away from the refugee-intensive regions (which are essentially the control regions in the above-mentioned studies using difference-in-differences across regions) is also positive. At the same time, the propagation impact is realized later. We find statistical evidence for it after 2017, whereas the above studies report the direct impacts are realized earlier than 2015. This implies that the propagation impact equilibrates the initial impact of the migrant shock on formal employment in the long run.

6 Conclusion

This paper examines the propagation of the economic impact of a massive refugee shock via firm-to-firm trade linkages. For this purpose, we combine very fine measures of firms' upstream and downstream exposures to the refugee shock with rich data on firm outcomes, covering the full population of firms.

We find that firms' sales and employment increase in both upstream and downstream exposure to the refugee labor supply shock. The impact on wages is, however, limited to large firms only. Our findings also indicate that firms' production costs decline in upstream exposure—consistent with the rise in their sales and employment—as upstream supplier firms lower their production costs by employing refugees at lower wages. In addition, we find that the impacts of the upstream and downstream exposures on sales and employment occur about two to three years after the peak of the refugee flow.

We uncover significant heterogeneity by firm characteristics in the effects of upstream exposure. High-tech firms, which are less likely to use low-tech supplies, do not benefit from upstream exposure. This is consistent with the fact that refugees work in low-tech sectors. The upstream supplier effects also increase with firm size and openness, while distance does not deter these effects. In contrast, all types of firms benefit from the downstream exposure

resulting from a larger consumer base—albeit to different degrees.

This study also examines how the share of refugees at the province level affects firm-to-firm trade between provinces to better understand the regional diffusion of the refugee shock. We find that provinces with higher exposure to refugees also increase their out-of-province trade volume and links. Moreover, this increase in out-of-province sales with higher levels of refugee exposure exists for provinces that are further away from the core refugee regions and have weak pre-shock trade levels with the core refugee regions.

A key contribution of this study is the analysis of the impact of a labor supply shock on production networks. Most studies examining the impact of the propagation of shocks take the production networks fixed, and none examine the impact of a labor supply shock on the production networks. We find that firms expand their trade network by increasing the number of downstream links (customers) in response to the refugee shock. This suggests that Turkish firms are quite flexible in finding new customers in refugee-dense regions. In contrast, we do not find that firms expand their supplier links, suggesting higher costs in finding new suppliers. This finding is similar to that of Barrot and Sauvagnat (2016) and Carvalho et al. (2021), who find high switching costs after the disruption in the supply chains caused by natural disasters.

Our firm-level analysis indicates that employment increases in both upstream and downstream exposure. Using our firm-level estimates, we quantify the percent increases in provincial formal employment levels and compare them with the percent increases in provincial formal employment levels caused by the direct migrant impact (typically estimated in the literature). We find that the propagation effect is at least one-fifth the size of the direct migrant impact on province-level employment levels.

This finding is important because it points to a novel reason for the difference between the short-term and long-term impact of the migrant shocks on labor market outcomes in the literature. The initial impact of the migrant shock on native employment and wages could dissipate or expand over time due to the propagation of the refugee shock due to firm-

to-firm trade linkages. In explaining the difference between the adverse short-term migrant impacts on native wages and employment and the null longer-term impacts in developed countries, the literature has pointed to equilibrating labor and capital movements (see, e.g., Card and DiNardo (2000), Card (2001), Borjas (2006), and Monras (2020)). Other studies have highlighted changes in the production technique (Lewis (2011)). This study provides a further potential channel that appears economically sizeable: propagation of the refugee shock via firm-to-firm linkages.

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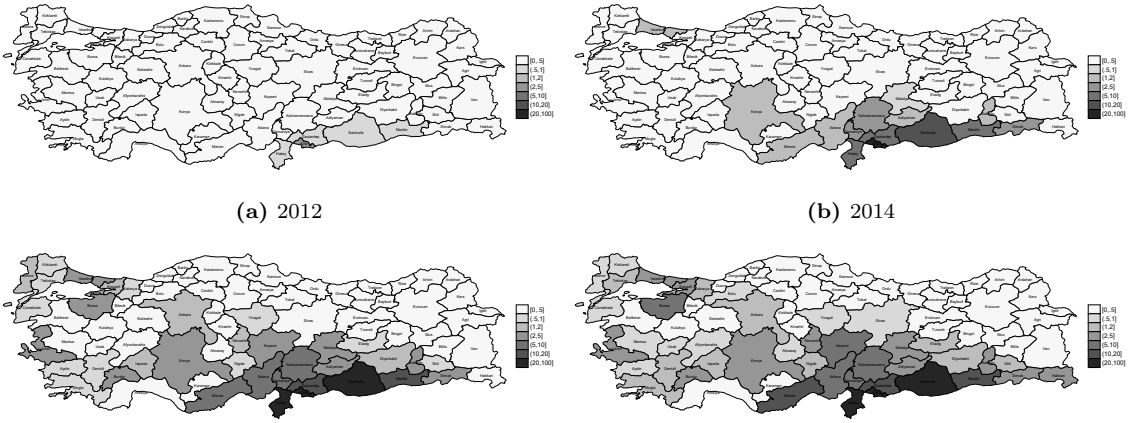
Figures

Figure 1. Refugee-Native Ratios across Provinces

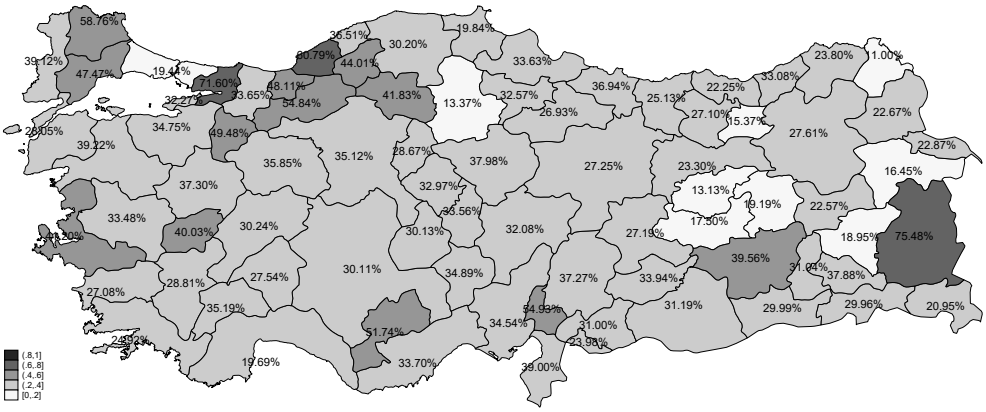


(a) 2012 **(b)** 2014

(c) 2016 **(d)** 2018

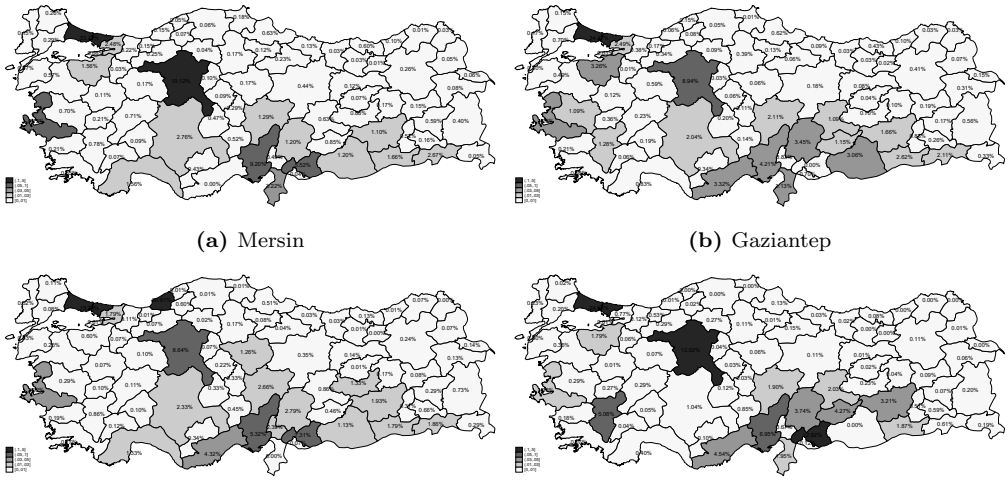
Source: Turkey Presidency of Migration Management.

Figure 2. Ratio of out-of-province sales to total sales by province



Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. The map shows the share of out-of-province sales in firms' total sales for each province.

Figure 3. Provincial distribution of out-of-province sales for selected provinces



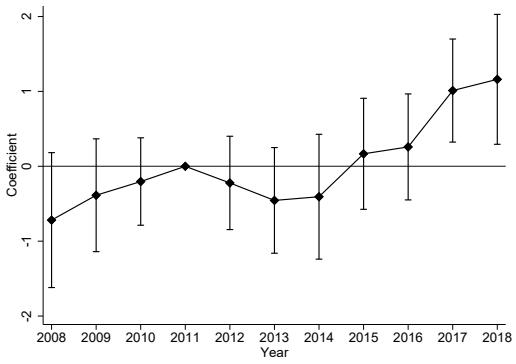
(a) Mersin **(b)** Gaziantep

(c) Hatay **(d)** Urfa

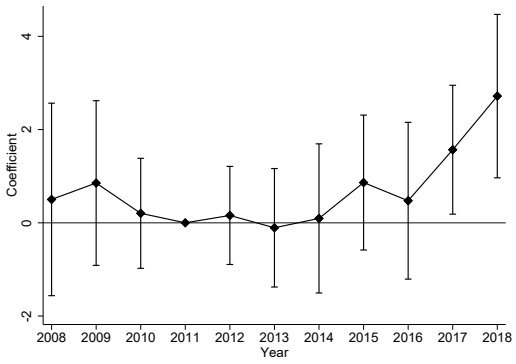
Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. The maps are given for four selected highly-populated provinces with high refugee-to-migrant ratios. On each map, the colors denote the shares of other provinces in the total out-of-province sales of that province in 2011. For instance, panel (B) shows that Gaziantep's out-of-province sales in 2011 were mostly to the highly-populated provinces in western Turkey, such as Istanbul, Ankara, Izmir, and Bursa, and to the highly-populated neighboring provinces, such as Adana, Urfa, Icel, Hatay, and Maras.

Figure 4. Event study of firm-level sales

(a) Event study - upstream ratio



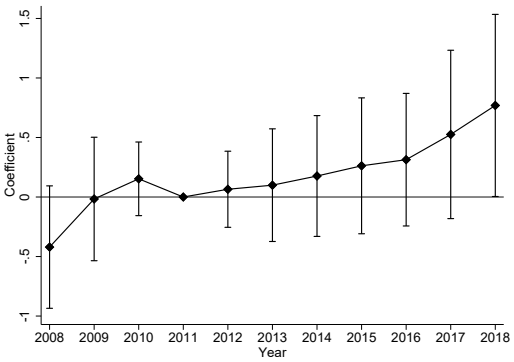
(b) Event study - downstream ratio



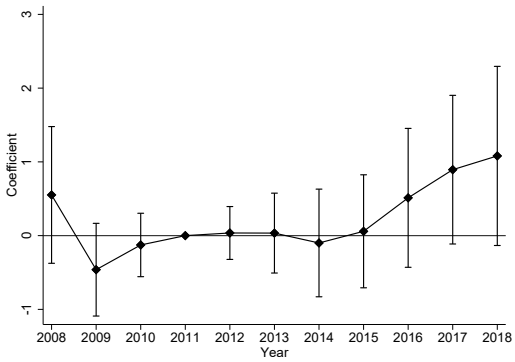
Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. The dependent variable is log-transformed sales. The key variables of interest given are firms' upstream and downstream exposure to the refugee shock. These variables depend on three factors: i) the distribution of Syrian refugees across provinces, ii) the provincial distribution of each firm's trade links, and iii) the share of out-of-province purchases (sales) in total costs (sales). We adopt a panel event study design that allows for dynamic lags and leads of the downstream and upstream exposures. We do this by interacting the instrumented exposure values for 2018 with the year dummies, defining 2011 as the baseline year. Panels (a) and (b) display the coefficients for the upstream and downstream ratios, respectively. We use a distance-based instrument for the distribution of Syrian refugees across provinces (which enters the formula of downstream and upstream exposures). This instrument depends on i) the number of refugees in four neighboring countries each year, ii) the distance of each Syrian province to the four neighboring countries, iii) the pre-war population share of each Syrian province, and iv) the distance of each Syrian province to each Turkish province. The empirical specification also includes firm and province x sector x year fixed effects, the interactions of the 2011 (pre-shock) firm-level share of the out-of-the-home-province purchases in total costs with year fixed effects, and the interactions of the 2011 firm-level share of the out-of-the-home-province sales in total sales with year fixed effects. Confidence intervals are based on standard errors estimated using clustered standard errors at the firm level and indicate the 95% confidence intervals.

Figure 5. Event study of firm-level employment

(a) Event study - upstream ratio

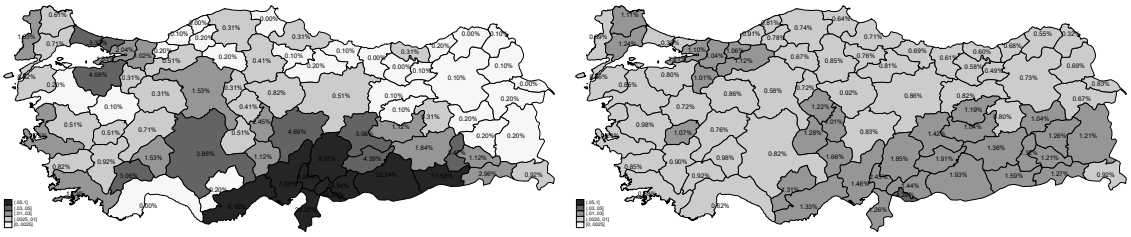


(b) Event study - downstream ratio



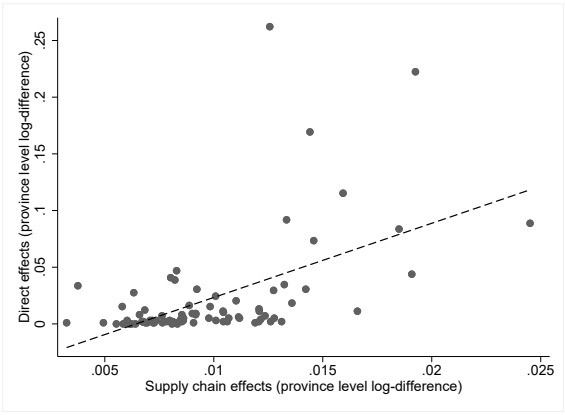
Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. The dependent variable is log-transformed employment. The key variables of interest given are firms' upstream and downstream exposure to the refugee shock. These variables depend on three factors: i) the distribution of Syrian refugees across provinces, ii) the provincial distribution of each firm's trade links, and iii) the share of out-of-province purchases (sales) in total costs (sales). We adopt a panel event study design that allows for dynamic lags and leads of the downstream and upstream exposures. We do this by interacting the instrumented exposure values for 2018 with the year dummies, defining 2011 as the baseline year. Panels (a) and (b) display the coefficients for the upstream and downstream ratios, respectively. We use a distance-based instrument for the distribution of Syrian refugees across provinces (which enters the formula of downstream and upstream exposures). This instrument depends on i) the number of refugees in four neighboring countries each year, ii) the distance of each Syrian province to the four neighboring countries, iii) the pre-war population share of each Syrian province, and iv) the distance of each Syrian province to each Turkish province. The empirical specification also includes firm and province x sector x year fixed effects, the interactions of the 2011 (pre-shock) firm-level share of the out-of-the-home-province purchases in total costs with year fixed effects, and the interactions of the 2011 firm-level share of the out-of-the-home-province sales in total sales with year fixed effects. Confidence intervals are based on standard errors estimated using clustered standard errors at the firm level and indicate the 95% confidence intervals.

Figure 6. Direct and indirect (propagation) employment effects at the province level



(a) Direct effects

(b) Indirect (propagation) effects



(c) Direct and indirect effect sizes

Notes: The data come from the 2008-18 period of the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. First, to calculate the direct impact of the refugee shock, using the estimated equation (6) in the text (results given in Table 11), we calculate the predicted firm-level employment levels at the 2017 values of the migrant-to-native shock for each province and in the absence of the migrant shock. Then, we aggregate these employment levels to the province level. The percent changes in formal employment due to migrant shock (in 2017 values) are displayed in panel (A). Second, to calculate the propagation impact of the refugee shock, using the estimated equation (1) in the text (results given in Table 2), we calculate employment at the 2017 values of the upstream and downstream exposures and in the absence of the migrant shock for each firm. We then aggregate these employment levels to the province level. The changes in province-level employment resulting from the upstream and downstream exposures generated by the migrant shock are displayed in panel (B). Panel (C) displays the correlation between the direct effects in panel (A) and the propagation effects in panel (B). In panel (C), Kilis (an outlier due to its position as a small province on the Syrian border) is excluded for readability.

Tables

Table 1. Summary statistics

	Mean	p50	SD	p10	p90	N
A) Dependent variables in firm-level data						
Sales	13.979	13.863	1.814	12.032	16.235	659,189
Employment	2.559	2.485	1.333	1.099	4.263	659,189
Wages	3.626	3.520	0.489	3.044	4.274	659,035
Cost to sales ratio	1.755	1.089	3.503	2.898	0.337	631,060
B) Treatment variables in firm-level data						
Upstream exposure	0.001	0	0.006	0	0.002	659,189
Downstream exposure	0.001	0	0.005	0	0.001	659,189
Ratio of out-of-province purchases to total purchases	0.267	0.177	0.268	0	0.697	659,189
Ratio of out-of-province sales to total sales	0.220	0.115	0.255	0	0.625	659,189
C) Dependent variables in province-pair level data						
Trade value	13.512	13.412	2.655	10.022	16.991	46,054
Trade links	2.202	1.946	1.516	0	4.029	46,054

Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. Both the firm-level and province-level dependent variables are log-transformed. The key variables of interest at the firm level, the upstream and downstream exposures to the refugee shock, depend on three factors: i) the distribution of Syrian refugees across provinces (Figure 1), ii) the provincial distribution of each firm's trade links, and iii) firm's share of out-of-province purchases (sales) in total costs (sales).

Table 2. Propagation effects on firm outcomes

	(1)	(2)	(3)
	Sales	Employment	Average wage
A- OLS			
Exposure upstream	1.4445***	0.8574**	0.1571
	(0.4502)	(0.3597)	(0.0997)
Exposure downstream	2.2433***	1.1596*	0.1948
	(0.7088)	(0.5940)	(0.1408)
B- 2SLS			
Exposure upstream	1.2423**	0.8851**	0.0802
	(0.4950)	(0.4036)	(0.1047)
Exposure downstream	2.5112***	1.2838*	0.2144
	(0.7132)	(0.6778)	(0.1794)
F-test	587.23	587.23	587.45
N	610,396	610,396	610,276
% change per SD upstream	1.534	1.093	-
% change per SD downstream	2.693	1.314	-

Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. The dependent variables, all log-transformed, are given in the column headings. The key variables of interest given in the table are firms' upstream and downstream exposures to the refugee shock. These variables depend on three factors: i) the distribution of Syrian refugees across provinces, ii) the provincial distribution of each firm's trade links, and iii) the share of out-of-province purchases (sales) in total costs (sales). The empirical specification also includes firm and province x sector x year fixed effects, the interactions of the 2011 (pre-shock) firm-level share of the out-of-the-home-province purchases in total costs with year fixed effects, and the interactions of the 2011 firm-level share of the out-of-the-home-province sales in total sales with year fixed effects. The 2SLS estimates use a distance-based instrument for the distribution of Syrian refugees across provinces (which enters the formula of downstream and upstream exposures). This instrument depends on i) the number of refugees in four neighboring countries each year, ii) the distance of each Syrian province to the four neighboring countries, iii) the pre-war population share of each Syrian province, and iv) the distance of each Syrian province to each Turkish province. To assess the magnitudes of the estimated coefficients, effects per standard deviation change in the key variables of interest are reported at the bottom of the table only for estimates that are statistically significant at least at the 10% level. Standard errors are clustered at the province level and reported in parentheses below the coefficient estimates. ***, **, * denote 1, 5, and 10 percent significance levels, respectively.

Table 3. Propagation effects on firm costs

	OLS	2SLS
Exposure Downstream	-4.4824**	-4.9684***
	(1.7415)	(1.7404)
Exposure Upstream	-2.7159	-1.3842
	(2.8020)	(3.143)
F-test	-	589.10
N	600,826	600,826
% Change per SD Upstream	-4.590	-5.089
% Change per SD Downstream	-	-

Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. The dependent variable is the ratio of costs to sales as reported in balance sheets. The key variables of interest given in the table are firms' upstream and downstream exposures to the refugee shock. These variables depend on three factors: i) the distribution of Syrian refugees across provinces, ii) the provincial distribution of each firm's trade links, and iii) the share of out-of-province purchases (sales) in total costs (sales). The empirical specification also includes firm and province x sector x year fixed effects, the interactions of the 2011 (pre-shock) firm-level share of the out-of-the-home-province purchases in total costs with year fixed effects, and the interactions of the 2011 firm-level share of the out-of-the-home-province sales in total sales with year fixed effects. The 2SLS estimates use a distance-based instrument for the distribution of Syrian refugees across provinces (which enters the formula of downstream and upstream exposures). This instrument depends on i) the number of refugees in four neighboring countries each year, ii) the distance of each Syrian province to the four neighboring countries, iii) the pre-war population share of each Syrian province, and iv) the distance of each Syrian province to each Turkish province. To assess the magnitudes of the estimated coefficients, effects per standard deviation change in the key variables of interest are reported at the bottom of the table only for estimates that are statistically significant at least at the 10% level. Standard errors are clustered at the province level and reported in parentheses below the coefficient estimates. ***, **, * denote 1, 5, and 10 percent significance levels, respectively.

Table 4. Effects by firm technology level

	(1)	(2)	(3)	(4)	(5)	(6)
	Low-tech			High-tech		
	Sales	Employment	Average wage	Sales	Employment	Average wage
A- OLS						
Exposure upstream	1.7693***	1.0883***	0.2055*	-1.3018	-1.0209	-0.2200
	(0.4470)	(0.3873)	(0.1084)	(1.1519)	(0.8687)	(0.1367)
Exposure downstream	2.0520**	1.1033*	0.1186	2.6856**	1.2932*	0.4383
	(0.8055)	(0.6170)	(0.1106)	(1.0367)	(0.7225)	(0.2958)
B- 2SLS						
Exposure upstream	1.4883***	1.0298**	0.1425	-1.2253	-0.4433	-0.4711*
	(0.4854)	(0.4279)	(0.1219)	(1.4762)	(0.9941)	(0.2515)
Exposure downstream	2.1371**	1.0743	0.0813	3.5002**	1.8818***	0.6422*
	(0.8442)	(0.7629)	(0.1400)	(1.3432)	(0.6502)	(0.3265)
F-test	470.92	470.92	471.16	171.39	171.39	171.36
N	491,741	491,741	491,647	118,655	118,655	118,629
% change per SD upstream	1.838	1.272	-	-	-	-0.582
% change per SD downstream	2.291	-	-	3.752	2.017	0.688

Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. The estimates are given separately for high-tech and low-tech sectors, which are defined according to EUROSTAT classifications. High-tech manufacturing sectors include NACE-2 codes 24, 29, 30, 32, 33, 34 and 35. The dependent variables, all log-transformed, are given in the column headings. The key variables of interest given in the table are firms' upstream and downstream exposure to the refugee shock. These variables depend on three factors: i) the distribution of Syrian refugees across provinces, ii) the provincial distribution of each firm's trade links, and iii) the share of out-of-province purchases (sales) in total costs (sales). The empirical specification also includes firm and province x sector x year fixed effects, the interactions of the 2011 (pre-shock) firm-level share of the out-of-the-home-province purchases in total costs with year fixed effects, and the interactions of the 2011 firm-level share of the out-of-the-home-province sales in total sales with year fixed effects. The 2SLS estimates use a distance-based instrument for the distribution of Syrian refugees across provinces (which enters the formula of downstream and upstream exposures). This instrument depends on i) the number of refugees in four neighboring countries each year, ii) the distance of each Syrian province to the four neighboring countries, iii) the pre-war population share of each Syrian province, and iv) the distance of each Syrian province to each Turkish province. To assess the magnitudes of the estimated coefficients, effects per standard deviation change in the key variables of interest are reported at the bottom of the table only for estimates that are statistically significant at least at the 10% level. Standard errors are clustered at the province level and reported in parentheses below the coefficient estimates. ***, **, * denote 1, 5, and 10 percent significance levels, respectively.

Table 5. Effects by firm size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Small (1-9)			Medium (10-49)			Large (50+)		
	Sales	Employment	Average wage	Sales	Employment	Average wage	Sales	Employment	Average wage
A- OLS									
Exposure upstream	1.0838*	-0.0854	0.0317	1.0081	0.9959	0.3098**	2.1396	1.4040	0.5670*
	(0.5675)	(0.3959)	(0.0767)	(0.6464)	(0.6093)	(0.1398)	(1.6212)	(1.2514)	(0.2918)
Exposure downstream	3.2165***	0.8209	0.3170**	1.3422	0.4809	0.1802	2.9173**	3.0060***	0.2377
	(1.0660)	(0.7764)	(0.1455)	(0.8420)	(0.5780)	(0.1852)	(1.3462)	(0.8719)	(0.1506)
B- 2SLS									
Exposure upstream	0.8222	-0.2327	-0.0640	0.8802	0.8884	0.2676*	2.2957	1.6000	0.7576**
	(0.6282)	(0.4458)	(0.0920)	(0.7145)	(0.7103)	(0.1377)	(1.7455)	(1.4012)	(0.2936)
Exposure downstream	2.9061**	0.3750	0.3410	2.1457**	0.5634	0.2811	3.2859**	3.5178***	0.1866
	(1.3017)	(0.7629)	(0.2112)	(0.9312)	(0.6956)	(0.2207)	(1.4794)	(0.9380)	(0.1907)
F-test	268.64	268.64	268.55	494.02	494.02	494.13	1811.21	1811.21	1808.07
N	266,611	266,611	263,953	257,203	257,203	257,173	76,841	76,841	76,830
% change per SD upstream	-	-	-	-	-	0.331	-	-	0.936
% change per SD downstream	3.115	-	-	2.300	-	-	3.522	3.771	-

Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. The estimates are given by firm size for small (1 to 9 employees), medium (10 to 49 employees), and large (50+ employees) firms. The dependent variables, all log-transformed, are given in the column headings. The key variables of interest given in the table are firms' upstream and downstream exposures to the refugee shock. These variables depend on three factors: i) the distribution of Syrian refugees across provinces, ii) the provincial distribution of each firm's trade links, and iii) the share of out-of-province purchases (sales) in total costs (sales). The empirical specification also includes firm and province x sector x year fixed effects, the interactions of the 2011 (pre-shock) firm-level share of the out-of-the-home-province purchases in total costs with year fixed effects, and the interactions of the 2011 firm-level share of the out-of-the-home-province sales in total sales with year fixed effects. The 2SLS estimates use a distance-based instrument for the distribution of Syrian refugees across provinces (which enters the formula of downstream and upstream exposures). This instrument depends on i) the number of refugees in four neighboring countries each year, ii) the distance of each Syrian province to the four neighboring countries, iii) the pre-war population share of each Syrian province, and iv) the distance of each Syrian province to each Turkish province. To assess the magnitudes of the estimated coefficients, effects per standard deviation change in the key variables of interest are reported at the bottom of the table only for estimates that are statistically significant at least at the 10% level. Standard errors are clustered at the province level and reported in parentheses below the coefficient estimates. ***, **, * denote 1, 5, and 10 percent significance levels, respectively.

Table 6. Effects by distance to Aleppo

	(1)	(2)	(3)	(4)	(5)	(6)
	Less than 800 km to Aleppo			More than 800 km to Aleppo		
	Sales	Employment	Average wage	Sales	Employment	Average wage
A- OLS						
Exposure upstream	0.9859***	0.5437*	0.0716	1.8762**	1.1233*	0.2496*
	(0.3550)	(0.2775)	(0.0864)	(0.7668)	(0.5682)	(0.1417)
Exposure downstream	2.0550**	-0.0697	0.0288	2.4516**	2.4214***	0.3485
	(0.8249)	(0.5209)	(0.0783)	(1.1402)	(0.7320)	(0.2144)
B- 2SLS						
Exposure upstream	0.9517*	0.6566*	0.0045	1.4800*	1.0221	0.1565
	(0.4879)	(0.3268)	(0.0775)	(0.8325)	(0.6594)	(0.1620)
Exposure downstream	1.9960**	-0.3472	0.0918	3.0152**	2.8530***	0.3222
	(0.7881)	(0.5663)	(0.1235)	(1.1763)	(0.7956)	(0.2938)
F-test	548.49	548.49	548.55	1099.94	1099.94	1100.96
N	151,472	151,472	151,442	458,924	458,924	458,834
% change per SD upstream	1.175	0.802	-	1.828	-	-
% change per SD downstream	2.140	-	-	3.232	3.058	-

Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. The estimates are given for two groups of firms defined according to the distance to Aleppo. The dependent variables, all log-transformed, are given in the column headings. The key variables of interest given in the table are firms' upstream and downstream exposures to the refugee shock. These variables depend on three factors: i) the distribution of Syrian refugees across provinces, ii) the provincial distribution of each firm's trade links, and iii) the share of out-of-province purchases (sales) in total costs (sales). The empirical specification also includes firm and province x sector x year fixed effects, the interactions of the 2011 (pre-shock) firm-level share of the out-of-the-home-province purchases in total costs with year fixed effects, and the interactions of the 2011 firm-level share of the out-of-the-home-province sales in total sales with year fixed effects. The 2SLS estimates use a distance-based instrument for the distribution of Syrian refugees across provinces (which enters the formula of downstream and upstream exposures). This instrument depends on i) the number of refugees in four neighboring countries each year, ii) the distance of each Syrian province to the four neighboring countries, iii) the pre-war population share of each Syrian province, and iv) the distance of each Syrian province to each Turkish province. To assess the magnitudes of the estimated coefficients, effects per standard deviation change in the key variables of interest are reported at the bottom of the table only for estimates that are statistically significant at least at the 10% level. Standard errors are clustered at the province level and reported in parentheses below the coefficient estimates. ***, **, * denote 1, 5, and 10 percent significance levels, respectively.

Table 7. Effects by firm openness

	(1)	(2)	(3)	(4)	(5)	(6)
	Low openness			High openness		
	Sales	Employment	Average wage	Sales	Employment	Average wage
A- OLS						
Exposure upstream	0.7807	0.5472	0.1934**	1.8543***	1.0296*	0.1795
	(0.5981)	(0.4413)	(0.0872)	(0.5788)	(0.5297)	(0.1231)
Exposure downstream	0.2102	-0.6915	0.4990	2.2491***	1.2924**	0.1535
	(7.6361)	(4.7463)	(1.0011)	(0.6901)	(0.5691)	(0.1982)
B- 2SLS						
Exposure upstream	0.4227	0.3397	0.0914	1.8772***	1.1835*	0.1535
	(0.5721)	(0.4560)	(0.1059)	(0.6408)	(0.6828)	(0.1247)
Exposure downstream	3.9531	1.9645	0.7469	2.4596***	1.3422**	0.1982
	(10.9419)	(5.9936)	(1.2919)	(0.7082)	(0.6299)	(0.1511)
F-test	428.92	428.92	428.42	627.04	627.04	627.23
N	303,011	303,011	302,944	304,514	304,514	304,460
% change per SD upstream	-	-	-	2.319	1.462	-
% change per SD downstream	-	-	-	2.636	1.439	-

Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. We estimate the effects separately for firms that have below the median share of out-of-province sales (low openness) and above the median (high openness). The dependent variables, all log-transformed, are given in the column headings. The key variables of interest given in the table are the upstream and downstream exposure of firms to the refugee shock. These variables depend on three factors: i) the distribution of Syrian refugees across provinces, ii) the provincial distribution of each firm's trade links, and iii) the share of out-of-province purchases (sales) in total costs (sales). The empirical specification also includes firm and province x sector x year fixed effects, the interactions of the 2011 (pre-shock) firm-level share of the out-of-the-home-province purchases in total costs with year fixed effects, and the interactions of the 2011 firm-level share of the out-of-the-home-province sales in total sales with year fixed effects. The 2SLS estimates use a distance-based instrument for the distribution of Syrian refugees across provinces (which enters the formula of downstream and upstream exposures). This instrument depends on i) the number of refugees in four neighboring countries each year, ii) the distance of each Syrian province to the four neighboring countries, iii) the pre-war population share of each Syrian province, and iv) the distance of each Syrian province to each Turkish province. To assess the magnitudes of the estimated coefficients, effects per standard deviation change in the key variables of interest are reported at the bottom of the table only for estimates that are statistically significant at least at the 10% level. Standard errors are clustered at the province level and reported in parentheses below the coefficient estimates. ***, **, * denote 1, 5, and 10 percent significance levels, respectively.

Table 8. Effects on province-level trade

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Value				Number of links			
A- OLS								
Ratio upstream	0.7413***	0.7663***	0.6205**	0.6472**	0.1290	0.1235	0.2194	0.2586*
	(0.2608)	(0.2487)	(0.3065)	(0.3062)	(0.1300)	(0.1213)	(0.1455)	(0.1422)
Ratio downstream	0.1545	0.2772	0.3990	0.3908	0.1259	0.2257***	0.1366	0.1361
	(0.2430)	(0.2402)	(0.2852)	(0.2851)	(0.1101)	(0.0873)	(0.0988)	(0.1048)
B- 2SLS								
Ratio upstream	1.3369***	1.2841***	1.2619***	1.3199***	0.0410	-0.0150	0.1457	0.1961
	(0.2984)	(0.3001)	(0.4071)	(0.4155)	(0.1317)	(0.1276)	(0.1657)	(0.1675)
Ratio downstream	0.5045*	0.6604**	1.0467***	1.0544***	0.3066**	0.3657***	0.3150**	0.3494**
	(0.3027)	(0.2966)	(0.3825)	(0.3800)	(0.1340)	(0.1233)	(0.1513)	(0.1529)
F-test	484.61	449.27	236.07	229.31	484.61	449.27	236.07	229.31
N	46,054	45,609	45,609	45,609	46,054	45,609	45,609	45,609
Year	+	+			+	+		
Upstream province	+				+			
Downstream province	+				+			
Province pair		+	+	+		+	+	+
NUTS-1 upstream x year FE			+				+	
NUTS-1 downstream x year FE			+				+	
NUTS-1 region pair x year FE				+				+

Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. We generate province-pair-level data on firm-to-firm trade by aggregating the trade between manufacturing firms. Each province pair appears twice in the data, with the selling and purchasing province roles switched. The outcome variables are the CPI-adjusted and log-transformed value of sales from one province to another and the log-transformed number of firm links between province pairs. The primary variables of interest are the refugee-to-native ratios in the destination and the origin provinces. The empirical specifications also include year dummies and destination-origin province pair fixed effects (except in columns (1) and (5), in which separate upstream and downstream province dummies are used). In addition, the specifications in columns (3) and (7) include the interactions of year dummies with NUTS-1 level region dummies for the upstream and downstream provinces separately, and the specifications in columns (4) and (8) include the interactions of year dummies with NUTS-1 level region-pair fixed effects. The 2SLS estimates use a distance-based instrument for the distribution of Syrian refugees across provinces (which enters the formula of downstream and upstream exposures). This instrument depends on i) the number of refugees in four neighboring countries each year, ii) the distance of each Syrian province to the four neighboring countries, iii) the pre-war population share of each Syrian province, and iv) the distance of each Syrian province to each Turkish province. Standard errors are clustered at the province level and reported in parentheses below the coefficient estimates. ***, **, * denote 1, 5, and 10 percent significance levels, respectively.

Table 9. Effects on province-level trade by province distance

	(1)	(2)	(3)	(4)	(5)	(6)
	Near		Distant		Distant exc. Istanbul	
	Value	Link	Value	Link	Value	Link
Ratio upstream	1.2623**	0.0466	1.3805*	0.4291	1.4780*	0.4436
	(0.5267)	(0.2084)	(0.7394)	(0.3010)	(0.8026)	(0.3221)
Ratio downstream	0.3971	0.1203	1.2436*	0.3927	1.2891*	0.4415*
	(0.4904)	(0.2111)	(0.6360)	(0.2406)	(0.6831)	(0.2583)
F-test	110.72	110.72	63.40	63.40	68.15	68.15
N	30,385	30,385	15,151	15,151	14,341	14,341

Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. We generate province-pair-level data on firm-to-firm trade by aggregating the trade between manufacturing firms. Each province pair appears twice in the data, with the selling and purchasing province roles switched. The results are given for near and distance provinces; province pairs are defined as near if their (road) distance is less than 800 kilometers and distant otherwise. The outcome variables are the CPI-adjusted and log-transformed value of sales from one province to another and the log-transformed number of firm links between province pairs. The primary variables of interest are the refugee-to-native ratios in the destination and the origin provinces. The specification also includes province dummies and interactions of NUTS-1 region-pair dummies and year dummies. The 2SLS estimates use a distance-based instrument for the distribution of Syrian refugees across provinces (which enters the formula of downstream and upstream exposures). This instrument depends on i) the number of refugees in four neighboring countries each year, ii) the distance of each Syrian province to the four neighboring countries, iii) the pre-war population share of each Syrian province, and iv) the distance of each Syrian province to each Turkish province. Standard errors are clustered at the province level and reported in parentheses below the coefficient estimates. ***, **, * denote 1, 5, and 10 percent significance levels, respectively.

Table 10. Effects on province-level trade by province link

	(1)	(2)	(3)	(4)
	Weak province links		Strong province links	
	Value	Link	Value	Link
Ratio upstream	1.6967***	0.3747	0.5506	-0.1211
	(0.5878)	(0.2306)	(0.5203)	(0.2560)
Ratio downstream	1.1150***	0.4286***	-0.2631	-0.3766
	(0.4192)	(0.1641)	(0.9365)	(0.3598)
F-test	177.37	177.37	35.36	35.36
N	34,375	34,375	10,956	10,956

Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. We generate province-pair-level data on firm-to-firm trade by aggregating the trade between manufacturing firms. Each province pair appears twice in the data, with the selling and purchasing province roles switched. The results are given for province pairs with strong and weak pre-shock links; province pair links are defined as strong if firms in the selling province make more than 1% of their out-of-province sales to firms in the purchasing province. The outcome variables are the CPI-adjusted and log-transformed value of sales from one province to another and the log-transformed number of firm links between province pairs. The primary variables of interest are the refugee-to-native ratios in the destination and the origin provinces. The specification also includes province dummies and interactions of NUTS-1 region-pair dummies and year dummies. The 2SLS estimates use a distance-based instrument for the distribution of Syrian refugees across provinces (which enters the formula of downstream and upstream exposures). This instrument depends on i) the number of refugees in four neighboring countries each year, ii) the distance of each Syrian province to the four neighboring countries, iii) the pre-war population share of each Syrian province, and iv) the distance of each Syrian province to each Turkish province. Standard errors are clustered at the province level and reported in parentheses below the coefficient estimates. ***, **, * denote 1, 5, and 10 percent significance levels, respectively.

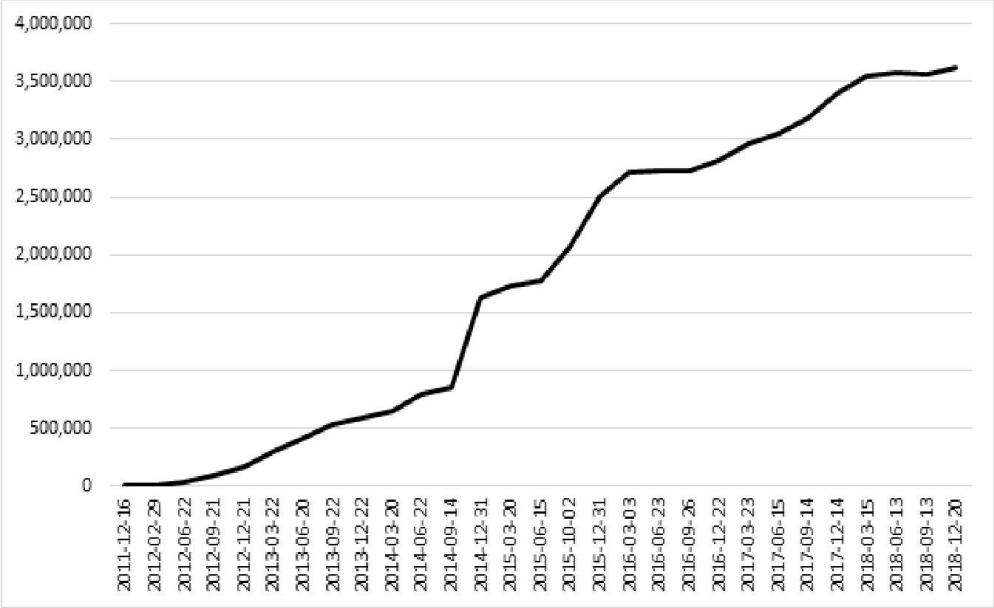
Table 11. Direct effects of Syrians in the province

	Sales	Employment
A- OLS		
Ratio	0.8468**	0.5791***
	(0.4153)	(0.2301)
B- 2SLS		
Ratio	0.8470*	1.0202**
	(0.6263)	(0.4730)
F-test	76.24	76.24
N	612,892	612,892

Notes: We use administrative data at the firm level for the 2008-18 period from the Entrepreneurship Information System of the Turkish Ministry of Industry and Technology. The sample is restricted to manufacturing firms with complete balance sheets and employment registered with the Social Security Institute. The dependent variables are the firm-level log of sales and the log of employment. The key variable of interest is the migrant-to-native ratio at the province level. All specifications include firm, province, and time dummies. In addition, we also include 2-digit NACE level sector–year fixed effects and region–year fixed effects (at the level of 12 NUTS-1 regions). The 2SLS estimates use a distance-based instrument for the distribution of Syrian refugees across provinces (which enters the formula of downstream and upstream exposures). This instrument depends on i) the number of refugees in four neighboring countries each year, ii) the distance of each Syrian province to the four neighboring countries, iii) the pre-war population share of each Syrian province, and iv) the distance of each Syrian province to each Turkish province. Standard errors are clustered at the province level and reported in parentheses below the coefficient estimates. ***, **, * denote 1, 5, and 10 percent significance levels, respectively.

Online Appendix

Figure A1. Number of Syrians in Turkey over Time



Notes: Source: UNHCR.