Formal Effects of Informal Labor
Evidence from the Syrian refugees in Turkey

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Abstract

I study how firms and native workers respond to an informal labor supply shock, driven by an inflow of refugees who are not provided work permits and are thus only employable in the informal economy. Crucially, I distinguish between native workers in the informal and formal sectors, of which the latter may be positively or negatively impacted. The empirical setting is the Syrian refugee crisis in Turkey. Using travel distance as an instrument for refugee location, I show that a one percentage point (pp) increase in the refugee/native ratio decreases native informal salaried employment by 0.17 pp and formal salaried employment by 0.13 pp among low-skill natives. I document two mechanisms: (i) formal firms reduce their formal labor demand, and (ii) new firms relocate from formal to informal economy. These estimates imply a relatively high elasticity of substitution, of approximately 10, between formal and informal workers. This is consistent with the Turkish context, where informal employment is often in the same sectors and even in the same firms as formal employment. As a counterfactual, I predict that granting refugees work permits would have created up to 112,000 more formal jobs in the economy through higher informal wages.

Keywords: Informality, Immigration, Refugee crises, Work permits

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1 Introduction

The number of refugees has more than tripled in the last decade, from 10 million in 2012 to 34 million in 2022 (UNHCR, 2021). Two aspects differentiate this flow from earlier migration flows. First, 74% of all refugees are hosted by developing countries with sizeable informal sectors. Second, policymakers in host countries often withhold work permits from refugees due to fear of negatively impacting natives.[1] Turkey hosts the largest number of refugees in the world, and yet the overwhelming majority of refugees in Turkey do not have permits. Consequently, the 3.6 million Syrian refugees constitute a massive informal labor supply shock, the consequences of which will depend on the dynamics between informal and formal sectors.

This paper studies how firms and natives respond to an informal labor supply shock and what their actions imply about our understanding of the informal economy. It first shows that in the canonical labor demand framework, where a representative firm can use both informal and formal labor in production, an informal labor supply shock necessarily reduces natives' wages and employment in the informal sector. However, more informal employment has two competing effects in the formal sector: it makes formal workers more productive because of Q-complementarity, and it also creates competition against formal employees, especially given diminishing returns to labor. Consequently, refugees' effect on the formal sector remains an empirical question. My model highlights that if informal and formal labor are largely substitutable in production, then informal immigrants can incentivize firms to become more informal.

Empirically, I study the Syrian refugee crisis in Turkey. The Syrian civil war displaced nearly 13 million Syrians, 6.6 million of whom sought refuge in neighboring countries. With 3.6 million registered Syrian refugees as of 2020, Turkey hosts the largest number in the world. Turkey makes an ideal setting to study the impact of informal labor on the informal and formal sectors for several reasons. First, it is a developing country where 40% of all employment is informal. Second, a significant portion of this informal labor works for formally registered firms that also employ formal workers, which is consistent with my model's assumptions and facilitates substitution. Third, the overwhelming majority of Syrian refugees in Turkey lack work permits and must seek informal employment. Fourth, Turkish labor force surveys include information on wages and employment of natives separately for the formal and informal sectors.[2] I adopt a quasi-experimental research design to distinguish the direct impact of an informal labor supply shock to the informal sector from its spillovers to the formal sector.

I first analyze the refugees' impact on natives' employment in salaried jobs.[3] Identification

[1] This fear is apparent in the following quote from the Minister of Work and Social Security of Turkey "There cannot be a general measure to provide [refugees] with work permits because we already have our workforce ... we are trying to educate and train our unemployed so they can get jobs in Turkey" (Afanasieva, 2015).

[2] By law, employers in Turkey have to pay for the social security coverage of their employees. Hence, the insurance status of a worker determines her formality type: those with (without) social security are formal (informal) workers.

[3] Household Labor Force Surveys in Turkey code employment under four categories: wage earners (defined as regular, salaried work), self-employed, unpaid family workers, and employers. Salaried employment is jointly determined by firms' labor demand and workers' labor supply, whereas self-employment and unpaid family work are solely individual labor supply decisions. Consequently, I focus on salaried employment to study changes in labor demand

comes from an exposure design, where travel distance between Turkish and Syrian cities operates as an instrument for migrants' location choice. Adjusting for pre-trends which reflect regional convergence in Turkey, I find that a 1 percentage point (pp) increase in the refugee/native ratio decreases native informal salaried employment rate by 0.17 pp, and formal salaried employment rate by 0.13 pp for the low-skill natives. The former is predicted by a downward-sloping labor demand curve in the informal sector, but the latter indicates that informal and formal labor are highly substitutable in production.

Several robustness checks show that these disemployment effects arise from the informal labor supply of refugees and not from other confounders that can reduce labor demand. First, disruptions in trade with Syria due to the Syrian Civil War were only temporary and were not large enough to change the total export volume from regions closer to the border. Second, there is no effect on the formal salaried employment rate among natives with high school degrees. This is a placebo check as Syrian refugees in Turkey are substantially less educated than the Turkish natives and, therefore, are not close substitutes for this sub-population. Third, the native disemployment comes precisely from industries that employ more refugees.[4] Fourth, a back-of-the-envelope calculation using refugees' employment rate suggests that the number of low-skill workers in the economy has increased by 3.9%. Fifth, consistent with high-skill/low-skill complementarity, the wages of formal, high-skill workers increase. Overall, the evidence indicates that refugees' labor supply is the main mechanism behind the adverse employment effects in the informal and formal sectors.

I use my empirical findings and moments from the data to estimate the key parameters of my model. The results imply that the elasticity of substitution between formal and informal labor is around 10. To the best of my knowledge, this is one of the first papers to estimate this elasticity.[5] This relatively high elasticity is consistent with the Turkish context, where informal workers are often in the same sectors and even in the same firms as formal workers. This finding supports the assumption of perfect substitutability between informal and formal workers in the recent structural literature on the informal sector as a first approximation (Ulyssea, 2018, 2020).

Finally, I use this model to estimate the labor market impacts of providing refugees with work permits. This counterfactual is of first-order importance for policy as (i) most refugees in the world do not have work permits (Clemens et al., 2018), and (ii) recently governments in both developing and developed countries started granting this right.[6] The model highlights a key trade-off for

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and on non-salaried employment to study native workers' response to immigration.

[4]Syrian refugees in Turkey predominantly do not speak Turkish, which limits the sectors they can work in. Survey evidence shows that refugees work more intensely in textile, construction, and agriculture. Consistent with my hypothesis, natives lose salaried jobs only in these sectors.

[5]The only other work that I could find that estimates this elasticity is Schramm (2014), who studies the equilibrium effects of taxation on sectoral choice, work hours and wages in Mexico. She finds this elasticity to be around 1.8, much lower than what I find. Informal and formal workers working in different sectors and firms in Mexico as opposed to working in the same firms as in Turkey could explain this discrepancy. Moreover, she relies on aggregate shocks to the tax code for identification, which can cause bias if changes in tax code are correlated with macroeconomic conditions and hence formal employment rates. In contrast, I use a difference in differences strategy combined with an exposure instrument, which can arguably provide more credible estimates.

[6]For example, Colombia started granting Venezuelan refugees work permits in waves as early as 2017 (Bahar et al., 2021), the US has declared that it will also provide work permits to five hundred thousand Venezuelan refugees

policymakers: work permits shift some of the informal labor supply shock to the formal sector, which (i) increases wages and native employment in the informal sector due to lessened competition, and (ii) decreases native employment in the formal sector due to increased competition. The increase in informal wages also causes firms to demand more formal workers due to the high substitutability between the two factors. This indirect effect can never dominate the direct effect of increased competition in the formal sector, hence work permits necessarily lower native employment in the formal sector. However, as the firms demand more formal labor in total, work permits create more formal jobs in the economy overall. The model predicts that if refugees had the same formality rate as the natives, a 1 pp increase in refugee/native ratio would have decreased informal salaried employment by 0.06 pp and formal salaried employment by 0.47 pp among natives. Despite more natives being replaced by refugees in the formal jobs, providing work permits would have created 120,000 more formal jobs in the economy through firms substituting away from informal labor due to higher informal wages. As a benchmark, this would be equivalent to a 18% growth in GDP per capita for creating formal jobs.[7]

I further explore how native workers respond to refugees. I find that immigrants *increase* male natives' non-salaried employment, primarily self-employment, and do not impact females' non-salaried employment. The distinction between salaried employment and self-employment is interesting because salaried jobs arise partly from firms' labor demand, whereas self-employment is solely a labor supply decision. This result implies that for low-skill men, the alternative to salaried employment is self-employment instead of unemployment.[8] This is a novel finding in the immigration literature, which primarily focuses on developed countries where self-employment is a much smaller component of the labor markets.[9] This finding suggests that labor market adjustments to immigration shocks can be different in developing countries where self-employment is a viable alternative to salaried employment.

Lastly, this paper investigates whether informal immigration impacts firms' decisions to become formal at the extensive margin; i.e., register to the tax authorities. It documents a change in the productivity distribution of new formal firms: a decrease in the number of less productive firms and an increase in more productive firms. To explain these results, I propose a model where entrepreneurs can choose to enter the informal or formal sectors à la Ulyssea (2018), and, *conditional* on being a formal firm, they can further choose to participate in international trade à la Melitz (2003). In this model, the missing mass of new small formal firms indicates marginal entrepreneurs

(Hesson, 2023), Poland was one of the first countries that stated that Ukrainian refugees would be given work permits (Lesinska, 2022).

[7] From 2004 to 2011, Turkey's GDP per capita increased by 87% from $6,102 to $11,420; and the informality rate among low-skill salaried jobs decreased by 8 pp from 0.45 to 0.37. If the informality rate of 2004 remained in 2011, there would be 650,000 fewer formal jobs. If all of this decrease in informality can be attributed to economic growth à la La Porta and Shleifer (2014), then providing work permits to refugees would be equivalent to a 18% growth in GDP per capita for creating formal jobs.

[8] One potential explanation to why men are so attached to employment is that in the treated regions in Turkey, men are the primary breadwinner of the household. They may be *expected* to keep having some labor market activity to continue providing for their families.

[9] For a literature review, please refer to Dustmann et al. (2016).

choosing to remain unregistered to have easier access to informal labor. If true, this would be an additional policy-relevant effect of an informal labor supply shock. Although the lack of credible data sources on unregistered firms in Turkey prevents testing whether the number of unregistered firms has increased, I provide suggestive evidence on this question.

This quasi-experimental paper complements a literature that has studied the dynamics of informal and formal sectors. Initial contributions in this field were largely theoretical (Rauch, 1991; Amaral and Quintin, 2006), while more recent efforts have concentrated on calibrating/estimating structural models (Bosch and Esteban-Pretel, 2012; Meghir et al., 2015; Ulyssea, 2018). A notable exception is Delgado-Prieto (2021), who studies the labor market consequences of the Venezuelan refugee shock in Colombia. He finds negative employment effects in the formal sector but none in the informal sector, which he rationalizes via a partial equilibrium model inspired by Ulyssea (2018). Two key dimensions distinguish our papers. First, the Venezuelan refugee shock was not only an informal labor supply shock as many Venezuelans were given work permits (Bahar et al., 2021). This prevents inferring the role of (the lack of) work permits in driving these effects. Second, his paper does not fully study how native workers respond to the immigration shock, because, as I document, a major part of this adjustment is the margin between salaried and non-salaried jobs. In fact, I show in my setting that not taking this margin into account leads to incorrect inferences. His approach can thus be seen as complementary to the one proposed here in this paper, which focuses on how both firms and natives respond to an informal labor supply shock, and the role of work permits in explaining these effects.

The counterfactual prediction on the formalizing effects of work permits is also related to a literature that studies the impact of different formalization policies in developing countries (Monteiro and Assunção, 2012; De Andrade et al., 2016; Rocha et al., 2018). Most similar to the present setting are two papers that focus on the role of work permits in refugee crises. On the policy front, Clemens et al. (2018) provide economic arguments as to why providing work permits to refugees can substantially benefit refugees and natives alike. Empirically, Bahar et al. (2021) study the effects of granting Venezuelan refugees work permits and find negative but negligible effects on the formal employment rate of Colombian workers.[10] This paper complements their findings by documenting that not providing work permits to refugees acts as an informalizing incentive for firms.

This paper builds on the large literature using refugee shocks to study the effects of immigration on labor markets. Examples of such episodes include the Mariel Boatlift (Card, 1990), the Algerian war of independence (Hunt, 1992), Jewish emigres to Israel (Friedberg, 2001), the Yugoslav wars (Angrist and Kugler, 2003), and the Venezuelan refugee crisis (Lebow, 2022). Despite 30 years of work, whether immigrants cause native disemployment is still debated (Borjas and Monras, 2017; Peri and Yasenov, 2019). Several factors distinguish the current Turkish setting from the existing literature. First, the treated Turkish regions received substantially more immigrants per

[10] I predict stronger disemployment of natives in the formal sector than what Bahar et al. (2021) document. One potential explanation to our different conclusions is that I focus on salaried employment whereas they study aggregate employment. If Colombian natives who lose their formal salaried jobs transition to formal non-salaried jobs as I documented in Turkey, then our conclusions would be consistent.

native than the aforementioned studies. For example, the Mariel Boatlift increased Miami's adult population by 8%. In comparison, Syrians increased Turkish cities' adult population by up to 94%. Second, this paper shows that when self-employment is a viable alternative to unemployment, immigration need not cause native unemployment. The canonical labor demand framework that predicts native displacement still empirically holds for salaried jobs. However, if enough workers transition to self-employment instead of unemployment, immigrants' effect on native unemployment can be minuscule.

More recently, several papers investigated the effects of the Syrian refugees on the Turkish labor markets (Del Carpio and Wagner, 2015; Tumen, 2016; Ceritoglu et al., 2017; Akgündüz and Torun, 2020; Erten and Keskin, 2021; Aksu et al., 2022; Cengiz and Tekgüç, 2022; Demirci and Kırdar, 2023) and on firm entry (Altındağ et al., 2020; Akgunduz et al., 2022). Using different identification strategies, this literature mostly found inconclusive results. Del Carpio and Wagner (2015) find an increase in formal employment among only low-skill men. However, Akgündüz and Torun (2020) claim instead that high-skill employment (which is mostly formal) has increased. Across men and women, Aksu et al. (2022) argue that refugees lead to an increase in formal employment for men, and a decrease for women. Their results are challenged by Erten and Keskin (2021), who find a decrease in employment only for women and not for men. Cengiz and Tekgüç (2022) claim that there was no employment loss among natives due to the refugee shock. As Appendix Section G explains in detail, this inconclusive set of results arises from a combination of two factors. They either did not separate employment into components that are governed by different economic forces, or they did not adequately adjust for the pre-trends in the data. Making these economic and econometric adjustments reveals that natives lose salaried jobs in both the informal and formal sectors. The present framework rationalizes these findings and isolates the relevant economic forces. Lastly, this paper shows that the change in the productivity distribution of new entrants is *suggestive* of marginal entrepreneurs choosing to remain informal. Future research can investigate this effect in more depth by collecting data on the unregistered firms in Turkey.[11] For instance, utilizing proxies to gauge the activity of informal firms would facilitate an analysis of whether there has been an uptick in informal firm presence.

The rest of this paper is structured as follows. Section 2 provides facts about the labor market and informality in Turkey, Section 3 introduces the model, Section 4 provides background on the Syrian refugees in Turkey, Section 5 explains the identification strategy, Section 6 presents the empirical results, and Section 7 concludes.

[11] Ozar (2003) is the only rigorous data collection effort on informal firms in Turkey. She finds that around 4% of firms self-declare that they are not registered. Updating this study today, where millions of refugees cannot work formally, could reveal interesting results. I leave this for future work.

2 Data and Informality Facts

Native employment

Information about the informal and formal labor market outcomes of native workers comes from the 2004–2016 Turkish Household Labor Force Surveys (HLFS) conducted by the Turkish Statistical Institute (TurkSTAT). HLFS is representative at the NUTS-2 level, which consists of 26 regions.[12] The sampling is based on the national address database and does not cover the Syrian refugees who are under temporary protection.

HLFS codes employment under four categories. Between 2004–2016, 61% of employed natives were regular salaried workers, 21% were self-employed, 13% were unpaid family workers, and 6% were employers. I combine the latter three under one "non-salaried employment" category.[13] This allows a tractable separation of jobs that are partly determined by the labor demand of firms and jobs that depend solely on individual labor supply decisions. This distinction is critical in studying how firms respond to the informal labor supply shock. For instance, consider a native who loses his formal, salaried job due to being replaced by informal refugees. This native may keep "working" as an unpaid family worker or trade items at the local markets as a self-employed person. The latter can also be formal if the worker pays his social security benefits. Either way, this native would appear as "employed" under the HLFS, even though his employer replaced him with informal immigrants. Consequently, focusing on the overall employment rate of natives would cause us to miss how firms respond to an informal labor supply shock. To prevent this problem, I study salaried employment and non-salaried employment separately while focusing on salaried employment as the key outcome of interest in both the theory and the empirics.[14] The salaried and non-salaried employment statistics among different types of natives and industries can be found in Table A.1 in the Appendix.

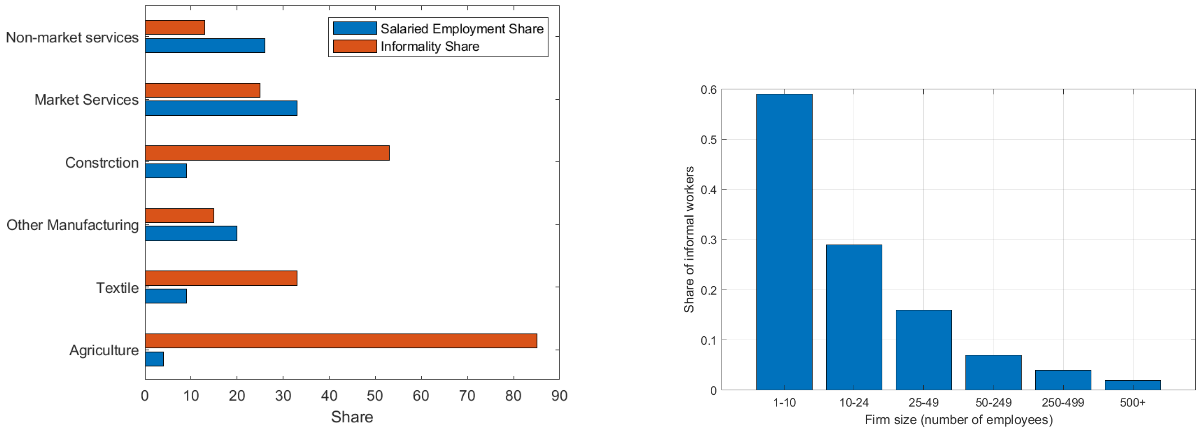
I distinguish between formal and informal employment through workers' self-reported social insurance coverage. By law, employers in Turkey must provide social insurance coverage for their workers. Consequently, all formal workers are insured, and no informal worker can be insured. Hence, assuming that workers report truthfully in HLFS, we can observe wages and employment status in both the formal and informal sectors. Although self-reported, insurance status is a good predictor of formality for two reasons. First, there is no incentive for workers to misreport their insurance status. It is not illegal to *work* informally; it is only illegal to *employ* informally. Second, the descriptive statistics on formal and informal employment using insurance status are consistent with the general knowledge on informal sectors (Ulyssea, 2020). Across regions and industries, the

[12]TurkSTAT follows the three levels of NUTS, Nomenclature of Territorial Units for Statistics, defined by the European Union. Under the NUTS definition, Turkey is divided into 11 NUTS-1, 26 NUTS-2, and 81 Nuts-3 regions. All of the analyses in this paper are conducted at the 26 NUTS-2 level to maintain consistency across different datasets unless specified otherwise.

[13]In general, salaried jobs are more desirable than non-salaried jobs. Not surprisingly, the probability of a job being a salaried job increases with education, formality, and regional GDP.

[14]Furthermore, HLFS collects income information only on salaried workers. Naturally, this also provides an easier comparison between the results on natives' wages and employment rates as the information comes from the same population.

Figure 1: Ratio of informal workers across industries and firm size



(a) Industries (b) Firm size

informality rate (defined as the ratio of employment that is informal) decreases with education. It is higher in less developed regions and in industries like agriculture, construction, and textiles, which are known to rely on informal labor.

Figure 1 shows the informality rate across select industries and firm sizes. The informality rate is heterogeneous across sectors, ranging from 85% in agriculture to 13% in non-market services. The latter is mostly provided by the government, which explains the low informality rate. However, across all industries, informal and formal workers coexist. For example, in the textile industry, which has the highest proportion of refugee workers (Turkish Red Crescent and WFP, 2019), for every three salaried employees, one is informal and two are formal workers. Figure 1 shows the informality rate across firms of different sizes. Firms of all sizes rely on informal workers and the informality rate goes down drastically as firms get bigger: from 59% in firms with 1–9 employees, to 29%, 16%, 7%, 4%, and 2% among firms with 10–24 employees, 25–49 employees, 50-249 employees, 250-499 employees, and more than 500 employees, respectively. This inverse relation between informality rate and firm size is well established in the literature and can be rationalized by larger firms being more visible and therefore having less room for illegal activities (Ulyssea, 2020).

Firm entry

To study the extensive margin adjustment of firms, i.e., firms' decision to register with tax authorities, I leverage data on firm formation from three different sources. First, the Union of Chambers and Commodity Exchanges of Turkey (TOBB in Turkish) publishes the number of incorporated firms in Turkey since 2010. This data covers the incorporated new firms (tacir), but does not include sole proprietorships (esnaf). The latter is covered in the Annual Business Registers Framework (Yıllık İş Kayıtları Çerçevesi) of Turkstat, which accounts for the universe of formal (registered) firms in Turkey since 2009. The difference between the two types of firms is related to the industry of operation and income. In general, sole proprietorships are smaller in magnitude and more susceptible to extensive margin informality in theory. Third, I use the data from the Entrepreneur Information System of the Ministry of Industry and Technology (GBS), which also covers the universe of formal firms like Turkstat but further allows me to separate firms participating in international trade. On an average year, there are 109 thousand new incorporated firms in Turkey. The average number of new formal firms (including sole proprietorships) is around 350 thousand in Turkstat and 304 thousand at GBS.[15] Of these firms in GBS, 8.7 thousand export and 9.1 thousand import at least once in their lifetime.

Turkish institutions do not collect data on informal/unregistered firms. Therefore, we do not have a good estimate of the ratio of new firms that remain unregistered. Ozar (2003) is the only rigorous data collection effort on informal firms in Turkey. She finds that around 4% of firms self-declare that they are not registered. The actual number is likely higher because, unlike working informally, operating an unregistered business is a crime. Consequently, informal firms have incentives to either not be interviewed or lie conditionally on being interviewed.[16] Moreover, 4% of firms being informal is an equilibrium outcome. If new informal firms have higher exit probabilities than new formal firms, then the ratio of informal firms among new firms would be higher. For example, Ulyssea (2018) estimates that the exit probability of unregistered firms is three times that of formal firms in Brazil. If this ratio is similar in Turkey, this would imply that at least 12% of new firms in Turkey in a given year remain informal.

This paper primarily examines intensive margin informality, both in its theoretical model and empirical sections, due to the lack of reliable data on informal firms in Turkey after 2001. Only Section 6.5 discusses refugees' effects on firm entry and their implications for extensive margin informality.

Additional Data sources

This paper relies on various data sources for robustness checks. Province-country level foreign trade statistics were gathered from Turkstat's Foreign Trade Statistics Micro Data Set. This data is used to study the trade shocks stemming from the Syrian War in the Appendix. Moreover, the study also employs provincial electricity consumption data from Turkstat as a proxy for total (formal and informal) firm activity.

3 Theory

This section aims to formalize the economic forces by which an informal labor supply shock can impact natives' wages and employment rates in the formal sector. For simplicity, I employ the

[15] Turktstat and GBS data do not exactly match, which is due to the different administrative sources they draw the data from. However, my qualitative results remain robust when using either data source.

[16] 4% firm informality is arguably too low for a country with 40% labor informality. As a comparison, Turkey and Brazil had similar GDP per capita and labor informality (40% and 46%, respectively) in 2011. Yet, 30% of firms with less than five employees in Brazil are unregistered (Ulyssea, 2018).

canonical labor demand framework with a representative firm that can use both informal and formal labor in production.[17] Considering that informal and formal workers coexist across various industries and firm sizes, the assumption of a representative firm does not limit the focus to just a small segment of labor demand, making it a harmless simplifying assumption. The hiring costs of formal and informal workers differ due to (1) different wages (e.g., there can be a binding minimum wage for formal workers) and (2) institutional reasons: the firm has to pay a constant payroll tax on formal workers, while it faces an increasing and convex expected cost to hire informal workers, which is summarized by the convex function $\tau(.)$. This assumption can be rationalized by the fact that larger firms are more likely to be caught (De Paula and Scheinkman, 2011). This convex cost structure also predicts that the probability of being informally employed should decrease by firm size, which is empirically consistent with the Turkish data. The cost of hiring ℓ formal workers is $(1+\tau_w)w_f\ell$, where τ_w is the payroll tax, while the cost of hiring ℓ informal workers is given by $\tau(\ell)w_i$.

The firm takes wages as given and produces a homogenous good whose price is normalized to one.[18] The firm's objective function can be written as follows:

$$\max_{\ell_i,\ell_f} F(\ell_i,\ell_f) - \tau(\ell_i)w_i - (1+\tau_w)w_f\ell_f \tag{1}$$

where τ_w is the payroll tax on formal workers, and $\tau(\ell_i)$ is the expected cost of hiring informal workers. In particular, I assume that $\tau(\ell_i) = \ell_i^{1+\gamma}$ with $\gamma > 0$, which satisfies the convex cost structure assumed in the literature (Ulyssea, 2018). The production function F has a CES form.

$$F(\ell_i,\ell_f) = (\eta\ell_i^\rho + (1-\eta)\ell_f^\rho)^{\frac{\alpha}{\rho}}$$

where $0 < \alpha < 1$ indicates a decreasing returns to scale (in labor) production function that is appropriate to study short-run adjustments; $\sigma = \frac{1}{1-\rho}$ is the elasticity of substitution between formal and informal labor, and η is the share parameter of informal labor input.

Given this setup, the first-order conditions of a profit-maximizing firm are given by:

$$\begin{aligned} \alpha\eta\ell_i^{\rho-1-\gamma}Y^{\frac{\alpha-\rho}{\alpha}} &= w_i(1+\gamma) \\ \alpha(1-\eta)\ell_f^{\rho-1}Y^{\frac{\alpha-\rho}{\alpha}} &= w_f(1+\tau_w) \end{aligned} \tag{2}$$

where $Y = (\eta\ell_i^\rho + (1-\eta)\ell_f^\rho)^{\frac{\alpha}{\rho}}$ is the output produced by the firm. Given wages w_i and w_f, the labor demand for informal workers, $L_i^d(w_i,w_f)$, and formal workers, $L_f^d(w_i,w_f)$, are given by equation 2.

[17] I introduce heterogeneity in productivity a la Ulyssea (2018) later while estimating the model.

[18] The competitive market assumption simplifies the algebra but can be opposed due to the various frictions in the labor markets of developing economies. The implications of monopsony and how it can interact with informality are beyond the scope of this paper.

3.1 Equilibrium

To close the model, I need to specify the labor supply. Let $L_i^{N,S}(w_i)$ and $L_f^{N,S}(w_f)$ denote the informal and formal labor supply curves of natives. Notice that labor supply curve in either sector is independent of the wage in the other sector. This simplifying assumption rules out workers' ability to search for both informal and formal jobs. Allowing workers to direct their search endogenously would reduce the effective increase in informal labor supply due to the refugee shock and limit the adjustments in the labor demand.[19]

In equilibrium, labor markets must clear: informal and formal wages are such that labor supply equals labor demand in both sectors.

$$\begin{aligned} L_i^S(w_i) &= L_i^D(w_i, w_f) \\ L_f^S(w_f) &= L_f^D(w_i, w_f) \end{aligned} \tag{3}$$

3.2 The effect of an informal labor supply shock

In this model, the effect of an informal labor supply shock on labor demand can be captured by the elasticities of informal and formal labor demand w.r.t. informal wages (assuming formal wages are fixed by a minimum wage for simplicity). After some algebra, one can show that these elasticities are given by:

$$\begin{aligned} \epsilon_{L_i,w_i} &= -\frac{1-\rho-(\alpha-\rho)s_f}{(1-\rho+\gamma)(1-\rho)-(\alpha-\rho)[(1-\rho+\gamma)s_f+(1-\rho)s_i]} \\ \epsilon_{L_f,w_i} &= -\frac{(\alpha-\rho)s_i}{(1-\rho+\gamma)(1-\rho)-(\alpha-\rho)[(1-\rho+\gamma)s_f+(1-\rho)s_i]]} \end{aligned} \tag{4}$$

where $s_i = \frac{\eta L_i^\rho}{\eta L_i^\rho + (1-\eta)L_f^\rho}$ is the informal share in the production, and vice versa for s_f.

Equation 4 formalizes two intuitive results. First, $\epsilon_{L_i,w_i} < 0$ for all potential values of ρ, meaning as informal wages decrease, firms demand more informal labor. However, the effect on the formal labor demand is more nuanced. Figure 2 shows the set of parameters in which the the elasticity of formal labor demand w.r.t. informal wages is negative. The sign of this elasticity depends solely on the sign of $\alpha-\rho$. When the labor share of production α is less than the CES parameter ρ, the elasticity of formal labor demand becomes positive, meaning formal labor demand goes down when informal wages go down.

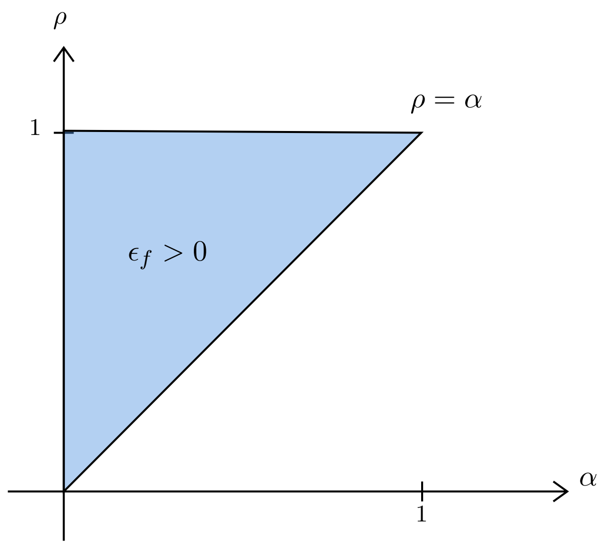
To understand the intuition behind this result, consider the change in the marginal productivity of a formal worker when an informal worker is hired:

$$\frac{\partial(log\frac{\partial F}{\partial L_f})}{\partial L_i} = (\alpha-\rho)L_i s_i$$

In the case of a CRTS production function ($\alpha = 1$) and formal and informal workers not being

[19]The interested reader can read Meghir et al. (2015) for a search model in which workers can search for jobs in both the formal and informal sectors.

Figure 2: Set of parameters in which the elasticity of formal labor demand w.r.t. informal wages is negative



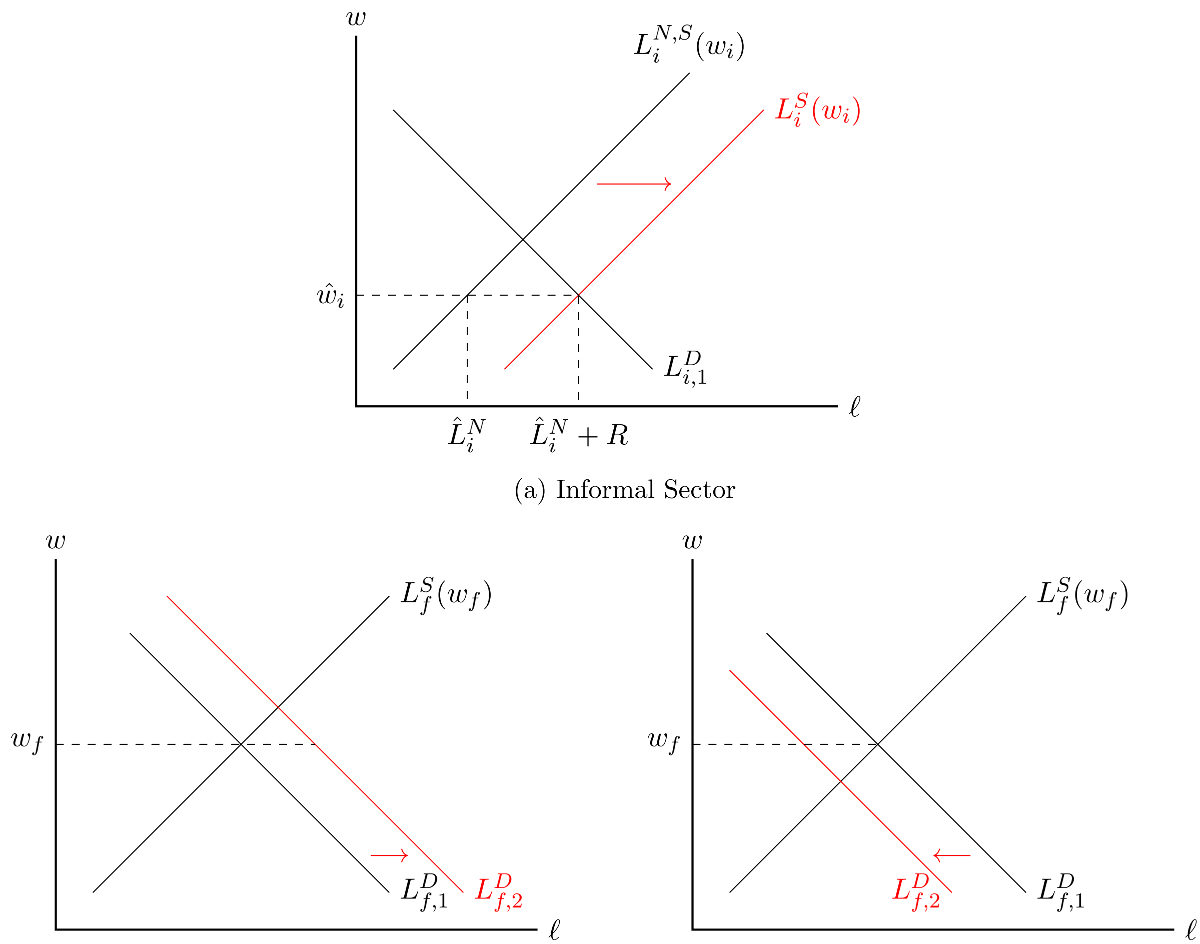
perfect substitutes ($\rho < 1$), hiring an informal worker makes formal workers *more* productive due to the Q-complementarity between workers. Consequently, the firm demands more formal labor, leading to a negative elasticity of formal labor demand $\epsilon_{L_f,w_i} < 0$. However, as α decreases, hiring an additional worker incurs productivity losses for the rest of the workers due to decreasing returns. If α is small enough (i.e., $\alpha < \rho$), then the productivity loss from technological constraints (e.g., capital being constant in the short run) overpowers the productivity gain from the Q-complementarity between workers. Consequently, an informal labor supply shock that reduces informal wages can incentivize firms to substitute formal workers with informal workers.[20]

Figure 3 shows how an informal labor supply shock impacts the labor market equilibrium in this model. Panel A shows the change in natives' wages and employment in the informal sector. Immigrants shift the informal labor supply curve outward, causing (1) a decline in informal wages, (2) a decline in native informal employment, and (3) an increase in aggregate informal employment. Panel B shows the case when the Q-complementarity between informal and formal workers is stronger than the reduction in productivity due to decreasing returns. In this setting, the increase in total informal employment increases the productivity of formal workers, which pushes the formal labor demand curve outward and increases both wages and employment in the formal sector. Panel C shows the case when formal and informal workers are highly substitutable. In this setting, the decrease in informal wages incentivizes formal firms to rely more intensively on informal workers. This shifts the formal labor demand curve inward. As firms reduce their demand for formal workers,

[20] An alternative way to generate this qualitative prediction is presented in Delgado-Prieto (2021), who incorporates a CRTS (in labor) production function with imperfect competition in that the price is determined by product demand into a framework similar to Ulyssea (2018). In his model, an increase in the number of informal workers can reduce the productivity of existing employees by lowering the price. This is different from the approach here. My model achieves the same results through a different mechanism, and moreover, it does so in a simpler fashion and without introducing additional free parameters.

native formal employment decreases despite refugees being unable to work formally. Overall, this figure visualizes the main intuition of this paper. Whereas the effect of an informal labor supply on natives' wages and employment in the informal sector is theoretically clear, its effect on the formal sector is an empirical question.

Figure 3: Equilibrium with informal labor supply shock



(a) Informal Sector

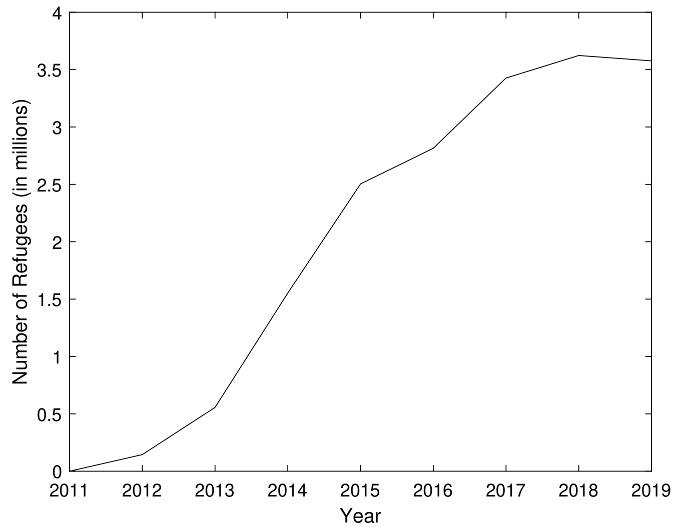
(b) Formal Sector ($\alpha > \rho$)

(c) Formal Sector ($\alpha < \rho$)

4 Background

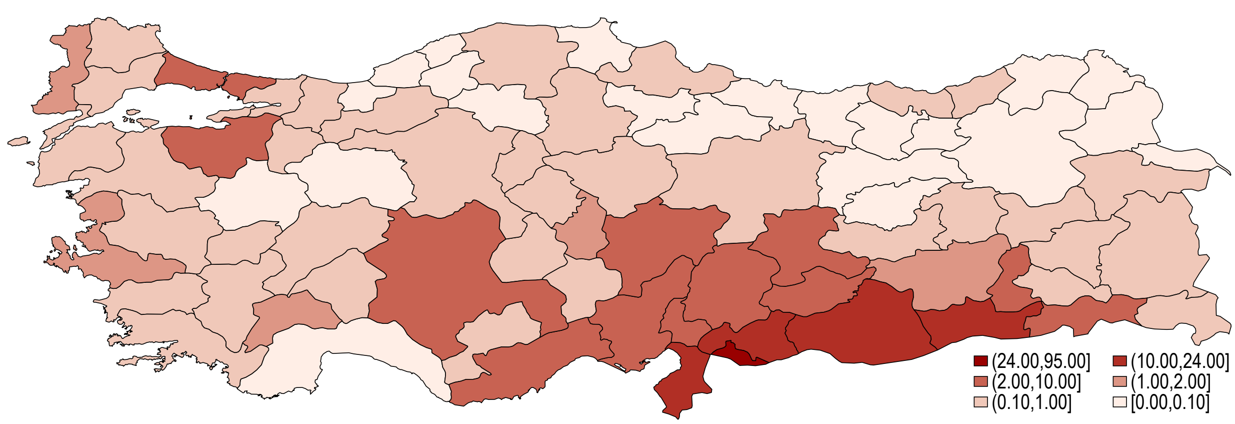
The Syrian Civil War started in March 2011. By 2017, 6 million Syrians had sought shelter outside of Syria, primarily in the neighboring countries Turkey, Lebanon, Jordan, and Iraq. With 3.6 million registered Syrian refugees, Turkey hosts the highest number of refugees in the world (UNHCR, 2022). The first waves of refugees began arriving in Turkey in late 2011, but their numbers remained small until mid-2012 (İçduygu, 2015). As the violent clashes intensified in the following months, there was a substantial increase in Syrians seeking refuge in Turkey. Figure 4 shows how the number of Syrian refugees in Turkey has evolved over time. There were around 170 thousand refugees by 2012, 500 thousand by 2013, 1.6 million by 2014, 2.5 million by 2015, and nearly 3 million by 2016.[21]

Figure 4: Timeseries of the number of Syrian refugees in Turkey



The Turkish government initially tried to host the Syrians in refugee camps in the southeastern part of the country across the Turkish-Syrian border. However, these camps quickly exceeded capacity as the number of arriving refugees increased. The refugees thus dispersed across Turkey in heterogeneous quantities.[22] Figure 5 shows the distribution of the number of Syrian refugees per 100 natives in Turkey at the province level.[23] Refugees are more densely located in regions closer to the border. Distance to the populous governorates in Syria strongly predicts the number of refugees per native in a given region, which constitutes the backbone of the identification strategy.

Figure 5: Share of Syrian refugees in Turkish population (in%) in 2015



[21]The number of refugees in Turkey across years and provinces are acquired from the Directorate General of Migration Management of Turkey.

[22]By 2017, only 8% of the refugees lived inside the camps.

[23]Turkey does not share the education and age break-down of refugees at the province level, which prevents the empirical investigation from exploiting that variation.

Most Syrians came under the temporary protection category, which permits access to health care, education, and grants freedom of movement.[24] Since the temporary protection regime does not offer work permits, the vast majority of the Syrian labor force works in the informal sector.[25] By the end of 2015, only around 7,300 work permits were issued for 2.5 million Syrian refugees residing in Turkey.

Syrian refugees are disproportionately less educated compared to Turkish natives.[26] Table 1 compares the education levels of Syrian refugees in Turkey with those of Turkish natives. For instance, 21% of Syrian refugees did not finish primary school compared to 12% of Turkish natives. In addition, 83% of Syrian refugees do not have a high school degree, in contrast to 61% of Turkish natives. Taking into account the potential educational downgrading (Dustmann et al., 2013) and the fact that most Syrian refugees have only basic Turkish language skills (Turkish Red Crescent and WFP, 2019), the Syrian refugee shock can be interpreted as a low-skill labor supply shock for the Turkish labor markets.

Table 1: Educational Attainment of Syrian Refugees and Natives

Educational Attainment	Syrian migrants (age 18+)	Natives (Age: 18-64)
No degree	0.21	0.12
Primary school	0.42	0.33
Secondary school	0.20	0.16
High school	0.10	0.20
Some college and above	0.08	0.19

Source: Author's calculation using 2019 Household Labor Force Survey for natives, and Turkish Red Crescent and WFP (2019) for the Syrian refugees.

There is no representative survey on Syrian refugees' employment outcomes before 2019. Labor force surveys conducted by the Turkish Statistical Institute do not sample from refugees. The only available data come from randomized surveys conducted on ESSN applicants by the Turkish Red Crescent and WFP. ESSN applicants are a selected sample, and the questions on labor market activity differ from those in HLFS. This complicates the interpretability of these estimates. Nonetheless, they shed some light on how refugees may have impacted the Turkish labor market. The relevant findings of these WFP surveys are summarized below.

According to these surveys, refugees have an astonishing 84% employment rate as opposed to 51% for Turkish natives (Turkish Red Crescent and WFP, 2019). The employment rates are high for both men (87%) and women (68%). In contrast, only 68% of native men and 29% of

[24] In technical terms, the Syrian population who fled to Turkey are given temporary protection status, which is different from the full refugee status defined by the Geneva Convention for Refugees. UNHCR uses the term "refugee-like" to encapsulate the various forms of protection across countries. I adopt this terminology in line with the literature.

[25] Turkey passed a law in 2016 to ease the process of acquiring work permits for Syrians. However, the take-up was minimal, potentially due to existing frictions. As of March 2019, only 31,000 Syrian refugees (1.5% of the working-age Syrians) had work permits.

[26] This is due to two reasons. First, Syria was less developed than Turkey, with a lower-educated workforce. Second, highly educated Syrians were more likely to go to Europe.

native women are employed. The high employment rates of refugees can be explained by the limited capital they brought to Turkey. Refugees have a comparative disadvantage in industries requiring language skills, as only 3% are proficient in Turkish. Perhaps not surprisingly, refugees work primarily in textiles (19%), construction (12%), and agriculture (10%). 47% of employed refugees work in regular jobs, defined as a job with a fixed salary and working hours. This is more restrictive than the salaried employment definition used by Turkstat, so the salaried employment rate of refugees should be even higher.[27] Textiles also have the highest share of refugees in regular positions, as 79% of the workers have regular positions. The average monthly income of refugees was 1058 TRY in 2019. In contrast, natives in the informal sector made 1565 TRY per month on average in the same year.

5 Identification

The identification strategy exploits the differential intensity of Syrian refugees across region-year cells. The treatment $R_{p,t}$ denotes the number of refugees per native in region p and year t. The key outcomes of interest are natives' salaried employment rates in the informal and formal sectors. If the local labor market conditions impact refugee settlement, then a simple difference in differences strategy would give biased estimates.

To circumvent this bias, I exploit the fact that travel distance strongly predicts migrant settlement in forced migration episodes (Angrist and Kugler, 2003; Del Carpio and Wagner, 2015). The weighted-distance instrument Z_p calculates the inverse travel distance between each Turkish region p and Syrian governorate s and takes an average using weights λ_s.

$$Z_p = \sum_{s=1}^{13} \lambda_s \frac{1}{d_{p,s}} \tag{5}$$

where $d_{p,s}$ is the travel distance between Turkish region p and Syrian governorate s, and λ_s is the weight given to Syrian governorate s.[28] Different weights λ have been used in the literature. In practice, weights matter little. I use the weights suggested by Aksu et al. (2022), which takes into account two empirical facts: the number of refugees from a region s increase with population and proximity to Turkey compared to other bordering countries.

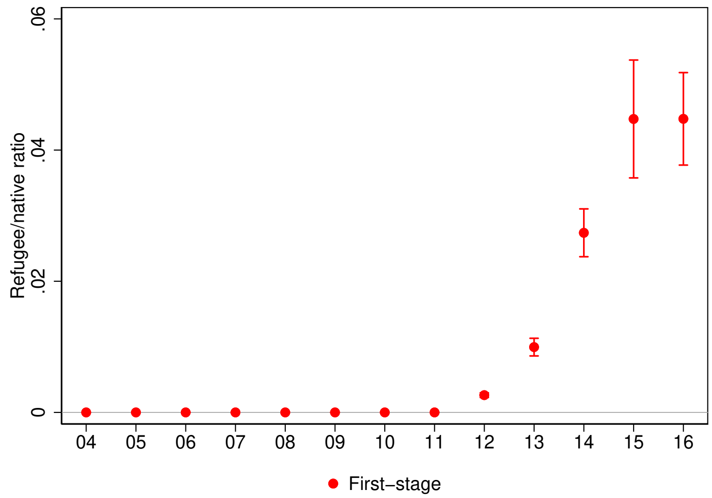
$$\lambda_s = \underbrace{\frac{\frac{1}{d_{s,T}}}{\frac{1}{d_{s,T}} + \frac{1}{d_{s,L}} + \frac{1}{d_{s,J}} + \frac{1}{d_{s,I}}}}_{\substack{\text{Relative distance} \\ \text{to Turkey}}} \times \underbrace{\quad \pi_s \quad}_{\substack{\text{Pop.} \\ \text{share}}} \tag{6}$$

where $d_{s,c} \quad c \in \{T, L, J, I\}$ is the travel distance between Syrian region s to Turkey, Lebanon, Jordan, and Iraq respectively; and π_s is the population share in 2011, which I calculate using the

[27] For example, most work in construction is salaried but irregular.

[28] City centers in each region are used to calculate the travel distance. The data is available upon request.

Figure 6: Event Study of the First-stage



Notes: The regression equation is: $R_{p,t} = \sum_{j \neq 2010} \theta_j(\text{year}_j \times Z_p) + f_p + f_t + \eta_{p,t}$, where the instrument Z_p is standardized to have mean zero and standard deviation of one to have economically meaningful coefficients, f_p and f_t are region and year fixed effects. Standard errors are clustered at the nuts2 region level. The 95% confidence interval is shown.

2011 census undertaken by the Central Bureau of Statistics of Syria.[29]

I use the instrument Z_p within both nonparametric and parametric event study models.

Nonparametric Event Study

The primary advantage of the nonparametric design is that it allows us to visually and flexibly assess the pattern of outcomes the distance instrument captures relative to the beginning of the refugee crisis. The basic nonparametric event study specification takes the form

$$y_{p,t} = \sum_{j \neq 2010} \theta_j(\text{year}_j \times Z_p) + f_p + f_t + \epsilon_{p,t} \tag{7}$$

where the instrument Z_p is standardized to have mean zero and standard deviation of one to have economically meaningful coefficients, f_p and f_t are region and year fixed effects. The standard errors are clustered at the region level. Figure 6 displays the estimates of θ_j from the first stage regression. As there are no refugees in Turkey before 2012, $\theta_j = 0$ if $j < 2012$. The instrument strongly predicts refugee settlement in all post-treatment periods. The instrument's joint F-statistic in the years 2012–2016 is 238.

This figure also reveals how the treatment intensity predicted by the instrument increases over time. The treatment intensity was low in 2012 as there were fewer refugees. It slightly increases from 2012 to 2013 and increases substantially in 2014 and 2015. This time-series variation is important

[29] Appendix Table A.2 shows that this instrument predicts the governorate-origins of the Syrian refugees in Turkey quite well.

for identification because, given any nonzero effect of refugees on the outcome of interest, we would expect the treatment effect to increase over time.

The identifying assumption in this exposure design is that the instrument is orthogonal to local economic trends. However, this does not hold for several of the outcomes in the current setting. Between 2004–2010 (before the refugee shock began), regions near the border observed higher growth in employment rates and wages, leading to a positive trend that is correlated with the instrument.[30]

To make progress, I exploit the empirical fact that pre-trends are approximately linear for most of the outcomes of interest throughout the paper. This guides my formulation of the parametric event studies that deliver the main estimates.

Parametric Event Study

I use the parametric event study to summarize the magnitude of estimated reduced-form effects and their statistical significance. The estimating equation and the presentation of results follow Dobkin et al. (2018) very closely. My choice of the functional form is guided by the patterns seen in the nonparametric event studies. In the figures below, I superimpose the estimated parametric event study on the nonparametric event study coefficients which allows for a visual assesment of my parametric assumptions. In particular, the baseline specification is

$$y_{p,t} = \sum_{j \geq 2011} \beta_j (\text{year}_j \times Z_p) + \gamma Z_p t + \delta_p + \delta_t + \epsilon_{p,t} \tag{8}$$

Equation 8 allows for a linear pretrend event-time*distance. Meaning, it allows for regions to follow different trends that is correlated with the instrument. The key coefficients of interest, the β_js, show the change in the outcome predicted by the instrument relative to any pre-existing linear trend γ. As before, I include region and time dummies in the regression.

Interpretation

The parametric event study allows for a linear trend in distance*time. The choice of the linear trend is motivated by the results from the nonparametric event studies which, as we will see in the results below, suggest that a linear trend captures the differences in regional trends quite well. For the parametric event study, the identifying assumption is that distance to the border is orthogonal to *deviations* from the linear trend in distance*time.

Accounting for pre-trends is one of the two reasons why this paper documents novel empirical results that the earlier literature studying the effects of Syrian refugees on Turkish labor markets did not (Del Carpio and Wagner, 2015; Tumen, 2016; Ceritoglu et al., 2017; Aksu et al., 2022). The other is separating salaried from non-salaried employment in the empirical investigation, which I discuss in the next section. Appendix Section G presents a thorough discussion of the shortcomings of the

[30] These pre-trends can be seen in the event study figures in the Appendix Section B.

identification strategies used in this literature. In short, no other strategy adequately addresses the fact that the border regions were catching up to the rest of the Turkish economy before the refugee crisis began.

IV Design

After showing the event study estimates, I also estimate the following IV design using 2SLS to get economically meaningful estimates:

$$\begin{aligned} y_{p,t} &= \beta R_{p,t} + \delta Z_p t + f_p + f_t + \epsilon_{p,t} \\ R_{p,t} &= \sum_{j \geq 2011} \theta_j (\text{year}_j \times Z_p) + \gamma Z_p t + g_p + g_t + \eta_{p,t} \end{aligned} \tag{9}$$

where the treatment $R_{p,t}$ is instrumented by the interaction of distance Z_p with year dummies in the post-period, δ and γ are the linear trends in the structural and first-stage equations, respectively. Instrumenting the treatment R with a full set of interactions of distance and post-year dummies ensures that the linear trend is estimated using only the pre-period variation in both equations.[31]

Threats to Identification

There are a few threats to identification that are worth discussing. Notice that the distance instrument compares the regions close to the border with those further away. This comparison may not identify the causal effect of refugees for three main reasons. First, this empirical strategy assumes that the Syrian war's impact on the Turkish local labor markets, if any, should be orthogonal to the distance from the border. This could fail if Syria were a major trade partner of border regions and the war had significantly disrupted the trade flows. Empirically, Syria was not a major trade partner of any region in Turkey. Moreover, even though trade initially fell in 2011 and 2012 at the beginning of the war, it more than recovered at the border regions after 2013. Hence, there was no significant trade shock that could impact the local labor markets. Appendix Figure C.2 provides more details on the evolution of trade flows across regions.

Second, even if refugees impact the regions they settle in, given enough time, markets could reequilibrate across space through the movement of capital and people. This would violate the SUTVA and cause the spatial difference in differences methodology to underestimate the treatment effect. However, such adjustments arguably take several years and, therefore, cannot impact the current analysis, which focuses only on the short run.[32] For example, there were only minor changes in the movement of people across space before 2016. Figure C.4 shows that regions closer to the border faced slightly more out-migration and less in-migration. However, these effects are

[31] This technical detail turns out to be pivotal in addressing the correlation between the instrument and the regional trends. More details can be found in Appendix Section G

[32] Treatment intensity was economically meaningful only after 2013. The analysis ends in 2016 for several reasons, including a minimum wage increase and the beginning of the Emergency Social Safety Net (ESSN) program in which refugees were given relatively large cash transfers. Both of these confounders could complicate the interpretability of the estimated effects post-2016.

meager in magnitude and hence cannot bias the IV estimates in an economically meaningful way. Consequently, potential violations of SUTVA are not a first-order concern.

6 Empirical Results

This section shows refugees' effect on natives' employment rates in informal and formal sectors. It focuses on the impact on salaried employment to capture changes along and the shifts in the labor demand. As Syrians refugees are predominantly low-skilled compared to Turkish natives, they are a closer substitute for low-skill natives. To capture the differences across skill-types, I analyze natives without a high-school degree (low-skill) and with at least a high-school degree (high-skill) separately in the formal sector. I do not make this distinction in the informal sector because very few high-skill natives work informally, and those who are working informally are likely negatively selected. Consequently, the empirical analysis divides the native labor market into three informality-skill categories: informal, low-skill formal, and high-skill formal. The impacts of Syrian refugees on these three groups are estimated separately.

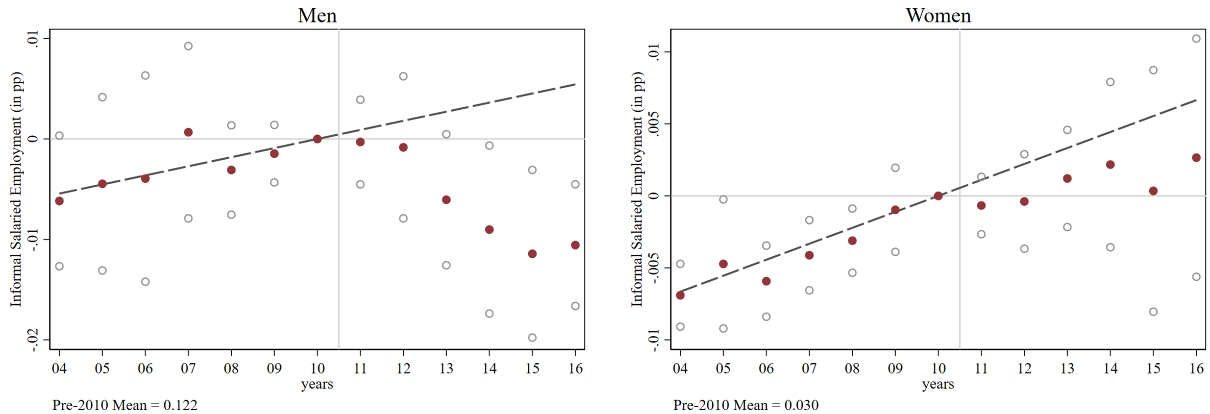
Event study estimates

I begin by estimating the nonparametric and parametric event study designs shown in equations 7 and 8. Figure 7 plots the point estimates from the nonparametric design, and the linear trend from the parametric design. Panel A shows the results on informal salaried employment. There are two important results. First, there is a significant pre-trend in the informal salaried employment rates of both men and women. Between 2004–2010 (before the treatment), regions closer to the border observed larger increases in employment. Importantly for the identification strategy, this trend was highly linear. The linear trend estimated in the parametric design not only falls under the 95% confidence intervals of the nonparametric estimates in the pre-period, but also is very close to the point estimates. Second, the estimated effects from the parametric design, which are the differences between the nonparametric estimates and the linear trend, intensify after 2013 in line with the refugee shock. The estimated effects are negative for both men and women, while only the effect on men are statistically significant.

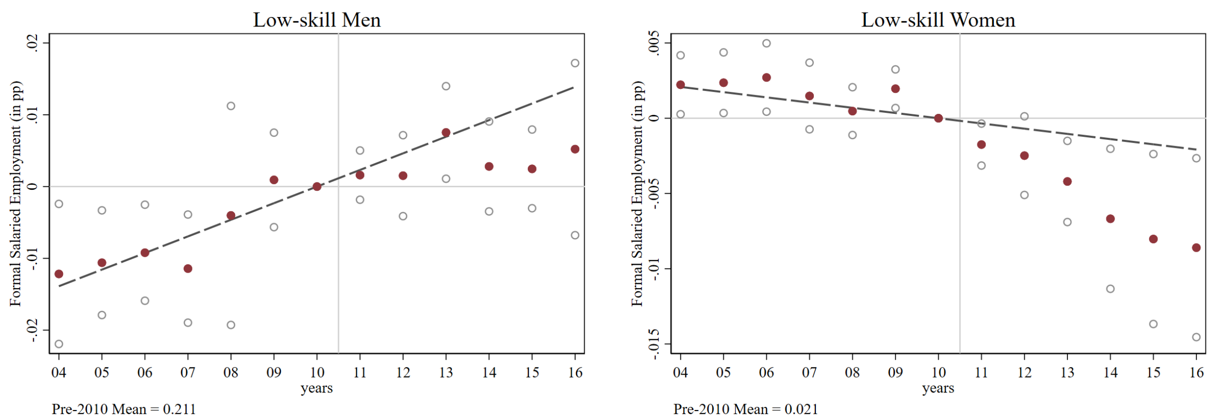
Before discussing the economic significance of these effects using the IV design, I continue by summarizing the reduced form results on formal employment. Panel B displays the non-parametric event study estimates on the formal salaried employment rates among low-skill natives. Distance exposure is associated with an increase in employment for men and a decrease in employment for women in the pre-period. The linear trend always falls under the 95% confidence interval of the pre-treatment estimates. As the treatment intensity increases after 2013, we observe statistically significant decreases in formal salaried employment rates of both low-skill men and women compared to their trends. This implies that despite refugees' inability to work in the formal sector, their informal labor can displace formally employed low-skill natives. Panel C exhibits the results on formal salaried employment rates among high-skill natives. There is no significant deviation from

Figure 7: Effect of Syrian Refugees on native salaried employment

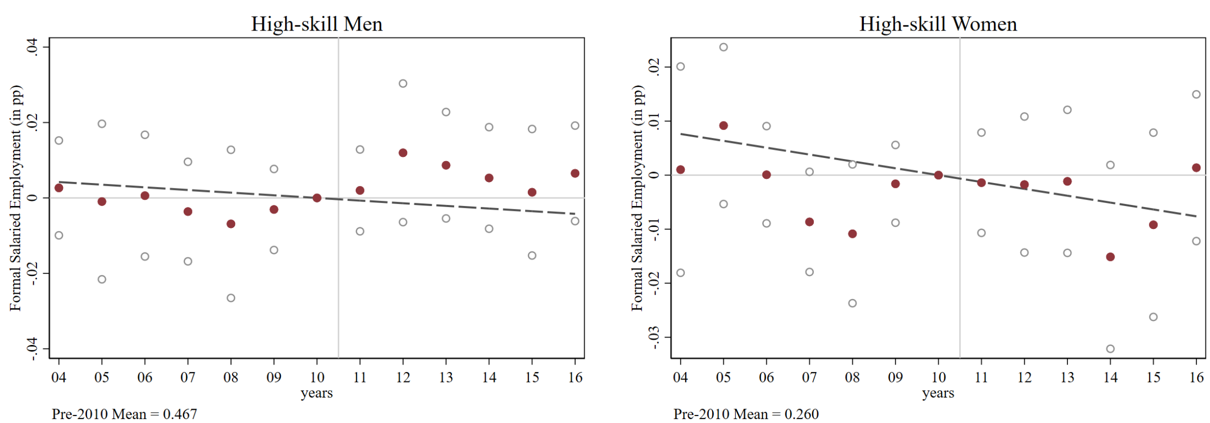
(a) Informal salaried employment



(b) Formal low-skill salaried employment



(c) Formal high-skill salaried employment



Notes: The points in each figure represent the estimated effects of event time shown in equation 7. The hollow circles present the 95 percent confidence intervals. The dashed line represents the estimated pre-2010 linear relationship between outcome and instrument * event time from the parametric event study in equation 8 with the level normalized to match the nonparametric estimates.

the linear trend among neither men nor women.

In summary, the event study figures show that the linear trend assumption holds well for all the outcomes for which distance predicts an effect in the post-period. The instrument is associated with significant decreases in both informal and formal salaried employment rates of low-skill natives. The latter is despite refugees' inability to find formal work. These effects become stronger after 2013 as the treatment intensity increases. Lastly, the instrument is not associated with a significant change in formal employment of high-skill natives .

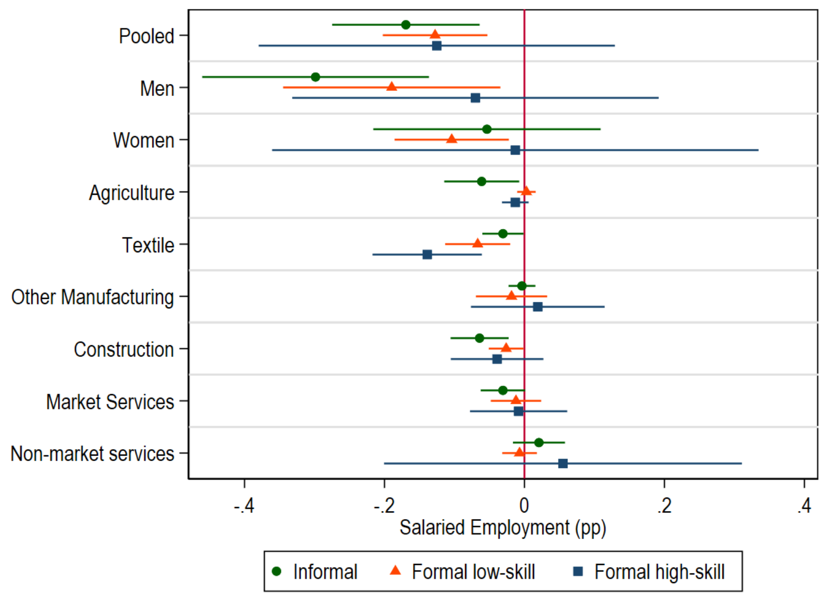
2SLS estimates

To get economically meaningful estimates, I estimate equation 9 using 2SLS. The first row of Figure 8 shows the estimated effects of refugees on the informal and formal salaried employment of natives. A 1 pp increase in the refugee/native ratio decreases the informal salaried employment rate of natives by 0.17 pp, the formal salaried employment rate of low-skill natives by 0.13 pp, and does not significantly impact the formal salaried employment rate of high-skill natives in the aggregate. The second and third rows of Figure 8 separate these effects by sex. A 1 pp increase in refugee/native ratio decreases men's informal salaried employment rate by 0.30 pp and low-skill formal employment by 0.19 pp. For women, these effects are 0.05 and 0.10, respectively, with only the effect on formal employment being statistically significant. Lastly, there are no significant effects on the formal salaried employment rates of high-skill men and women.

The model predicts that while the immigration shock replaces some natives, it increases the total number of workers in the economy. The estimates support this prediction. 39% of ESSN applicants were working in regular jobs with fixed salaries and working hours in 2019 (Turkish Red Crescent and WFP, 2019). This is more restrictive than the salaried employment definition used by the TurkSTAT, so the salaried employment levels of refugees should be even higher. Moreover, due to income effects, the employment rates were likely higher before the unconditional cash transfer began. So, I assume that for every 100 Syrians in Turkey, 45 were working as salaried workers. Consider the following thought experiment. Let region A have 1000 natives in period 1, all low-skill for simplicity. On average, 23.3% of low-skill natives are salaried workers, meaning 233 salaried natives. In period 2, this region receives 100 refugees, a 10 pp increase in refugee/native ratio. My estimates suggest that this shock leads to 30 natives losing informal and formal salaried jobs combined. In other words, 45 working refugees replace 30 natives. The total low-skill employment increases by $15/233 = 6.4\%$

These estimates suggest that the informal refugee shock has caused native disemployment in both the informal and formal sectors. My preferred interpretation is that an informal labor supply shock incentivizes firms to become more informal by replacing their formal (and informal) native workers with informal refugees. However, there are alternative mechanisms that could create native disemployment in the formal sector. In a model where only unregistered/informal firms can employ informal workers and informal and formal firms compete in the product market, an informal labor supply shock would cause formal firms to shrink due to business stealing. This would reduce

Figure 8: Effect of Refugees on native salaried employment rates



Notes: The 2SLS estimates come from estimating equation 9 using natives' informal, low-skill formal, and high-skill formal salaried employment rates. The first row shows the estimates using the pooled data. The second and third rows condition on men and women separately. Rows 4–9 show the heterogeneity across industries. The industry specifications follow the ISIC standards. Standard errors are clustered at the region level. The 95% confidence intervals are plotted.

formal labor demand and create native disemployment in the formal sector. Alternatively, refugees demanding mostly the goods and services of informal firms could also reduce formal labor demand in general equilibrium. However, such demand side channels are ruled out by the empirical fact that only the low-skill natives lose jobs in the formal sector. This is consistent with refugees being closer substitutes in production to low-skill natives, but inconsistent with these alternative models. The evidence suggests that formal firms can substitute between formal and informal workers among the low-skilled. Before exploring the implications of these findings further, I investigate their robustness.

6.1 Supporting Evidence

Heterogeneity across Industries

Syrian refugees disproportionately work in particular industries due to comparative advantage. Most are not proficient in Turkish, which makes them less likely to perform tasks requiring written or spoken communication. Consequently, they work predominantly in jobs that require manual work: textiles (19%), construction (12%), and agriculture (8%) (Turkish Red Crescent and WFP, 2019). If the disemployment effects of natives are due to the labor supply of Syrian refugees, then we would expect to see higher disemployment effects on the more intensely treated industries.

To test this hypothesis, I separate native employment into six categories: agriculture, textile, other manufacturing, construction, market services, and non-market services, following ISIC definitions. Rows 4–9 of Figure 8 show the estimated refugee effects on each industry.[33] As expected, the disemployment effects in the informal and formal sectors come mostly from these intensely treated industries. Most notably, the textile industry observes decreases in informal and formal employment among all skill groups. A 1 pp increase in refugee/native ratio decreases natives' informal salaried employment by 0.03 pp, formal salaried employment by 0.07 pp for the low-skilled and by 0.14 pp for the high-skilled. Put differently, the industry that hires the most refugees lets go the most natives. Other manufacturing industries do not observe similar decreases in salaried employment. Moreover, natives lose informal and formal jobs also in construction, the second most intensely treated industry. Lastly, there is no change in formal salaried employment in market and non-market services. There is a small and statistically significant decrease in informal salaried employment in market services.

The finding that refugees do not impact native employment rates in the less intensely treated industries is also interesting because these industries are still *treated*. Absent equilibrium effects, a labor supply shock alone would still cause some native disemployment. Two additional forces working in the opposite direction can explain this null result. First, refugees demand goods and services, which may push the labor demand curve outwards. If the industry-specific labor supply shock is small enough, it may be completely offset by this demand shock. Second, in an equilibrium model with multiple sectors and flexible native labor supply across sectors, a refugee labor supply shock to one sector would cause the natives to focus their search for jobs in the other sectors, increasing the equilibrium employment rate in these industries. I suspect both effects play some part in explaining this null effect, but I leave this for future research due to data limitations.

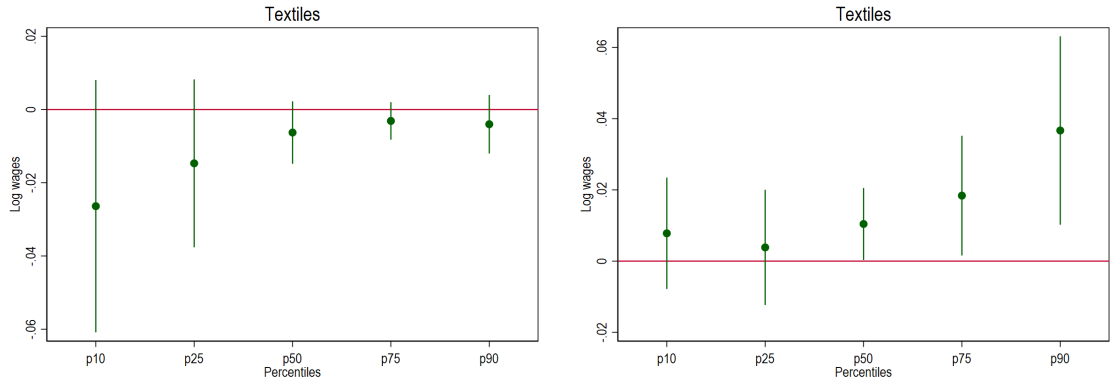
Wages

The previous section shows that the refugee shock has increased the amount of low-skill workers in the economy. Under the canonical labor demand model, this increase in low-skill labor should increase the productivity and, therefore, the wages of high-skill labor in the economy. To test this intuition, I compare refugees' effect on the wages of low-skill and high-skill natives in the textile industry. In particular, I estimate versions of equation 9 for low-skill and high-skill natives separately, where the outcome variables are the 10th, 25th, 50th, and 75th, and 90th percentiles of wages. Figure 9 plots the estimates. The low-skill refugees decrease the wages of low-skill natives in the textile industry throughout the wage distribution, but particularly among the lower percentiles. They also increase the wages of high-skill natives throughout the wage distribution, particularly so among the higher percentiles. A 1 pp increase in refugee/native ratio increases the 90th percentile of wage distribution among high-skill natives by almost 4%.

The fact that the wages of high-skill natives increase in textiles, the most exposed industry in Turkey, helps eliminate one of the major identification concerns in the empirical design. Regions

[33] The event study estimates for these outcomes can be found in Figure 8 in the Appendix Section B.

Figure 9: Effect of refugees on wages in textile industry



(a) low-skill

(b) high-skill

Notes: The 2SLS estimates come from the IV design in equation 9. The outcome variable is the pth percentile of log wages in the textile industry among low-skilled natives in Panel A, and among high-skilled natives in Panel B. Standard errors are clustered at the nuts2 region level. The 95% confidence intervals are plotted. The nonparametric and parametric event study estimates following equations 7 and 8 can be found in Appendix Figure B.2.

near the border could have received negative demand shocks from the Syrian Civil War, for example, through trade disruptions. Both an increase in labor supply and a decrease in labor demand would have caused natives to lose jobs in the informal and formal sectors. However, negative demand shocks would have decreased wages, whereas low-skill labor supply shocks can increase the wages of high-skill workers. Consequently, the decrease in employment and the increase in high-skill wages can only be explained by the labor supply channel.

In what model of the world can high-skill natives both lose jobs and observe an increase in wages? The key piece of the puzzle is that only the highest earners among the high-skill natives observe productivity gains. The evidence is consistent with the less productive high-school graduates being closer substitutes for, and therefore being replaced by, low-skill refugees, and the most productive high-school graduates gaining from the increase in low-skill labor.

6.2 How substitutable are formal and informal labor in production?

I motivated the empirical analysis by arguing that informal refugees' impact on the formal labor markets is ambiguous. Section 3 shows that if informal and formal labor are largely substitutable, then an increase in informal labor lowers firms' demand for formal labor. Empirical results indicate that Syrian refugees caused natives to lose both informal and formal jobs, which implies that these two types of labor are largely substitutable in production. It is of general interest to quantify their substitutability, which is governed by the CES parameter ρ in the model. Here, I briefly describe how the IV estimates and certain moments from the data help identify the model parameters. The details of the model estimation are shown in Appendix Section E.

The difficulty in estimating ρ arises from the fact that the two labor demand elasticities given in equation 4 depend on four parameters. Hence, the main IV estimates that map to these elasticities are insufficient to point identify ρ. To make progress, I introduce firm heterogeneity in productivity. In this model, the sole means by which firms can augment their output is by increasing their workforce, as labor constitutes the exclusive input in the production process. Consequently, the distinction between larger and smaller firms hinges entirely upon disparities in their productivities. More productive firms choose to expand their workforce. The parameter γ, which governs the marginal cost of employing informal workers, predominantly hinges on the extent to which larger firms opt for formalization at the intensive margin. For all types of firms, the share parameter η is linked to the relative productivity of formal and informal workers and, thus, is determined by the proportion of informal workers in the overall economy. The elasticity of substitution between informal and formal workers is primarily dictated by demand elasticities. For instance, the relative magnitudes of the elasticities of informal and formal labor demand, expressed as $\frac{\epsilon_{L_f,w_i}}{\epsilon_{L_i,w_i}} = \frac{(\alpha-\rho)s_i}{1-\rho-(\alpha-\rho)s_f}$, assist in pinpointing ρ. Holding the share of informal labor constant, this ratio exhibits a declining trend with respect to ρ.

Using the IV estimates and moments from the data, I estimate ρ to be around 0.9, which implies an elasticity estimate of $\sigma = \frac{1}{1-\rho}$ of around 10. To the best of my knowledge, this is one of the first papers to estimate this elasticity. This relatively high elasticity is consistent with the Turkish context, where informal employment is often in the same sectors and even in the same firms as formal employment. It also supports the assumption of perfect substitutability between informal and formal workers in the recent structural literature on the informal sector (Ulyssea, 2018, 2020).

6.3 The effects of granting refugees work permits

The presence or absence of work permits constitutes a pivotal distinction between immigration episodes and contemporary refugee crises. Unlike immigrants, most refugees worldwide lack formal authorization to participate in the labor market (Clemens et al., 2018). To illustrate, as of 2024, most Syrian refugees in Turkey remain without work permits. However, it is noteworthy that this approach is not uniformly applied across nations. Colombia, for instance, adopted a phased approach by granting work permits to Venezuelan refugees in waves (Bahar et al., 2021). Furthermore, nearly all European countries extended the right to work for Ukrainian refugees (European Commission, 2022). Most recently, the United States announced its intention to provide work permits to Venezuelan refugees already residing within its borders (Hesson, 2023). Given the diverse strategies different countries employ regarding work permits and the far-reaching implications of these policies spanning multiple nations, it is imperative to comprehend the repercussions associated with providing refugees with work permits. This section studies the counterfactual outcomes if Turkey were to grant all Syrian refugees work permits. Does providing refugees with work permits hurt native workers? Does it change firms' incentives to employ informal labor?

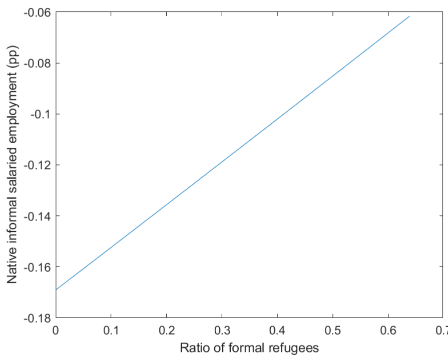
In the model presented in Section 3, where labor is the only factor of production and labor supplies are taken as given, introducing work permits for refugees has a singular effect: it reallocates a portion of the informal labor force into the formal sector. This reallocation causes a *reduction* in the total informal labor supply in the economy, leading to an increase in informal wages and an increase in informal employment of natives. In the formal sector, the shift in the formal labor supply curve does not affect wages, as the minimum wage is assumed to be binding. Consequently, formal employment depends exclusively on the demand for formal labor. Therefore, if there is no shift in the formal labor demand curve, the employment of refugees in the formal sector would lead to an equivalent reduction in the employment of native workers in that sector. However, since the informal wage elasticity of formal labor demand is positive (i.e., $\alpha < \rho$ in the model), the increase in informal wages pushes the formal labor demand curve outwards, increasing the total formal employment in the economy. The magnitude of these changes depends on two factors: (1) the model parameters, estimates of which are reported in Table E.1 in the Appendix, and (2) the percentage of working refugees who can transition to formal sector if given permits.

Let $c \in [0, 1]$ denote the ratio of refugees that are endowed with only formal labor. $c = 0$ implies that all working refugees are constrained to informal labor even with work permits. Conversely, $c = 1$ implies that all working refugees would secure formal employment if granted work permits. Unfortunately, there is no good data-driven way to estimate c. In Turkey, there are very few and highly selected refugees with work permits. Therefore, I cannot credibly estimate c from the data. Instead, I assume that the underlying formality of refugees is weakly lower than that of the natives: $c \in [0, 0.64]$, which is a conservative assumption.

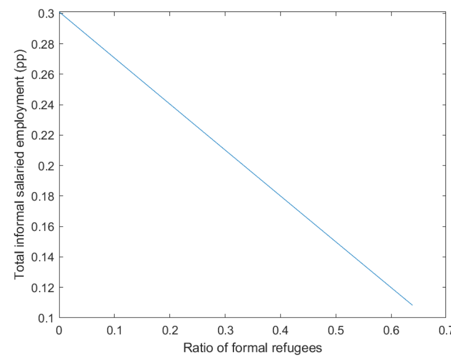
Figure 10 shows the counterfactual effects of a 1 pp increase in refugee/native ratio for all potential values of c. As a benchmark, if refugees had the same formality rate as the natives, a 1 pp increase in refugee/native ratio would have caused a 0.061 pp decrease in native informal employment, 0.11 pp increase in total informal employment, 0.47 pp decrease in native formal employment, and only a 0.047 pp decrease in total formal employment (as opposed to the 0.13 pp decrease estimated in the empirical section). Intuitively, as more refugees can find formal jobs, fewer natives lose informal jobs, and more natives lose formal jobs.

A direct interpretation of these findings is that not providing work permits to refugees costs tax revenue to the host countries through reduced formal employment. For example, in 2011, there were 50 million natives in Turkey between the ages of 15–65. 33.75 million were not in school and had less than a high-school degree. By 2016, refugees had increased Turkey's overall population by 4 pp. Using the estimates in Figure 10d and the benchmark case of refugees having the same informality rate as low-skill Turkish natives, I conclude that not providing work permits to refugees caused approximately 120 thousand formal jobs to disappear in 2016. At the time, the formal monthly minimum wage was around \$549 before tax and \$433 after tax. Assuming that all the jobs lost were paying the minimum wage as in the model, not providing work permits to refugees caused 167 million USD in personal income tax revenue to Turkey in 2016. In reality, there were likely more informalizing incentives that affected tax revenue that the model cannot capture, e.g., firms' choosing to remain smaller to avoid detection while hiring informal workers. Future work can shed more light on the extent of the friction created by the lack of work permits.

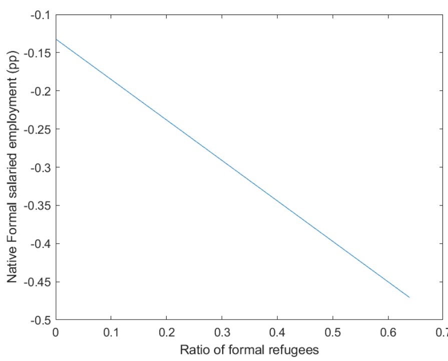
Figure 10: Effects of a 1 pp increase in refugee/native ratio with different levels of refugee informality



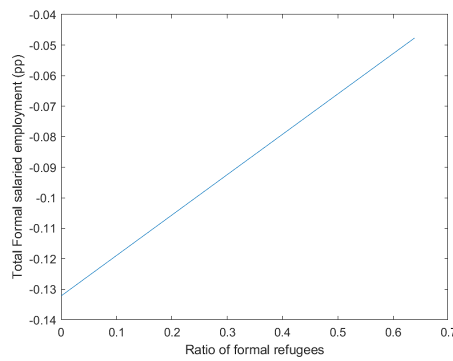
(a) Native Informal



(b) Total Informal



(c) Native Formal



(d) Total Formal

6.4 Natives' escape to non-salaried employment

The empirical investigation thus far has focused on salaried employment instead of overall employment. This subsection shows the importance of separating salaried employment from non-salaried employment while studying the labor demand.[34]

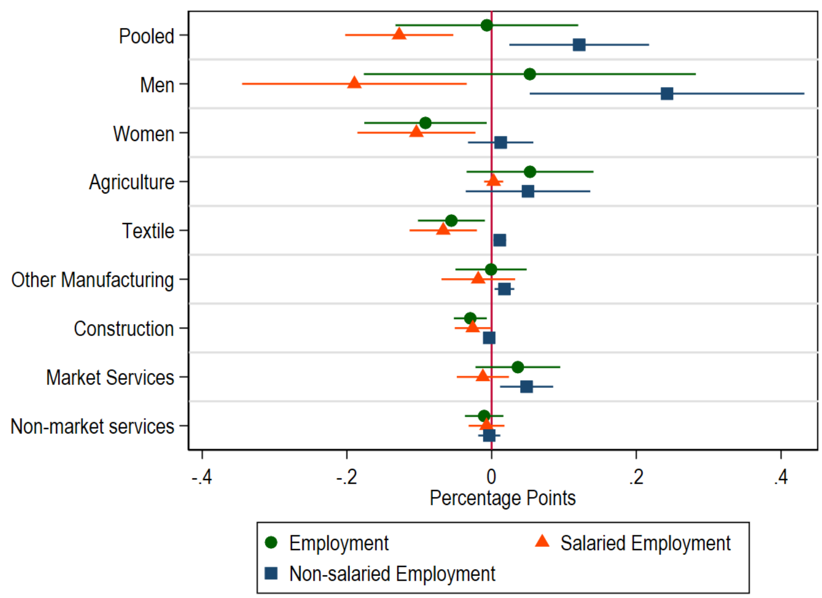
As Section 2 explains in detail, there is an economically meaningful distinction between salaried and non-salaried employment in Turkey, which can be generalized to similar developing countries. Salaried jobs are jobs in which the worker's employment status depends on an employer's decision. If an employer finds cheaper labor to perform the same tasks, the worker could lose her job. However, anyone who is doing some amount of market activity can correctly declare themselves to be self-employed. For example, when refugees displace natives in the salaried jobs in textiles, the displaced natives who have strong labor force attachment may still remain *employed* by doing any market activity on their own. In the extreme, the net effect on employment could be zero, even though many natives have lost their salaried jobs. To show this, I estimate refugees' effect on natives' total, salaried, and non-salaried employment rates separately in the formal sector for

[34]This distinction also sheds more light on why this paper's empirical results differ from the rest of the literature studying the labor market consequences of the Syrian refugees in Turkey.

low-skill natives. I follow the structure in Section 6 and show the heterogeneity in these effects across sex and industry.

Figure 11 shows the estimates.[35] Looking at the first row, we see that refugees did not affect natives' total employment. However, this null effect masks a substantial heterogeneity across the employment types. As the previous sections show, natives' formal salaried employment rate decreases considerably. However, this decline in salaried employment is offset by an increase in non-salaried employment. This dichotomy is consistent with natives who lose their salaried jobs transitioning into non-salaried market activities.

Figure 11: Refugees' effect on salaried and non-salaried employment rates of low-skill natives



Notes: The 2SLS estimates come from the IV desing in equation 9. The outcome variable is either the informal salaried employment rate or the formal salaried employment rate for the low-skilled. The first row shows the estimates using the pooled data. The second and third rows condition on men and women separately. Rows 4–9 show the estimates separately by industry categories. Industries are defined using two-digit NACE codes following ISIC Rev 4 definitions. Standard errors are clustered at the nuts2 region level. The 95% confidence intervals are plotted.

The second and third rows show the heterogeneity across sexes. This exercise reveals that whereas both men and women incur similar decreases in salaried employment, only the men transition into non-salaried jobs. The most plausible explanation for this heterogeneity is the predominant role of men as the primary breadwinners in Turkish households. For households with lower levels of education that predominantly live paycheck to paycheck, it is logical that men maintain some form of market activity after losing their salaried positions. In contrast, women, not bound by this cultural expectation or necessity, do not pursue this shift following the loss of their salaried jobs.

This explanation is also supported by the heterogeneity across industries. The decline in formal salaried employment predominantly affects the textile industry, while the rise in non-salaried work

[35] The event-study estimates for these outcomes can be found in Figure B.4 in the Appendix Section B.

is largely seen in the services sector. This observation aligns intuitively with the opportunities available to self-employed individuals. It is much harder for a laid-off textile worker to open a textile shop than to buy and sell goods in the market. This figure shows that both men and women lose their salaried jobs, mainly in textile, yet only men transition to non-salaried roles in the services sector.

However, there is an alternative explanation for this finding. Refugees could increase demand in the non-tradable services sector, which could have led to better job openings. Perhaps refugees did not replace natives in salaried jobs: natives *preferred* the non-salaried jobs in the services to the salaried jobs in textiles. This explanation could have been true, but it is inconsistent with the data. First, it is hard to rationalize a demand shock that leads to only non-salaried employment gains. As the figure shows, there is no increase in salaried employment in market services. Second, such a demand shock would have drawn natives from many other industries, not solely textiles. Yet, formal salaried employment of natives remains similar in industries that do not employ refugees. Third, this demand shock cannot explain why both men and women lose their salaried jobs, while only the men transition into non-salaried market services. Overall, the evidence does not support the conclusion that natives leave their salaried jobs for better opportunities arising from a demand shock. The evidence strongly suggests that formally employed natives are being displaced by informal refugees in the workforce.

All of the estimates shown in the figures in this section, together with 2SLS estimates using all education-formality-gender-industry-employment type combinations, can be found in the Tables C.1, C.2, and C.3 in the Appendix Section C. The results are robust across different cuts of the data.

6.5 Firms' escape to informal sector

The IV and the counterfactual results show that informal labor supply shocks cause firms to become more informal on the intensive margin by replacing formal workers with informal ones. This *informalization* on the intensive margin raises a question about the effects on the extensive margin of informality: whether new entrepreneurs register their businesses. This section studies how the refugee shock impacts firms' decision to formalize by registering with the tax authorities.

The identification challenge in this section is more nuanced. First, refugees increase the local population immensely and, therefore, can increase the formation of new firms (Seim, 2006). In contrast, if there are marginal entrepreneurs who are in between becoming formal or informal, the decrease in informal wages can incentivize these entrepreneurs to remain informal. This would decrease formal firm entry and increase informal firm entry. The empirical challenge is that informal firm entry is not observed. Therefore, these two channels cannot be separately estimated.

To make progress, I exploit the empirical fact that informal firms are less productive than formal firms (La Porta and Shleifer, 2014; Ulyssea, 2020). This means that marginal entrepreneurs should be less productive than non-marginals. Assuming that the demand shock induces new firm formation homogenously across the productivity distribution, there is a testable implication of the informalization effect: there should be a larger increase in entry among large/productive firms and a meager increase, even a decrease, in entry among small/less productive firms.

To distinguish between more/less productive firms, I first use firms' incorporation status using admin data from Turkstat. New firms in Turkey are put into one of two categories for tax purposes: incorporated firms (tacir) and sole proprietorships (esnaf). The difference between the two types of firms is related to the industry of operation and income. In general, sole proprietorships are smaller in magnitude and, hence, more susceptible to informality.

I first estimate the nonparametric event study design shown in equation 7, where the outcome variable is the natural logarithm of the number of (i) all firms, (ii) incorporated firms, and (iii) sole proprietorships.[36] The results are shown in Figure 12a. By 2016, a one standard deviation increase in the instrument is associated with a 7.6% increase in new corporations and no significant change in the number of new sole proprietorships. Since most new firms are sole proprietorships, we do not see an increase in the number of new firms in the aggregate. The 2SLS estimates are shown in columns 1–3 of Figure 12c. A 1 pp increase in refugee to native ratio increases the number of new corporations by 1.8% and decreases the number of sole proprietorships by 0.4%. These two effects cancel each other in the aggregate, which leads to a null result of refugees on total firm formation. These results suggest that refugees increased the number of new, productive firms and decreased the number of new, less productive firms.

To provide more evidence for this change in the productivity distribution of new firms, I separate firms into three groups based on their participation in international trade: non-traders, exporters, and importers.[37] The intuition is that firms participating in international trade are more productive than the rest. Hence, the existence of demand and informalization effects would imply that we should observe a higher number of exporter and importer firms and a smaller, even null effect for non-trader firms. Following the same empirical strategy, I first estimate the reduced form using equation 7, where the outcome variable is the natural logarithm of the number of (i) non-trader, (ii) exporter, and (iii) importer firms. The results are shown in Figure 12b. Refugees cause significant increases in the number of both exporter and importer firms and do not change the number of non-trader firms. The 2SLS estimates are shown in columns 4–6 of Figure 12c. A 1 pp increase in the refugee/native ratio causes a 3.2% increase in the number of new exporter firms and a 2.0% increase in the number of new importer firms. It increases the number of non-trader firms only by 0.6%, which is also statistically insignificant.

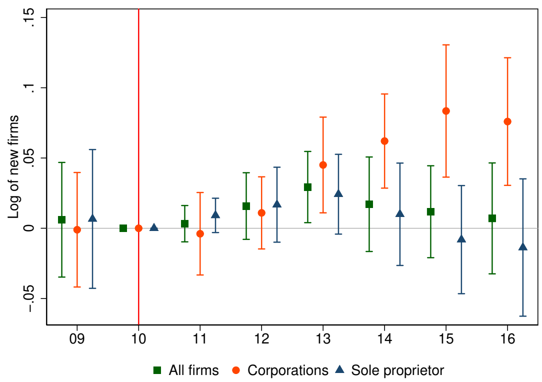
Refugees' null effect on non-trader firm entry is even more surprising considering that refugees increase the local population substantially, which should create more firms via market size effects (Seim, 2006). Appendix Section C.4 shows that the more populous regions in Turkey have more firm creation. It further shows that refugees substantially increase the total population while not causing a significant decrease in the native population.

The heterogeneous effects on the number of new firms across firm types are consistent with a

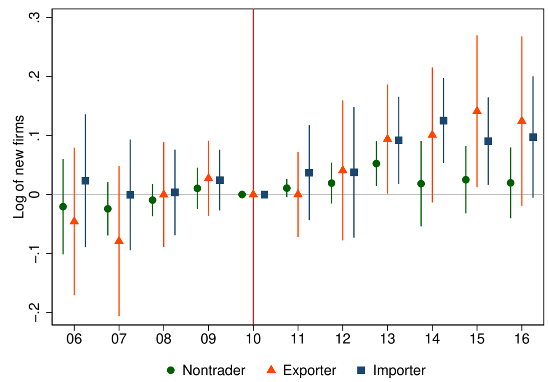
[36] Since there are only two periods before treatment, I do not adjust for linear trends.

[37] A firm is an exporter (importer) if it appears for at least once in the exports (imports) data during its lifetime.

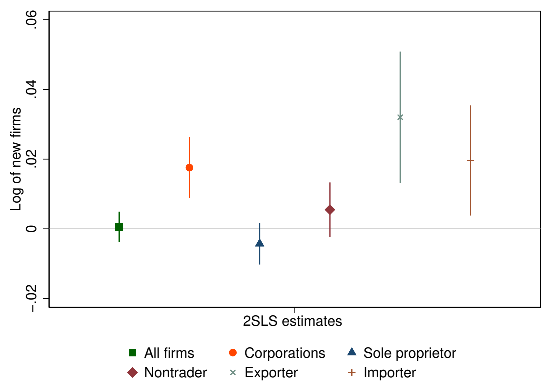
Figure 12: Effect of refugees on formal firm entry



(a) Tax status



(b) Trade participation



(c) 2SLS estimates

Notes: The points in Panels A and B represent the estimated effects of event time shown in equation 7. The 2SLS estimates in Panel C come from the IV design in equation 9. Standard errors are clustered at the nuts2 region level. The 95% confidence intervals are plotted.

positive effect of immigration on firm entry and an escape to informality among less productive firms. Alternative explanations must rationalize why low-skill immigrants increase the number of only productive firms, such as corporations or exporter and importer firms, and decrease the number of less productive firms, such as small sole proprietorships.

Without data on informal firms, I cannot credibly conclude that the informal refugee labor supply has incentivized firms to remain unregistered. However, to make as much progress as possible without such data, I study refugees' effect on electricity consumption, which is a commonly used indicator to measure informal firm activity (La Porta and Shleifer, 2014). Figure C.1 displays the results. A 1 pp increase in refugee/native ratio increases the regional electricity consumption by 0.8%. Put differently, whereas refugees did not lead to more firm formation in the aggregate, they caused a sizeable increase in electricity consumption, which would be consistent with more firm activity in the informal sector.

The Appendix Section F provides a tractable model that marries Melitz (2003) and Ulyssea (2018) to formalize the preferred explanation. In this model, heterogeneous firms can exploit two margins of informality: not registering their business and hiring workers off the books. Moreover, conditional on registering, firms can also choose to be exporters. The model emphasizes two economic forces at play. First, immigrants can induce new firm formation across the productivity distribution via demand and entrepreneurial effects. Second, the informal labor supply shock induces the marginal small firms to remain in the informal sector to obtain more access to informal workers. These forces are sufficient to rationalize the reduced form results on formal firm entry.

7 Conclusion

This paper provides a theoretical and empirical analysis of how firms and native workers respond to an informal labor supply shock, using the Syrian refugee crisis in Turkey as a quasi-experiment. The findings illuminate our understanding of the informal economy and have important policy implications.

This paper shows that an increase in the informal labor supply due to the influx of Syrian refugees significantly impacts both the informal and formal sectors. Native salaried employment decreases in both the informal and formal sectors. The former can be explained by a downward-sloping labor demand curve in the informal sector. However, the native disemployment in the formal sector, despite refugees' inability to work formally, highlights that firms substitute formal workers for informal workers. Robustness checks confirm that the disemployment effects result from refugees' informal labor rather than other confounding factors.

Furthermore, it estimates a model of the informal sector and uses it to offer insights into the trade-offs of providing refugees with work permits. The elasticity of substitution between formal and informal labor is estimated to be approximately 10, which supports the assumption of perfect substitutability in the recent structural literature on the informal sector (Ulyssea, 2018, 2020). To the best of my knowledge, this is one of the first papers to estimate this elasticity. The paper also studies the labor market consequences of granting refugees work permits. Permits boost native employment in the informal sector while reducing it in the formal sector. However, the increase in informal wages encourages firms to hire more formal workers, ultimately creating more formal jobs in the economy. The magnitude of these changes depends on the formality rate of refugees, with significant potential benefits in terms of job creation and government tax revenue.

This paper also investigates how native workers respond to the refugee shock and finds that male natives shift towards non-salaried employment, particularly self-employment, as an alternative to salaried jobs. This adjustment is economically and empirically significant, underscoring the importance of distinguishing between salaried and non-salaried employment when studying immigrants' effect on the labor market.

Finally, this paper investigates whether informal immigration impacts firms' decision to formalize by registering with the tax authorities. It documents a change in the productivity distribution of new formal firms: a decrease in the number of less productive firms and an increase in more productive firms. The missing mass of new, small firms indicates less productive entrepreneurs choosing to remain unregistered, arguably to have easier access to informal labor. If true, this would be an additional effect of an informal labor supply shock. Further research is needed to ascertain whether the number of informal firms has increased.

In conclusion, this research provides valuable insights into the complex dynamics of the informal economy, the labor market effects of refugee inflows, and the potential policy implications of granting work permits to refugees. The findings challenge conventional assumptions and offer a nuanced understanding of the interactions between formal and informal sectors in the context of an informal labor supply shock.

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A Data

Table A.1: HLFS Summary Statistics

	Salaried Employment				Non-salaried Employment			
Formality	All	Informal	Formal		All	Informal	Formal	
Skill			Low	High			Low	High
Panel A: Aggregate								
Pooled	0.323	0.071	0.157	0.459	0.188	0.124	0.061	0.071
Men	0.491	0.106	0.292	0.544	0.251	0.134	0.122	0.107
Women	0.160	0.037	0.045	0.340	0.127	0.115	0.010	0.020
Panel B: Across industries								
Agriculture	0.011	0.009	0.002	0.002	0.101	0.085	0.021	0.006
Textile	0.028	0.008	0.021	0.018	0.006	0.004	0.002	0.002
Other manufacturing	0.062	0.008	0.042	0.081	0.010	0.004	0.006	0.007
Construction	0.028	0.012	0.016	0.015	0.007	0.003	0.003	0.005
Market Services	0.110	0.023	0.056	0.155	0.056	0.024	0.026	0.047
Non-market Services	0.084	0.011	0.020	0.188	0.008	0.004	0.004	0.005

Note: Household Labor Force Surveys between 2004–2016 are used. Salaried employment is defined as regular, salaried work. Non-salaried employment consists of self-employment, unpaid family work, and being an employer. Skill levels are determined by education. Low-skill refers to people without high-school degrees. High-skill refers to people with at least high-school degrees. Industry specifications follow the ISIC categories. Details can be found following this link: https://ilostat.ilo.org/resources/concepts-and-definitions/classification-economic-activities/

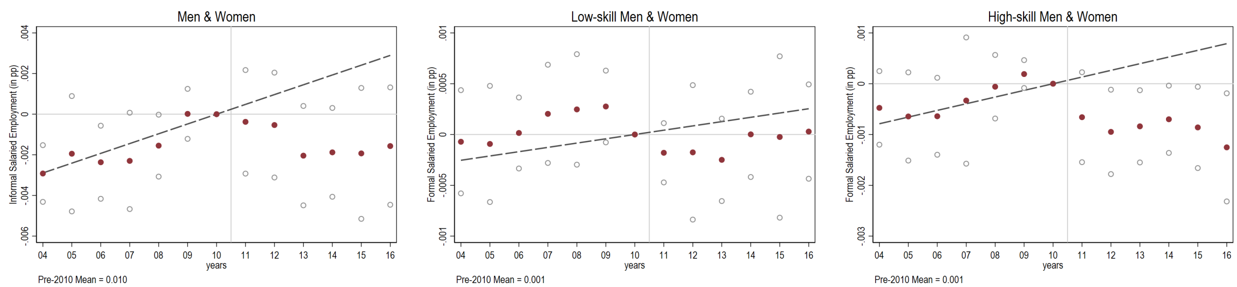
Table A.2: The weights assigned to Syrian regions

Governorate	Pop share	Share in Turkey	IV-weight
Aleppo	24.2	35.7	42.5
Idleb	8.5	20.9	15.4
Raqqa	4.1	10.9	5.8
Lattakia	5.0	9.2	7.7
Hama	8.6	7.5	5.9
Hassakeh	6.5	5.4	9.3
Dayr Az Zor	6.9	3.9	4.8
Damascus	15.0	3.8	2.7
Homs	8.7	1.7	2.8
As Suweida	2.0	0.4	0.4
Daraa	4.6	0.3	0.2
Al Qunaytirah	2.0	0.1	0.4
Tartous	3.9	0.1	2.0

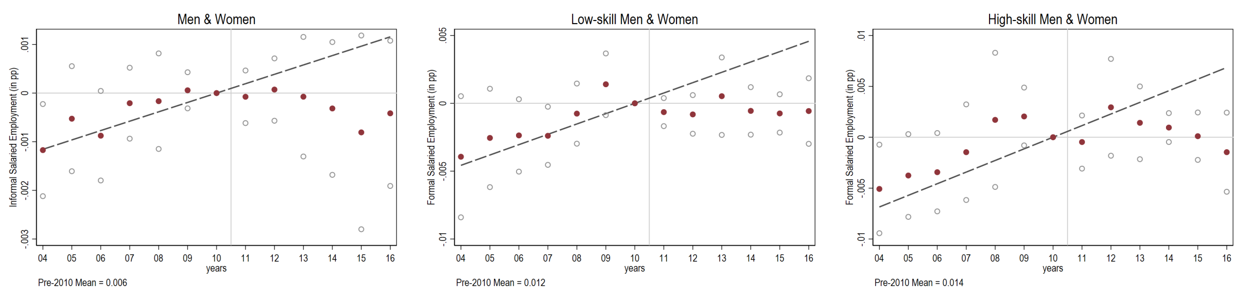
B Event study figures of the 2SLS estimates given in text

Figure B.1: Event study figures of industry specific estimates in Figure 8

(a) Agriculture



(b) Textile



(c) Other Manufacturing

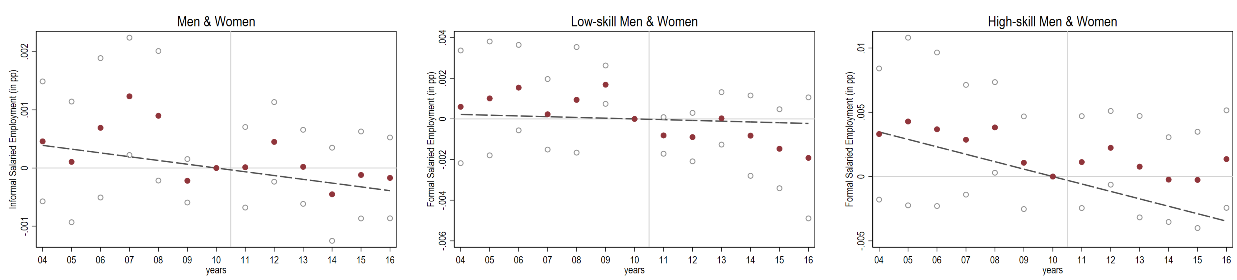
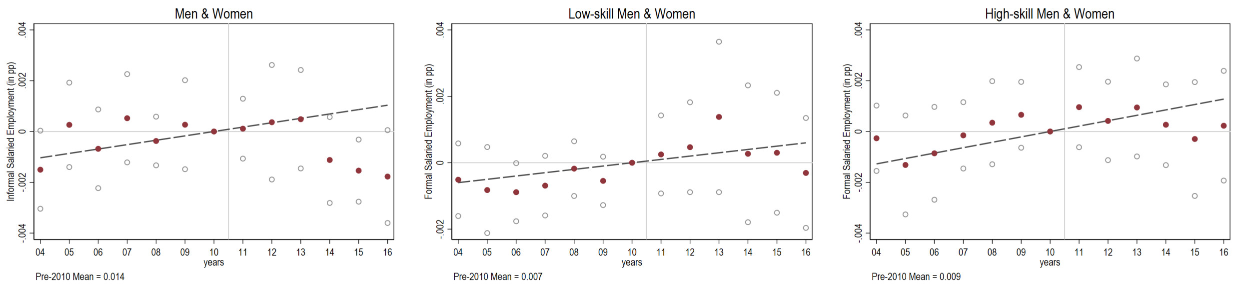
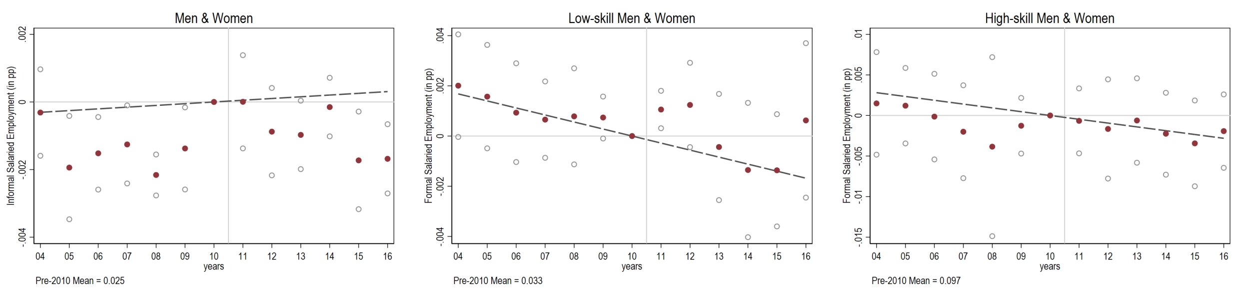


Figure B.1: Event study figures of industry specific estimates in Figure 8 (cont.)

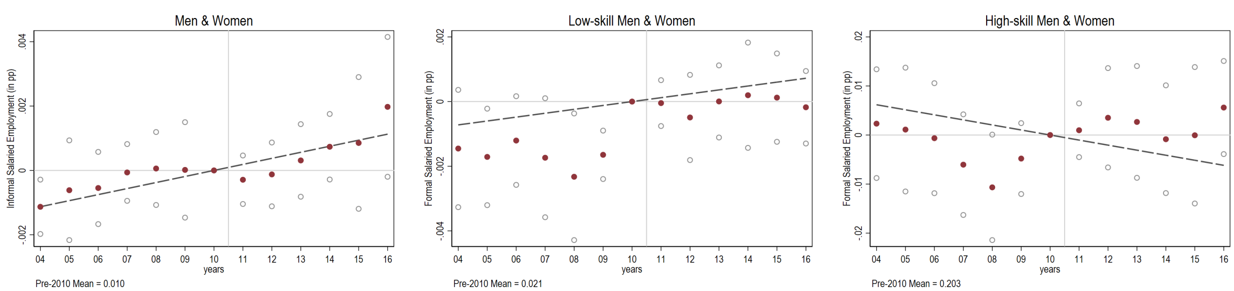
(d) Construction



(e) Market Services



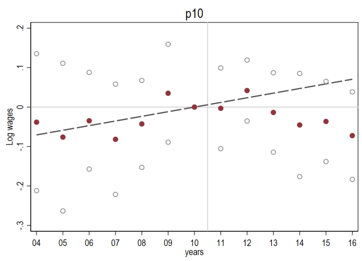
(f) Non-market Services



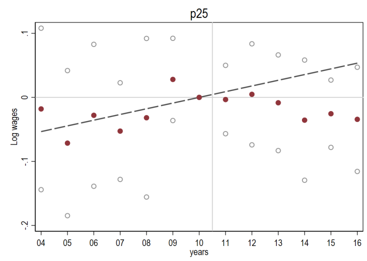
Notes: The points in each figure represent the estimated effects of event time shown in equation 7. The hollow circles present the 95 percent confidence intervals. The dashed line represents the estimated pre-2010 linear relationship between outcome and instrument * event time from the parametric event study in equation 8 with the level normalized to match the nonparametric estimates.

Figure B.2: Event study figures of the wage estimates in Figure 9
Impact on the wage distribution of low-skill natives

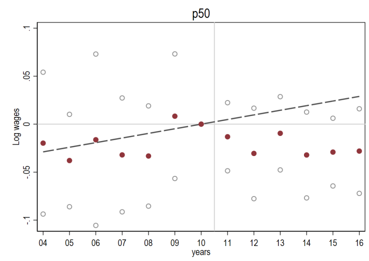
(a) 10th percentile



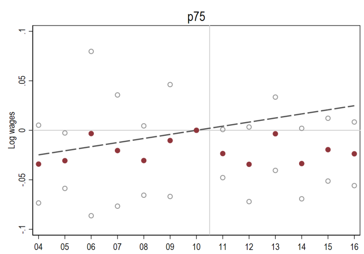
(b) 25th percentile



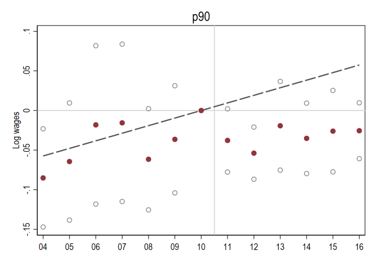
(c) 50th percentile



(d) 75th percentile



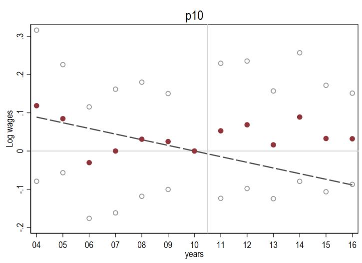
(e) 90th percentile



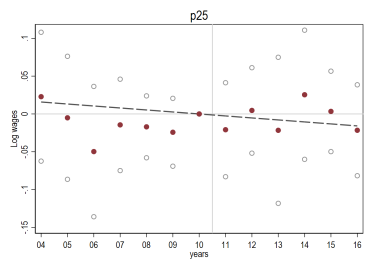
Notes: The points in each figure represent the estimated effects of event time shown in equation 7. The hollow circles present the 95 percent confidence intervals. The dashed line represents the estimated pre-2010 linear relationship between outcome and instrument * event time from the parametric event study in equation 8 with the level normalized to match the nonparametric estimates.

Figure B.3: Event study figures of the wage estimates in Figure 9
Impact on the wage distribution of high-skill natives

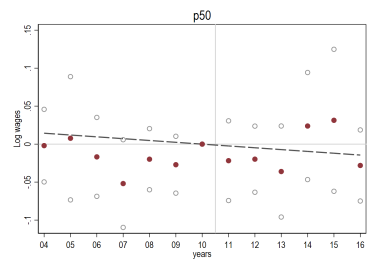
(a) 10th percentile



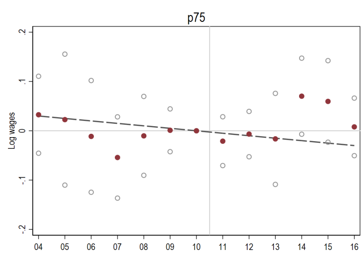
(b) 25th percentile



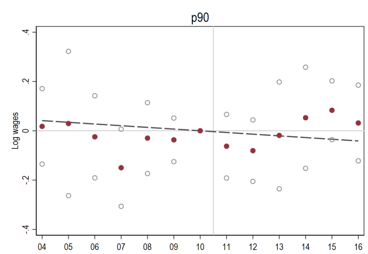
(c) 50th percentile



(d) 75th percentile



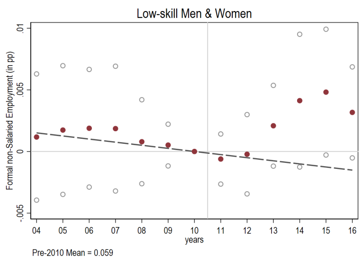
(e) 90th percentile



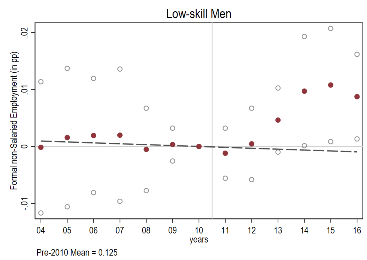
Notes: The points in each figure represent the estimated effects of event time shown in equation 7. The hollow circles present the 95 percent confidence intervals. The dashed line represents the estimated pre-2010 linear relationship between outcome and instrument * event time from the parametric event study in equation 8 with the level normalized to match the nonparametric estimates.

Figure B.4: Event study figures of the estimates in Figure 11
Impact on the formal non-salaried employment of low-skill natives

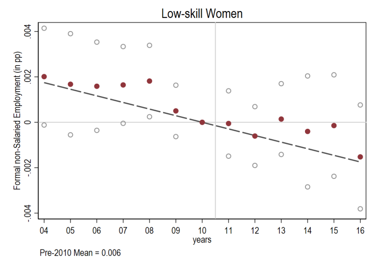
(a) Pooled



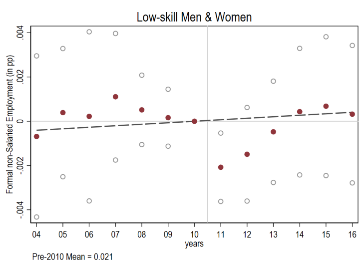
(b) Men



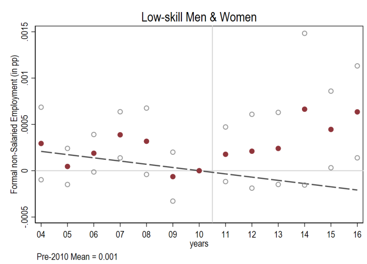
(c) Women



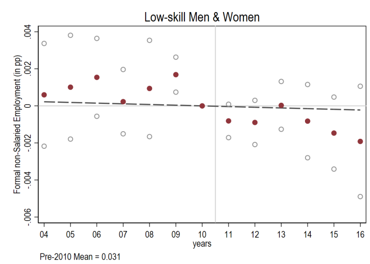
(d) Agriculture



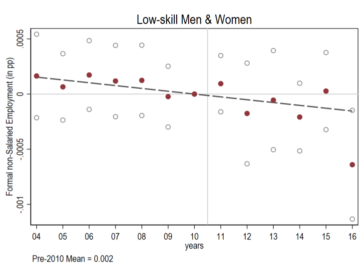
(e) Textile



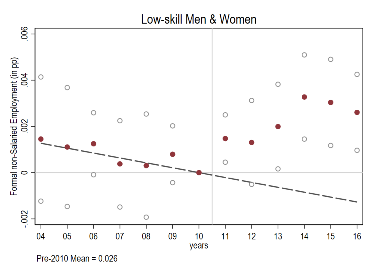
(f) Other Manufacturing



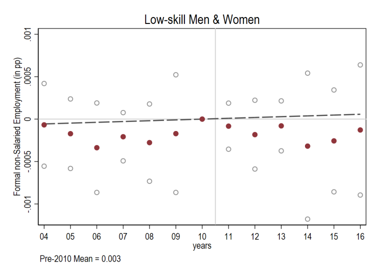
(g) Construction



(h) Market Services



(i) Non-market Services



Notes: The points in each figure represent the estimated effects of event time shown in equation 7. The hollow circles present the 95 percent confidence intervals. The dashed line represents the estimated pre-2010 linear relationship between outcome and instrument * event time from the parametric event study in equation 8 with the level normalized to match the nonparametric estimates.

C Additional Empirical Results

C.1 Empirical Results on Employment, Salaried Employment, and non-Salaried Employment

Table C.1: Refugees' effect on the employment rate of natives

Formality	Sex	All	Agriculture	Manufacturing Textiles	Manufacturing Other	Construction	Services Market	Services Non-market
		(1)	(2)	(3)	(4)	(5)	(7)	(8)
Informal	Pooled	-0.277	-0.218	-0.0349**	0.00670	-0.0581***	-0.0185	0.0453
		(0.250)	(0.189)	(0.0162)	(0.0103)	(0.0204)	(0.0504)	(0.0281)
	Men	-0.298	-0.173	-0.0334***	0.0144	-0.125***	-0.0206	0.0398*
		(0.201)	(0.131)	(0.0106)	(0.0176)	(0.0418)	(0.0856)	(0.0208)
	Women	-0.257	-0.252	-0.0356	-0.000296	0.00219	-0.0210	0.0502
		(0.315)	(0.255)	(0.0267)	(0.00691)	(0.00145)	(0.0199)	(0.0455)
Formal Low-skill	Pooled	-0.00660	0.0531	-0.0556**	-0.000736	-0.0294**	0.0363	-0.0103
		(0.0644)	(0.0447)	(0.0236)	(0.0251)	(0.0116)	(0.0299)	(0.0136)
	Men	0.0528	0.0993	-0.104**	0.0243	-0.0661**	0.114*	-0.0150
		(0.117)	(0.0863)	(0.0410)	(0.0492)	(0.0270)	(0.0610)	(0.0289)
	Women	-0.0914**	0.00890	-0.0224	-0.0279*	-0.00212	-0.0389***	-0.00898
		(0.0432)	(0.0187)	(0.0168)	(0.0150)	(0.00204)	(0.0148)	(0.00760)
Formal High-skill	Pooled	0.000265	0.0117	-0.135***	0.0582	-0.0461	0.0441	0.0675
		(0.164)	(0.0245)	(0.0357)	(0.0526)	(0.0316)	(0.0473)	(0.138)
	Men	0.176	0.0335	-0.183***	0.135*	-0.0679	0.156**	0.102
		(0.200)	(0.0393)	(0.0397)	(0.0749)	(0.0539)	(0.0643)	(0.148)
	Women	-0.00729	-0.00711	-0.0202	0.00226	0.00512	-0.0241	0.0368
		(0.171)	(0.00623)	(0.0281)	(0.0252)	(0.0120)	(0.0451)	(0.180)

The 2SLS estimates come from estimating equation 9 using natives' informal, low-skill formal, and high-skill formal salaried employment rates. Standard errors are clustered at the region level. Industry codes are determined according to ISIC. Details can be found following this link: https://ilostat.ilo.org/resources/concepts-and-definitions/classification-economic-activities/ Standard errors are in parenthesis. * p<0.10, ** p<0.05, *** p<0.01

Table C.2: Refugees' effect on the salaried employment rate of natives

				Manufacturing			Services	
Formality	Sex	All	Agriculture	Textiles	Other	Construction	Market	Non-market
		(1)	(2)	(3)	(4)	(5)	(7)	(8)
Informal	Pooled	-0.169***	-0.0611**	-0.0307**	-0.00358	-0.0641***	-0.0307*	0.0207
		(0.0538)	(0.0273)	(0.0150)	(0.00979)	(0.0211)	(0.0162)	(0.0190)
	Men	-0.298***	-0.0694**	-0.0417***	-0.00351	-0.137***	-0.0388	-0.00792
		(0.0826)	(0.0291)	(0.0156)	(0.0197)	(0.0433)	(0.0243)	(0.0223)
	Women	-0.0536	-0.0540	-0.0202	-0.00347	0.00240**	-0.0250*	0.0467
		(0.0829)	(0.0352)	(0.0174)	(0.00497)	(0.00106)	(0.0132)	(0.0412)
Formal Low-skill	Pooled	-0.128***	0.00281	-0.0668***	-0.0185	-0.0261**	-0.0121	-0.00700
		(0.0381)	(0.00674)	(0.0237)	(0.0260)	(0.0127)	(0.0184)	(0.0126)
	Men	-0.190**	0.0116	-0.130***	-0.0139	-0.0597**	0.00926	-0.00723
		(0.0792)	(0.0121)	(0.0420)	(0.0500)	(0.0294)	(0.0360)	(0.0251)
	Women	-0.104**	-0.00514	-0.0214	-0.0285*	-0.00109	-0.0390**	-0.00888
		(0.0416)	(0.00404)	(0.0159)	(0.0148)	(0.00166)	(0.0157)	(0.00797)
Formal High-skill	Pooled	-0.125	-0.0131	-0.139***	0.0191	-0.0391	-0.00835	0.0551
		(0.130)	(0.00972)	(0.0399)	(0.0487)	(0.0337)	(0.0354)	(0.130)
	Men	-0.0700	-0.0168	-0.188***	0.0614	-0.0600	0.0589	0.0747
		(0.134)	(0.0147)	(0.0454)	(0.0658)	(0.0565)	(0.0408)	(0.142)
	Women	-0.0131	-0.00319	-0.0220	0.00940	0.00666	-0.0490	0.0450
		(0.177)	(0.00293)	(0.0265)	(0.0272)	(0.0122)	(0.0382)	(0.179)

The 2SLS estimates come from estimating equation 9 using natives' informal, low-skill formal, and high-skill formal salaried employment rates. Standard errors are clustered at the region level. Industry codes are determined according to ISIC. Details can be found following this link: https://ilostat.ilo.org/resources/concepts-and-definitions/classification-economic-activities/ Standard errors are in parenthesis. * p<0.10, ** p<0.05, *** p<0.01

Table C.3: Refugees' effect on the non-salaried employment rate of natives

Formality	Sex	All	Agriculture	Manufacturing: Textiles	Manufacturing: Other	Construction	Services: Market	Services: Non-market
		(1)	(2)	(3)	(4)	(5)	(7)	(8)
Informal	Pooled	-0.108	-0.156	-0.00423	0.0103	0.00597	0.0122	0.0246**
		(0.220)	(0.167)	(0.0112)	(0.00822)	(0.00611)	(0.0382)	(0.0109)
	Men	0.000352	-0.104	0.00824	0.0179	0.0119	0.0183	0.0477**
		(0.192)	(0.111)	(0.00684)	(0.0161)	(0.0120)	(0.0717)	(0.0198)
	Women	-0.203	-0.198	-0.0155	0.00318	-0.000210	0.00397	0.00355
		(0.258)	(0.240)	(0.0189)	(0.00323)	(0.000546)	(0.0114)	(0.00820)
FormalLow-skill	Pooled	0.121**	0.0503	0.0113**	0.0177**	-0.00334	0.0484***	-0.00327
		(0.0493)	(0.0439)	(0.00440)	(0.00696)	(0.00378)	(0.0187)	(0.00776)
	Men	0.242**	0.0876	0.0260***	0.0382**	-0.00637	0.105***	-0.00775
		(0.0968)	(0.0828)	(0.00963)	(0.0150)	(0.00813)	(0.0401)	(0.0137)
	Women	0.0125	0.0140	-0.000991	0.000528	-0.00102	0.0000680	-0.0000968
		(0.0230)	(0.0208)	(0.00186)	(0.00162)	(0.000623)	(0.00454)	(0.00361)
FormalHigh-skill	Pooled	0.126**	0.0247	0.00383	0.0391***	-0.00698	0.0525**	0.0123
		(0.0566)	(0.0177)	(0.00732)	(0.0106)	(0.00802)	(0.0257)	(0.0108)
	Men	0.246**	0.0503*	0.00566	0.0735***	-0.00797	0.0971**	0.0270
		(0.102)	(0.0292)	(0.0154)	(0.0206)	(0.0121)	(0.0444)	(0.0168)
	Women	0.00579	-0.00393	0.00177	-0.00714	-0.00155	0.0249	-0.00826
		(0.0292)	(0.00549)	(0.00452)	(0.00572)	(0.00179)	(0.0182)	(0.00838)

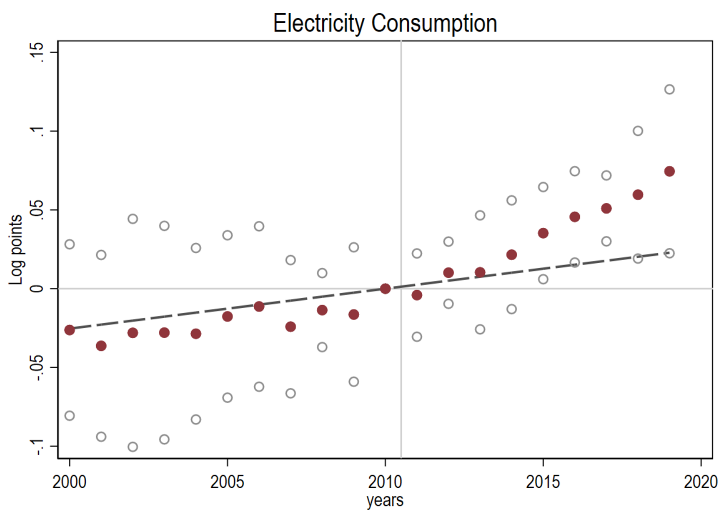
The 2SLS estimates come from estimating equation 9 using natives' informal, low-skill formal, and high-skill formal salaried employment rates. Standard errors are clustered at the region level. Industry codes are determined according to ISIC. Details can be found following this link: https://ilostat.ilo.org/resources/concepts-and-definitions/classification-economic-activities/ Standard errors are in parenthesis. * p<0.10, ** p<0.05, *** p<0.01

C.2 Electricity Consumption

Section 6.5 of the main text investigates whether informal immigration impacts firms' decisions to formalize on the extensive margin; i.e., register with the tax authorities. It documents a change in the productivity distribution of new formal firms: a decrease in the number of less productive firms and an increase in more productive firms. It argues that the missing mass of new small formal firms is indicative of less productive entrepreneurs choosing to remain unregistered to have easier access to informal labor. If true, this would be an additional effect of an informal labor supply shock. However, the lack of credible data sources on unregistered firms in Turkey prevents testing whether the number of informal firms has increased.

Without data on informal firms, I cannot credibly conclude that the informal refugee labor supply has incentivized firms to remain unregistered. However, to make as much progress as possible without such data, I study refugees' effect on electricity consumption, which is a commonly used indicator to measure informal firm activity (La Porta and Shleifer, 2014). Data on electricity consumption at the province level comes from Turkstat. For consistency with the rest of the paper, I perform the analysis at the NUTS2 level. I estimate the nonparametric and parametric event study designs shown in equations 7 and 8. Figure C.1 shows the point estimates from the nonparametric design, and the linear trend from the parametric design. The distance exposure is associated with significant and positive deviations from the trend after 2015. A one standard deviation increase in the instrument is associated with a 3.8% increase in electricity consumption in 2016. Put differently, whereas refugees did not lead to more firm formation in the aggregate, they caused a sizeable increase in electricity consumption, which would be consistent with more firm activity in the informal sector.

Figure C.1: Event study design on electricity consumption



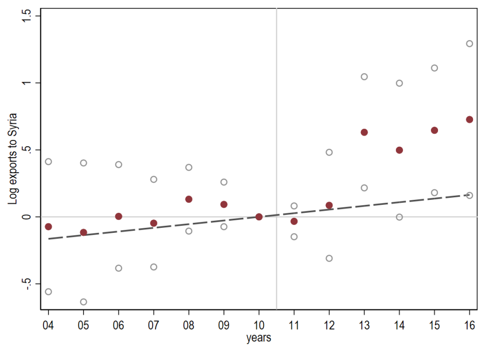
Notes: The points in each figure represent the estimated effects of event time shown in equation 7. The hollow circles present the 95 percent confidence intervals. The dashed line represents the estimated pre-2010 linear relationship between outcome and instrument * event time from the parametric event study in equation 8 with the level normalized to match the nonparametric estimates.

C.3 Trade-related confounders

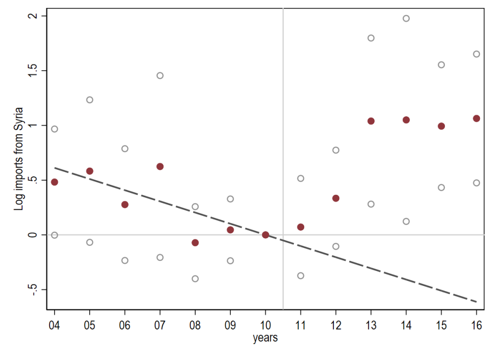
I rely on a spatial IV-DiD strategy to identify the effects of Syrian refugees on labor markets. I use a distance-based instrument, which boils down to comparing regions close to the border with regions that are further away. This empirical strategy assumes that the Syrian war's impact on the Turkish local labor markets, if any, should be orthogonal to the distance from the border. This could fail if Syria were a major trade partner of border regions and the war had significantly disrupted the trade flows. To investigate this, I calculated the trade flows between Turkish regions and Syria and the rest of the world from Turkstat's customs data. In particular, for each region-year cell, I calculated the total amount of exports to Syria, total exports to other countries, total imports from Syria, and total imports from other countries. I then estimate the nonparametric and parametric event study designs shown in equations 7 and 8, where the outcome variables are the natural logarithm of trade flows.

Panels A, B, C, and D of Figure C.2 plot the results. Panels A and B show that regions close to the border do not observe significant decreases in imports from and exports to Syria. If anything, exports to and imports from Syria actually increase after 2011. This evidence rules out a negative trade shock causing native disemployment in the border regions. Moreover, the trade relations with Syria were not significant enough to disrupt the labor markets. This can be seen in Panels C and D, which show the effect of distance on total exports and imports. Despite regions closer to the border observing increases in trade with Syria, total exports remain unaffected, and total imports decrease by a small amount. The latter is likely a causal effect of the refugee labor supply, which lowers the production costs of local goods. Overall, the evidence strongly suggests that the Syrian Civil War did not cause a significant trade shock to Turkey that can explain my findings.

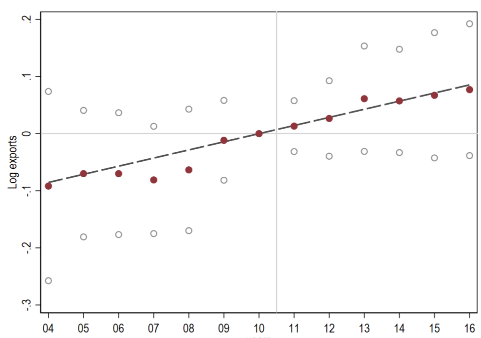
Figure C.2: Event study estimates on exports and imports



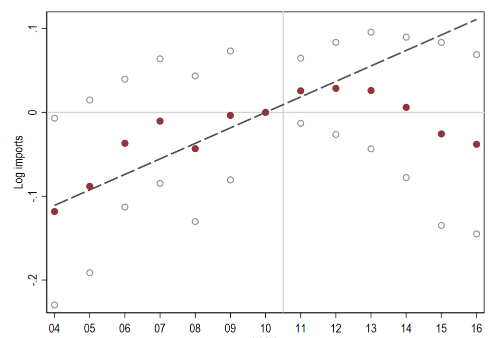
(a) Exports to Syria



(b) Imports from Syria



(c) Total Exports



(d) Total Imports

Notes: The points in each figure represent the estimated effects of event time shown in equation 7. The hollow circles present the 95 percent confidence intervals. The dashed line represents the estimated pre-2010 linear relationship between outcome and instrument * event time from the parametric event study in equation 8 with the level normalized to match the nonparametric estimates.

C.4 Refugees' effect on Native population

In the main text, I argue that refugees' null effect on the creation of non-trader firms is highly suggestive of new firms choosing to remain informal. This is because there is a well known relationship between firm entry and market size, and therefore an increase in population should cause more firm creation. An alternative hypothesis could be that refugees decrease the native population of the host regions, e.g., by increasing out-migration or decreasing in-migration. If this effect was large enough, refugees could decrease new firm creation simply by reducing native population. In this section, I show evidence againts this alternative hypothesis. First, I document the relationship between native population and firm entry. Second, I show that refugees decrease in-migration and increase out-migration of natives my economically insignificant amounts. Consequently, refugees do not impact the native population in the time period of study.

C.4.1 Relationship between population and firm entry

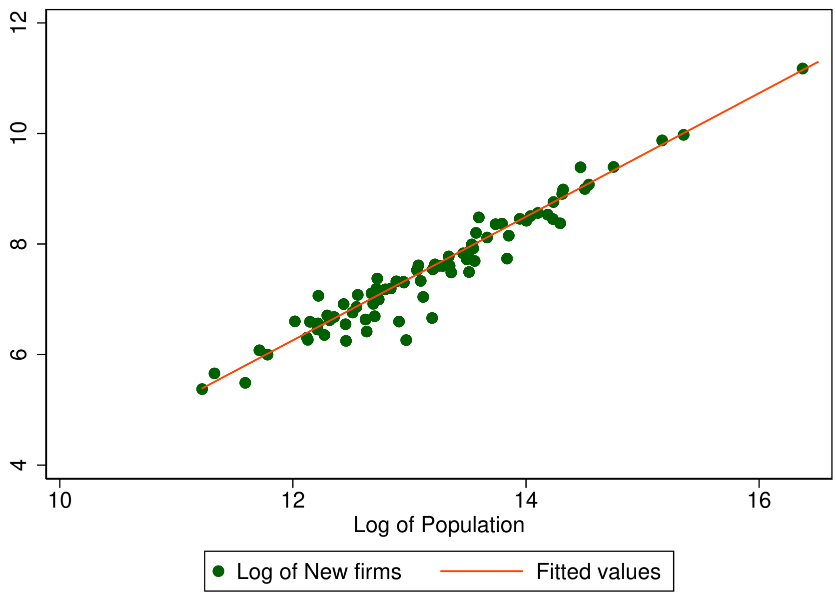
In Turkey, population and number of new firms is strongly correlated. Figure C.3 plots the natural logarithm of the number of new firms and native population at the province level in 2009. There is strong correlation between new entrants and local population. A linear line fits the data almost perfectly with an R-square of 0.94. Across provinces, a 1% increase in native population is associated with a 1.1% increase in new firm entry per year. This suggestive correlation does not imply causation: cities where many people live may have other amenities that allow for new firm formation. Within province variation in population and firm entry is more informative. Regressing the natural logarithm of number of new firms on the natural logarithm of local population while controlling for province and year fixed effects in the pre-period result in an elasticity estimate of around 0.75, which is still large.

C.4.2 Refugees' Null effect on native population

In this subsection, I show that refugees have only a minor effect on in-migration and out-migration of natives. Consequently, they lead to no significant change in the native population. If anything, the treated regions keep observing a growth in their native population due to higher growth rates. To show this, I estimate the nonparametric event study design shown in equation 7 of the main text where the outcome variable is the natural logarithm of the amount of in-migration and out-migration at the region-year level. Panels A and B of Figure C.4 shows the results. we see that the provinces closer to the border observed statistically significant changes in both in-migration and out-migration. The effects are apparent initially in 2011 and 2012 when the Syrian war began (even before refugees started coming in masses), but then subside until the end of 2015, and then slightly increase again in 2016.

Overall, it is apparent that the instrument does capture some statistically significant changes in native in-migration and out-migration. However, these effects are small in magnitude. For instance, a 1 standard deviation in the predicted treatment intensity increases (decreases) out-migration (in-

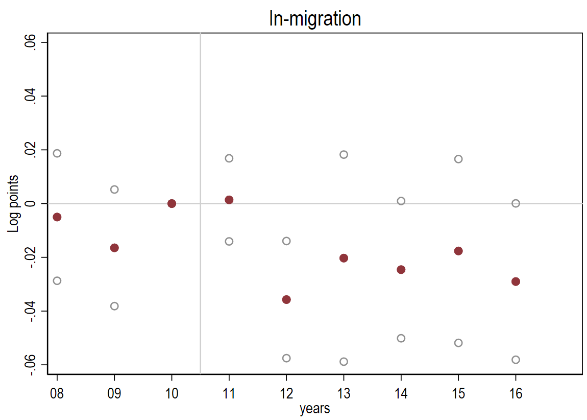
Figure C.3: Market size and firm entry in 2009



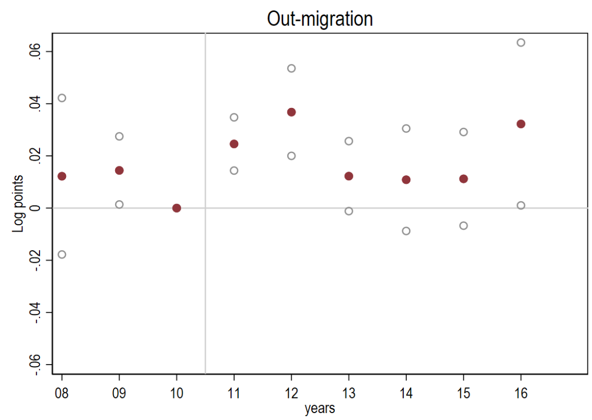
migration) by less than 3%. Whereas this may sound large, in/out-migration each constitutes around 3% of the native population in the more intensely treated provinces in each year. Hence, a 2 standard deviation increase in treatment intensity decreases native population in a province by around 0.36%. Given the 0.75 elasticity between firm entry and native population, this would lead only to a mild 0.27% decrease in the number of new firms.

In fact, the changes in in and out migration does not lead to a detectable change in native population. Panels C and D of Figure C.4 plot the same event study figures on the natural logarithm of the native population and working age native population, respectively. We see that the regions closer to the border were observing larger increases in their populations in percentage terms even before the refugee crisis began. However, the crisis did not alter this pre-existing trajectory. The parametric linear trend falls within the nonparametric estimates in all years.

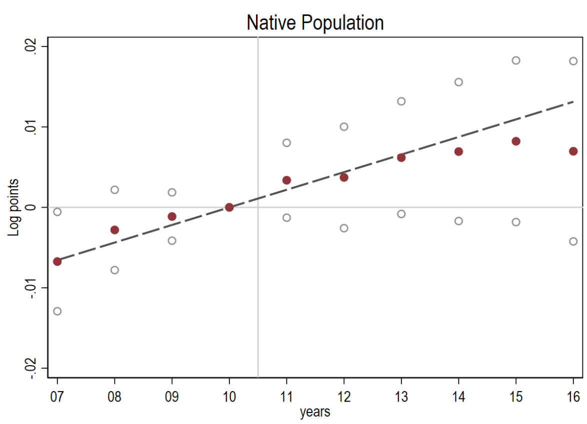
Figure C.4: Nonparametric Event study figures on native population



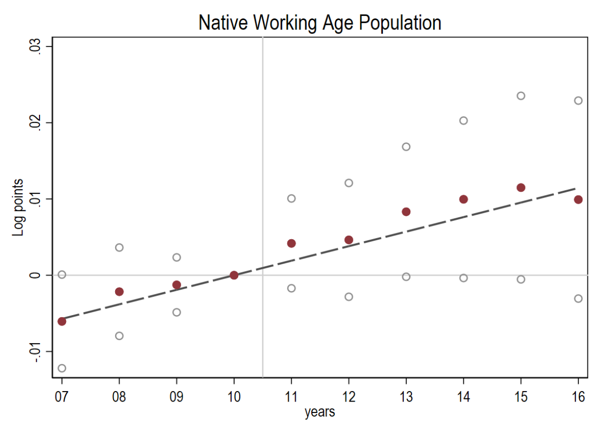
(a) RF effect on native in-migration



(b) RF effect on native out-migration



(c) RF effect on native population



(d) RF effect on working age population

D Derivations of the baseline model

To calculate these elasticities, first take the logarithm of the FOCs:

$$\begin{aligned}
(\rho-1-\gamma)logL_i &= logw_i + log(1+\gamma) - log(\alpha\eta) - \frac{\alpha-\rho}{\rho}log(\eta L_i^\rho + (1-\eta)L_f^\rho) \\
(\rho-1)logL_f &= logw_f + log(1+\tau_w) - log(\alpha(1-\eta)) - \frac{\alpha-\rho}{\rho}log(\eta L_i^\rho + (1-\eta)L_f^\rho)
\end{aligned} \tag{10}$$

Fix $w_f = \overline{w_f}$, and differentiate w.r.t. w_i

$$\begin{aligned}
(\rho-1-\gamma)\epsilon_{L_i,w_i} &= 1 - (\alpha-\rho)[s_i\epsilon_{L_i,w_i} + s_f\epsilon_{L_f,w_i}] \\
(\rho-1)\epsilon_{L_f,w_i} &= -(\alpha-\rho)[s_i\epsilon_{L_i,w_i} + s_f\epsilon_{L_f,w_i}]
\end{aligned} \tag{11}$$

where $s_i = \frac{\eta L_i^\rho}{\eta L_i^\rho + (1-\eta)L_f^\rho}$ and $s_f = \frac{(1-\eta)L_f^\rho}{\eta L_i^\rho + (1-\eta)L_f^\rho}$ are the informal and formal share in the production. Two linearly independent equations with two unknowns can easily be solved analytically, which reveals:

$$\epsilon_{L_f,w_i} = \frac{(\alpha-\rho)s_i}{1-\rho-(\alpha-\rho)s_f}\epsilon_{L_i,w_i} \tag{12}$$

and

$$\begin{aligned}
\epsilon_{L_i,w_i} &= -\frac{1-\rho-(\alpha-\rho)s_f}{(1-\rho+\gamma)(1-\rho)-(\alpha-\rho)[(1-\rho+\gamma)s_f + (1-\rho)s_i]} \\
\epsilon_{L_f,w_i} &= -\frac{(\alpha-\rho)s_i}{(1-\rho+\gamma)(1-\rho)-(\alpha-\rho)[(1-\rho+\gamma)s_f + (1-\rho)s_i]]}
\end{aligned} \tag{13}$$

E Model Estimation

This section discusses the estimation of the full model with firm heterogeneity. To analyze counterfactual policy changes, it is necessary to estimate and calibrate the four key parameters of the model: the share of labor in production α, the elasticity of substitution between the informal and formal labor $\sigma = \frac{1}{1-\rho}$, the share parameter of informal labor η, and the convex cost structure of hiring informal workers γ. The model is estimated using a minimum distance estimator. Firm heterogeneity is introduced to obtain additional moments for identification. Section E.1 sets up the full model, while Section E.2 describes the estimation method, identification, and the model's fit.

E.1 Introducing Firm heterogeneity in productivity

Building on the representative firm framework of Section 3 I allow for firms to have different productivities denoted by $\theta \in \{\theta_1, \dots, \theta_K\}$, which enters firms' production function in a Hicks-neutral way:

$$F(\ell_i, \ell_f; \theta) = \theta(\eta \ell_i^\rho + (1-\eta)\ell_f^\rho)^{\frac{\alpha}{\rho}}$$

Firm of type θ's objective function is given by:

$$\max_{\ell_i, \ell_f} F(\ell_i, \ell_f; \theta) - \ell_i^(1+\gamma)w_i - (1+\tau_w)w_f\ell_f$$

The first-order conditions determine the labor demand functions of each firm of type θ:

$$\begin{aligned}
\alpha\eta\ell_i^{\rho-1-\gamma}Y^{\frac{\alpha-\rho}{\alpha}} &= w_i(1+\gamma) \\
\alpha(1-\eta)\ell_f^{\rho-1}Y^{\frac{\alpha-\rho}{\alpha}} &= w_f(1+\tau_w)
\end{aligned}$$

where $Y(\theta) = \theta(\eta\ell_i^\rho + (1-\eta)\ell_f^\rho)^{\frac{\alpha}{\rho}}$ is the output produced by the firm of type θ. Solving these two equations for $L_i(\theta)$ and $L_f(\theta)$ determines the informal and formal labor demanded by firms of type θ. The total labor demand curves are given by aggregating these group-specific labor demand curves.

Given K types of firms with productivities $\theta \in \{\theta_1, \dots, \theta_K\}$, let n_j and m_j denote the ratio of informal and formal labor hired by firms of type θ_j. The aggregate informal labor demand elasticities w.r.t. informal wages are then given by weighted averages of group-specific elasticities:

$$\begin{aligned}
\overline{\epsilon_{L_i,w_i}} &\coloneqq \sum_{j=1}^{K} \epsilon_{L_i,w_i}(\theta_j)n_j \\
\overline{\epsilon_{L_f,w_i}} &\coloneqq \sum_{j=1}^{K} \epsilon_{L_f,w_i}(\theta_j)m_j
\end{aligned}$$

where the group-specific labor demand elasticities are given by:

$$\epsilon_{L_i,w_i}(\theta) = -\frac{1-\rho-(\alpha-\rho)s_f(\theta)}{(1-\rho+\gamma)(1-\rho)-(\alpha-\rho)[(1-\rho+\gamma)s_f(\theta)+(1-\rho)s_i(\theta)]}$$
$$\epsilon_{L_f,w_i}(\theta) = -\frac{(\alpha-\rho)s_i(\theta)}{(1-\rho+\gamma)(1-\rho)-(\alpha-\rho)[(1-\rho+\gamma)s_f(\theta)+(1-\rho)s_i(\theta)]]}$$

where $s_i(\theta) = \frac{\eta\ell_i(\theta)^\rho}{(\eta\ell_i(\theta)^\rho+(1-\eta)\ell_f(\theta)^\rho)}$ is the share of informal labor in production for firms of type θ.

I partition the vector of parameters into two groups based on whether they are calibrated or estimated. $\alpha = 0.45$ is calibrated based on the share of labor in production in Turkey (Sevinc et al., 2021), informal wage w_i and formal wage w_f for the low-skilled are estimated using the labor force surveys, the labor tax rate is set to its statutory value $\tau_w = 0.25$. The value of τ_w corresponds to the effective tax rate for minimum wage earners. The mean formal wage for low-skill earners is inflated by 1/12 to account for the statutory severance pay rate.

E.2 Estimation Method

I take the parameters defined in the first step as given and use a Minimum Distance estimator to obtain the remaining model parameters. The model has three core parameters $\{\gamma, \eta, \rho\}$ and K productivity measures θ_K that need to be estimated. The estimator proceeds in two steps. First, it uses the model to generate the informal and formal labor demanded by each firm type. Second, it uses these inputs to compute the set of moments computed from actual data and the IV estimates. The estimate is obtained as the parameter vector that best approximates these moments.

Let $\hat{m}_N = \frac{1}{N}\sum_{i=1}^{N} m_i$ denote the vector of moments computed from data, which can include, for example, the share of informal workers hired by firms of different sizes. Let the model-generated counterpart of these moments be denoted by $m(\Phi;\Psi)$. Define $g_N(\Phi;\Psi) = \hat{m}_N - m_s(\Phi;\Psi)$; the estimator is then given by

$$\hat{\Phi} = \arg\min_{\Phi} Q(\Phi;\Psi) = \left\{g_N(\Phi;\Psi)' W_N g_N(\Phi;\Psi)\right\} \tag{14}$$

where W_N is a positive, semi-definite weighting matrix. For simplicity, I use a diagonal matrix where each element is the inverse of the square of the empirical moment. This way, percentage deviations from the moments take equal weight.

Moments and Identification

I use nine moments from the data and my IV results to form the vector $\hat{m}_N$. HLFS asks respondents how many people work in their establishment, and group results in K categories: less than 10, between 10–24, 25–49, 50–249, and 250–499 workers. I follow this structure of the HLFS and further calculate the average number of employees in each group of firms using the census of firms in Turkey.[38] The moments I choose are (i) the size of firms in different groups (calculated using HLFS and Turkish census), (ii) the informality rate of firms in different groups (calculated using HLFS), (iii) the ratio of informal and formal labor demand elasticities (estimated in the empirical section).

This section's main goal is not to provide a rigorous proof of identification. Nonetheless, here I explain how the observed variations in data, combined with the outcomes of reduced-form analyses and the structure of the underlying model, help determine the model's parameters. In this model, the sole means by which firms can augment their output is by increasing their workforce, as labor constitutes the exclusive input in the production process. Consequently, the distinction between larger and smaller firms hinges entirely upon disparities in their productivities denoted as θ. More productive firms choose to expand their workforce. The parameter γ, which governs the marginal cost of employing informal workers, predominantly hinges on the extent to which larger firms opt for formalization at the intensive margin. For all types of firms, the share parameter η is linked to the relative productivity of formal and informal workers and, thus, is determined by the proportion of informal workers in the overall economy. The elasticity of substitution between informal and formal workers is primarily dictated by demand elasticities. For instance, the sign of the formal labor demand elasticity in isolation provides set identification for ρ as $\rho > \alpha \iff \epsilon_{L_f,w_i} > 0$. Similarly, the relative magnitudes of the elasticities of informal and formal labor demand, expressed as $\frac{\epsilon_{L_f,w_i}}{\epsilon_{L_i,w_i}} = \frac{(\alpha-\rho)s_i}{1-\rho-(\alpha-\rho)s_f}$, assist in pinpointing ρ. Holding the share of informal labor constant, this ratio exhibits a declining trend with respect to ρ.

Estimates and Model Fit

Table E.1 shows the values of all parameters. The most critical estimate is that the CES elasticity parameter ρ is 0.89, which implies an elasticity of substitution between informal and formal labor of 10. To the best of my knowledge, this is one of the first papers to estimate this elasticity. This relatively high elasticity is consistent with the Turkish context, where informal employment is often in the same sectors and even in the same firms as formal employment. It also supports the assumption of perfect substitutability between informal and formal workers in the recent structural literature on the informal sector (Ulyssea, 2018, 2020).

The implied elasticity of informal and formal labor demand w.r.t informal wages are -2.50 and 0.64, respectively. The relatively large elasticity in the informal sector can be explained by the lack of institutional forces that protect workers, such as severance pay. Moreover, the model allows me to back up the decrease in informal wages faced by firms. I estimate that for every 1 pp increase in refugee/native ratio, the informal wages faced by firms decrease by 1.39%. A

[38] An important detail is that I observe only formal workers in the Turkish census, whereas HLFS considers informal and formal workers combined. To account for this disparity, I first estimate the informality ratio of each group of firms using the HLFS, which I use to calculate the range of formal workers these firms should be employing on average. For example, I calculate that 58,5% of salaried workers in firms with less than 10 employees are informal, which means that these firms, on average, hire between 1–4 formal workers. I then look at the firm size distribution in the Turkish census, calculate the average formal firm size within each group, and then calculate the average total firm size by dividing by the formality rate.

Table E.1: Parameter Values

Parameter	Description	Source	Value
τ_w	Payroll tax	Statutory values	0.25
w_i	Informal wages	Calibrated	2.95
w_f	Formal wages for the low-skilled	Calibrated	4.44
α	Cobb-Douglass coefficient	Calibrated	0.54
γ	Intensive mg. cost of informal labor	Estimated	0.24
η	Informal share parameter	Estimated	0.46
ρ	CES elasticity parameter	Estimated	0.89
θ_1	Productivity of firms between 1–9 workers	Estimated	26.48
θ_2	Productivity of firms between 10–24 workers	Estimated	50.70
θ_3	Productivity of firms between 25–49 workers	Estimated	76.12
θ_4	Productivity of firms between 50–249 workers	Estimated	127.02
θ_5	Productivity of firms between 50–249 workers	Estimated	209.45
$\sigma_{i,f}$	Elasticity of substitution between informal and formal workers	Implied	9.58
ϵ_{L_i,w_i}	Average Elasticity of informal labor demand w.r.t. informal wages	Implied	-2.50
ϵ_{L_f,w_i}	Average Elasticity of formal labor demand w.r.t. informal wages	Implied	0.64
	Effect of a 1pp increase in refugee/native ratio on informal wages faced by firms	Implied	-1.32%

Note: Formal and informal hourly wage estimates are expressed as averages of log hourly earnings.

reduced-form test of this prediction would require observing the universe of informal wages in the economy. Unfortunately, I do not observe the wages of refugees in the HLFS, and I cannot account for the compositional change in the HLFS as it is not a panel of individuals. Instead, I use a back-of-the-envelope calculation to estimate how much the average informal wages in the economy have decreased due to the compositional effects of refugees earning less than natives. Turkish Red Crescent and WFP (2019) survey refugees in Turkey in selected regions and find that refugees earn 1058 TRY on average per month. Most of them are working informally due to the lack of work permits. Using HLFS in 2018 and restricting the data to those regions, I calculate that natives in the informal sector earn 1373 TRY on average per month. Using the 47% salaried employment rate among refugees (Turkish Red Crescent and WFP, 2019) and the 8.5% informal salaried employment rate among natives, I estimate that the average informal wage faced by firms has decrease by 1.23% just from the compositional change due to refugees. The difference between the two wage estimates may be explained by refugees' lowering wages of natives who are not displaced. For example, Figure 9a shows that the wages of low-skill natives in textile industry also go down.

Table E.2 shows how the model performs compared to all of the targeted moments in the data. The model matches most of the moments of the data quite well. In general, there is a larger deviation between model and data in larger firms in contrast to smaller firms.

Table E.2: Model Fit

Moments	Source	Data	Model
Size of firm			
1–9 workers	HLFS and census	4.38	4.32
10–24 workers	HLFS and census	15.36	15.24
25–49 workers	HLFS and census	34.85	34.52
50–249 workers	HLFS and census	98.64	106.10
250–499 workers	HLFS and census	341.22	312.98
Share of informality			
1–9 workers	HLFS	0.59	0.58
10–24 workers	HLFS	0.29	0.28
25–49 workers	HLFS	0.16	0.16
50–249 workers	HLFS	0.071	0.079
250–499 workers	HLFS	0.043	0.038
Ratio of demand elasticities	IV estimates	-3.82	-3.89

F Extended model to explain the results on formal firm entry

In this section, I provide a tractable model that can rationalize the empirical results on firm entry. In particular, I find that whereas refugees increase the formal entry of productive firms (such as traders or incorporated firms) it decreases the formal entry of the least productive firms. In the text, I argue that this change in the productivity distribution of new formal firms is indicative of less productive entrepreneurs to remain unregistered. Here I formalize the economic forces behind this claim in an equilibrium model where firms can exploit both the intensive and extensive margins of informality. The model is based on Ulyssea (2018)'s framework to capture intensive and extensive margins of informality, but also uses some intuition from Melitz (2003) to divide formal firms into trader and non-trader types.

F.1 Baseline Framework

I begin with a closed economy to set notation and intuition, and will introduce exporter firms later. This part follows Ulyssea (2018) closely but presents a more simplified version as the present model will not be estimated with data. Firms are heterogenous and indexed by their individual productivity, θ. They produce a homogenous good using labor as their only input.[39] Product and labor markets are competitive, and formal and informal firms face the same prices. For simplicity, I assume that workers have only one skill type and therefore are perfect substitutes given formality type.[40] I further assume that formal and informal labor are perfect substitutes in production. This is motivated by the large elasticity of substitution I estimate in the main text. On the labor supply side, workers are endowed with either formal or informal labor. Hence, there are natives who can provide only informal labor, and there are natives who can provide only formal labor.[41]

F.1.1 Firms

Both formal and informal firms have access to the same technology. Output of a given firm with productivity θ is given by $y(\theta, \ell) = \theta q(\ell)$, where the function $q(.)$ is assumed to be increasing, concave, and twice continuously differentiable.

Informal firms are able to avoid taxes and labor costs, but face a probability of detection by government officials. This expected cost takes the form of an ad-valorem labor distortion denoted by $\tau_i(\ell)$, which is assumed to be increasing and strictly convex in firm's size ($\tau_i', \tau_i'' > 0$).[42] Informal

[39] By assuming a homogenous good, I abstract away from the demand effects of the refugee shock. I talk about potential extensions at the end of this section.

[40] The main insights of the model carry over to a model with multiple skill types.

[41] This is a reduced-form simplification. One can allow natives to search for both formal and informal jobs, but with heterogeneous productivity in searching for formal jobs. Since I do not have data on transitions from unemployment to formal/informal employment, I won't dive into the details of such a search model. However, the main insights from this model would carry over.

[42] These assumptions can be rationalized, for instance, by the fact that larger firms have a greater probability of being caught.

firms' profit function is given by:

$$\pi_i(\theta, w_i) = \max_{\ell}\{\theta q(\ell) - w_i \tau_i(\ell)\} \tag{15}$$

where the price of the final good is normalized to one.

Formal incumbents must comply with taxes and regulations, but they can hire informal workers to avoid the costs implied by the labor legislation. For formal firms, informal and formal workers are perfect substitutes. The hiring costs of formal and informal workers differ due to (1) different wages (e.g., there can be a binding minimum wage for formal workers), and (2) institutional reasons: formal firms have to pay a constant payroll tax on formal workers, while they face an increasing and convex expected cost to hire informal workers, which is summarized by the strictly convex function $\tau_{fi}(.)$, $\tau'_{fi}, \tau''_{fi} > 0$. The cost of hiring ℓ informal workers is given by $\tau_{fi}(\ell)w_i$, while the cost of hiring ℓ formal workers is $(1+\tau_w)w_f\ell$, where τ_w is the payroll tax.

Formal firms' profit function can be written as follows:

$$\pi_f(\theta, w_i, w_f) = \max_{\ell_i, \ell_f}(1-\tau_y)[\theta q(\ell_i + \ell_f) - \tau_{fi}(\ell_i)w_i - (1+\tau_w)w_f\ell_f] \tag{16}$$

where τ_y denotes the corporate tax. Formal firms maximizing profits reveals the demand for formal labor as a function of informal wages w_i, formal wages w_f, and productivity θ. The demand for informal workers come both from informal firms and formal firms.

Becoming a formal firm introduces the technology to hire workers formally with constant marginal costs as opposed to informally with increasing marginal costs. Hence, more productive firms that want to hire more workers become formal.

F.1.2 Entry

There are two periods. In period 1, a large mass $\mathcal{M}$ of potential entrants observe their productivity, which is distributed according to the cdf G. To enter either sector, firms must pay a fixed cost that is assumed to be higher in the formal sector: $E_f > E_i$. If firms enter either sector, they can hire labor to produce and sell the final good in period 2.

As there is only one period after entry, firm's value function assumes a clean form:

$$V_s(\theta, w_i, w_f) = \pi_s(\theta, w_i, w_f) \quad ; \, s \in \{i, f\}$$

Potential entrants choose between three options. They can choose not to enter and receive zero payoff, enter the informal sector by paying entry cost E_i, or enter the formal sector by paying E_f. Given the value functions, a potential entrant with productivity θ decides to:

- enter into the formal sector if $V_f(\theta, w_i, w_f) - E_f > max\{V_i(\theta, w_i) - E_i, 0\}$
- enter into the informal sector if $V_i(\theta, w_i) - E_i > max\{V_f(\theta, w_i, w_f) - E_f, 0\}$
- not enter into either sector otherwise

Figure F.1: ZPC and free-entry

$$0 \;\underbrace{\qquad\qquad\qquad}_{\text{No entry}}\; \overline{\theta_i} \;\underbrace{\qquad\qquad\qquad}_{\text{Informal Entry}}\; \overline{\theta_f} \;\underbrace{\qquad\qquad\qquad}_{\text{Formal Entry}}\; \infty$$

If entry in both sectors is positive, the following entry-conditions must hold:

$$\begin{aligned} V_i(\overline{\theta_i}, w_i, w_f) &= E_i \\ V_f(\overline{\theta_f}, w_i, w_f) &= V_i(\overline{\theta_f}, w_i) + (E_f - E_i) \end{aligned} \tag{17}$$

where $\overline{\theta_i}$ and $\overline{\theta_f}$ are the productivity of firms that are at the margin of entering into informal and formal sectors, respectively. The least productive entrepreneurs with productivity $\theta < \overline{\theta_i}$ choose not to enter. Firms with productivity $\theta \in [\overline{\theta_i}, \overline{\theta_f}]$ are productive enough to make positive profits and prefer the informal sector over formal sector. The more productive firms with productivity$\theta > \overline{\theta_f}$ want to hire many workers, which is too costly to do in the informal sector due to the convex costs of hiring. In this model, the ability to hire workers with constant marginal cost is the only reason why firms wish to become formal. The sorting of firms into no entry, informal entry, and formal entry brackets based on their productivity draws is plotted in Figure F.1. The mass of new formal firms is given by $(1 - \overline{\theta_f})\mathcal{M}$.

F.1.3 Equilibrium

To close the model, I need to specify the labor supply. Let $L_i^{N,S}(w_i)$ and $L_f^{N,S}(w_f)$ be the informal and formal labor supply curves of natives.[43] Since formal and informal workers are substitutes, the labor demand for workers in one sector depends on the wages in both sectors. In equilibrium, labor markets must clear: informal and formal wages are such that labor supply equals labor demand.

$$\begin{aligned} L_i^S(w_i) &= L_i^D(w_i, w_f) \\ L_f^S(w_f) &= L_f^D(w_i, w_f) \end{aligned} \tag{18}$$

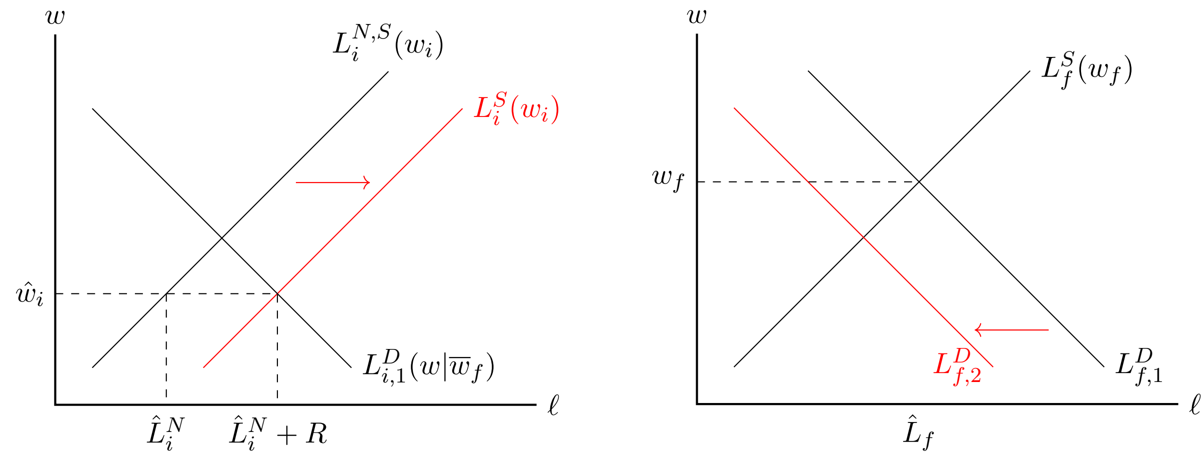
To summarize, the equilibrium conditions are given by the following conditions: (i) in period 1, the zero profit cutoff and free entry conditions hold in both sectors; and (ii) in period 2, labor markets clear. Product market clearing comes freely from the Walras' Law.

F.1.4 Effects of an informal labor supply shock

As in most refugee crises in the developing world, the overwhelming majority of Syrian refugees in Turkey did not have work permits. In the model, this will be captured by an increase in the informal labor supply. Figure F.2 shows how the refugee labor supply impacts the labor market equilibrium in this model. The left panel shows the equilibrium for informal workers and the right

[43] Labor supply curves being independent of the wages in the other sector comes from natives having either formal or informal labor endowment. Relaxing this assumption would not change the predictions of the model.

Figure F.2: Equilibrium with informal labor supply shock



(a) Informal Sector

(b) Formal Sector

Notes: For illustrative purposes, I assume the formal wage is fixed by a binding minimum wage. Otherwise, a decrease in the effective formal wage would also push the informal labor demand curve slightly upwards.

panel shows the equilibrium for formal workers. For ease of exposition, I assume that refugees supply labor inelastically. This results in a parallel shift in the informal labor supply curve, causing (1) a decline in informal wages, (2) a decline in native informal employment, and (3) an increase in the aggregate informal employment. Since formal and informal workers are substitutes, the decrease in the informal wages incentivizes formal firms to rely more intensively on informal workers. This shifts the formal labor demand curve inward. As firms reduce their demand for formal workers, the amount of native formal employment decreases, despite refugees being unable to work formally.

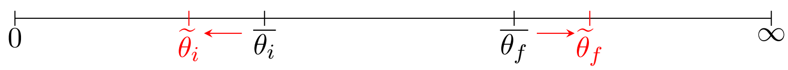
In the main text I argue that an increase in population should create more firms due to market size effects. This could be due to both more people demanding goods and services (the demand side), and the entrepreneurial potential of immigrants. Since the price of the final good is normalzied to one, this model cannot incorporate the demand channel. This channel will be introduced in the next subsection. However, this model can incorporate immigrants' shock on the size of potential entrepreneurs by changing the mass of potential entrants $\mathcal{M}$. As the number of new formal entrants is given by $(1 - \overline{\theta_f})\mathcal{M}$, increasing $\mathcal{M}$ increases new firm formation.

In the main text I show that despite a large increase in the total population refugees do not cause an increase in the number of new formal firms in the aggregate. I argue that this is due to informal refugees incentivizing the marginal new firms to remain informal instead. In this model, if access to informal workers is not easier for formal firms, it is easy to prove the following result:

Proposition. *The informal labor supply increase incentivizes firms to enter the informal sector instead of the formal sector. Formally,* $\frac{d\overline{\theta_f}}{dR} > 0$*, where R denotes the number of refugees in the economy.*

The intuition behind the proof is that the informal firm is more informal labor intensive. Hence, a decrease in wages for informal labor disproportionately increases the informal firm profits. Consequently, the marginal firm strictly prefers the informal sector as it provides easier access to informal labor. This effect is visualised in figure F.3.[44]

Figure F.3: Effect of Informal LS on the extensive margin



To sum up, the null effect in the total number of new firms can be rationalized by two opposing forces cancelling each other out. Refugees increase the mass of potential entrepreneurs, $\frac{\partial \mathcal{M}}{\partial R} > 0$, and they incentivize marginal firms to remain in the informal sector: $\frac{\partial \overline{\theta_f}}{\partial R} > 0$. As the mass of new entrants is given by $(1 - \overline{\theta_f})\mathcal{M}$, these two forces oppose each other. A testable prediction of this model is that the number of informal firms, which is given in the model by $(\overline{\theta_f} - \overline{\theta}_i)\mathcal{M}$, should definitely increase.

This prediction of the model has significant implications regarding refugee crises. The current debate about the work permit status of refugees trades off the benefits of refugees becoming self-reliant (instead of relying on government resources) with native disemployment if refugees could work freely. This debate completely ignores the existence of an informal sector that absorbs the informal refugee labor supply. Taking firms' decision to be informal both on intensive and extensive margins rigorously reveals that by not allowing refugees to work formally, host countries are incentivizing firms to become more informal. This may have several implications, including decrease in tax revenue

F.2 Extension with exporter firms

F.2.1 Firms

Informal firms cannot participate in the exports market, and hence have to sell domestically for price p. Informal firms' profit function is now given by $\pi_i(\theta, \ell_i) = \{p\theta q(\ell_i) - w_i\tau_i(\ell_i)\}$. Formal firms can participate in the export market. I assume a small, open economy where the local production or demand does not affect the international price $\bar{p} > p$, which is normalized to one. This simplifying assumption implies that for exporter firms, selling abroad is always more profitable than selling domestically. Consequently, non exporter firms sell only to domestic consumers, and exporter firms sell solely to international markets.[45] Hence, formal firms' profit function is given by:

$$\pi_f(\theta, \ell_i, \ell_f) = \begin{cases} p\theta q(\ell_i + \ell_f) - w_i\tau_{fi}(\ell_i) - w_f\ell_f & \text{if non-exporter} \\ \theta q(\ell_i + \ell_f) - w_i\tau_{xi}(\ell_i) - w_f\ell_f & \text{if exporter} \end{cases} \tag{19}$$

[44] An untestable prediction of the model due to lack of data is that the decrease in informal wages should also increase the number of informal firms by allowing unproductive entrepreneurs to enter the informal sector instead of not creating any firm.

[45] This unrealistic assumption is to simplify the model. This could be relaxed by introducing a continuum of unique goods where producers value variety a la Melitz (2003), but this would introduce additional parameters to the model without adding much to the intuition that I aim to capture.

where τ_{si} denotes the costs of hiring informal workers for firms with type s. As multinatonal firms sourcing from developing countries often try to enforce local labor laws on their suppliers, I assume that it is costlier for exporter firms in Turkey to hire informal workers at the margin: $\tau'_{xi}(\ell) > \tau'_{fi}(\ell)$. For notational simplicity, I denote the profit function of the non-exporter and formal firm by π_f and that of the exporter firm by $\pi_x(\theta)$.

Introducing exporter firms serve two purposes. Mechanically, it introduces a second price that is set by the international markets, and hence unaffected by refugees. This enables me to model refugees' demand effect in a straight-forward way (Borjas, 2014). Second, it divides the set of (formal) entrepreneurs into two groups: those who are productive enough to export and others. This distinction helps separate the labor supply and entrepreneurial effects of refugees in a testable way, which will become apparent once I close the model.

F.2.2 Entry

Entry is similar to the baseline model. There is a large mass $\mathcal{M}$ of potential entrants who observe their productivity $\theta \sim G$. Entering the formal sector costs more than entering the informal sector: $E_f > E_i$. Additionally, becoming an exporter requires a fixed cost of entry a la Melitz (2003). Let E_x denote the total cost of becoming an exporter firm. Naturally, $E_x > E_f$.

As there is only one period after entry, firm's value function assumes a clean form $V_s(\theta) = \pi_s(\theta, w_i, w_f)$, where I suppress the wages in the value function for notational simplicity, and $s \in \{i, f, x\}$. Potential entrants choose between four options. They can choose not to enter and receive zero payoff, enter the informal sector by paying entry cost E_i, enter the formal sector as a non-exporter by paying E_f, or enter the exports market by paying E_x. Given the value functions, a potential entrant with productivity θ decides to:

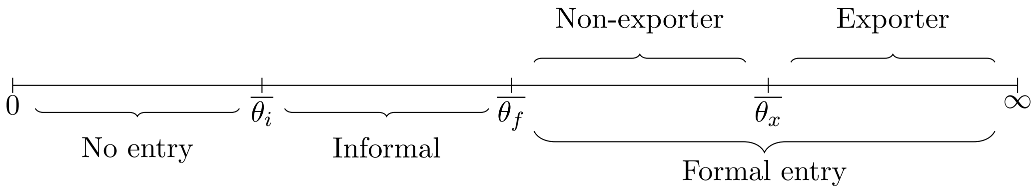
- enter into the export market if $V_x(\theta) - E_x > max\{V_f(\theta) - E_f, V_i(\theta) - E_i, 0\}$
- enter into the formal sector if $V_f(\theta) - E_f > max\{V_x(\theta) - E_x, V_i(\theta) - E_i, 0\}$
- enter into the informal sector if $V_i(\theta) - E_i > max\{V_x(\theta) - E_x, V_f(\theta) - E_f, 0\}$
- not enter into either sector otherwise

If entry in all sectors is positive, the following entry-conditions must hold:

$$\begin{aligned} V_i(\overline{\theta_i}) &= E_i \\ V_f(\overline{\theta_f}) &= V_i(\overline{\theta_f}) + (E_f - E_i) \\ V_x(\overline{\theta_x}) &= V_f(\overline{\theta_x}) - (E_x - E_f) \end{aligned} \tag{20}$$

where $\overline{\theta_i}$, $\overline{\theta_f}$, and $\overline{\theta_x}$ are the productivity of firms that are at the margin of entering into informal, formal, and exporter sectors, respectively. The sorting of firms into no entry, informal, formal, and exporter sectors based on their productivity draws is plotted in Figure F.4. As in Melitz (2003), the most productive firms enter the export market to sell at a higher international price.

Figure F.4: ZPC and free-entry with exports



F.2.3 Equilibrium

To close the model, I need to specify the labor supply and the domestic product demand. Let $L_i^{N,S}(w_i)$ and $L_f^{N,S}(w_f)$ be the informal and formal labor supply curves of natives. Let $w \coloneqq \{w_i, w_f\}$ denote the vector of wages. In equilibrium, wages are determined such that the formal labor demand equals formal labor supply, and vice versa for the informal workers.

$$\begin{aligned} \int_{\overline{\theta_i}}^{\overline{\theta_f}} \ell_{i,i}^d(\theta, p, w_i) dG(\theta) + \int_{\overline{\theta_f}}^{\overline{\theta_x}} \ell_{f,i}^d(\theta, p, w) dG(\theta) + \int_{\overline{\theta_x}}^{\infty} \ell_{x,i}^d(\theta, p, w) dG(\theta) &= L_i^S(w_i) \\ 0 + \int_{\overline{\theta_f}}^{\overline{\theta_x}} \ell_{f,f}^d(\theta, p, w) dG(\theta) + \int_{\overline{\theta_x}}^{\infty} \ell_{x,f}^d(\theta, p, w) dG(\theta) &= L_f^S(w_f) \end{aligned} \tag{21}$$

Unlike the baseline model, product market clearing no longer comes free. Let the domestic product demand be given by $C(p)$. Let $q_s(\theta, p, w)$ denote the optimal production of firm with productivity θ in sector s for given price p and wages $w \coloneqq \{w_i, w_f\}$. In equilibrium, domestic product supply and demand determines the domestic price p.

$$\int_{\overline{\theta_i}}^{\overline{\theta_f}} q_i(\theta, p, w) dG(\theta) + \int_{\overline{\theta_f}}^{\overline{\theta_x}} q_f(\theta, p, w) dG(\theta) = C(p) \tag{22}$$

To summarize, in equilibrium (i) the zero profit cutoff and free entry conditions hold; (ii) labor markets clear, (iii) domestic product markets clear.

F.2.4 Labor supply, product demand, and entrepreneurial effects of refugees

This model is rich enough to incorporate the empirical facts that refugees work, consume goods and services, and form businesses themselves. Let R denote the amount of refugees in the economy. Refugees' labor supply effect is captured by $\frac{dL_i^S(w_i)}{dR}$, the same way as the baseline model. Refugees' product demand effect can be captured by an increase in the consumer base, $\frac{dC(p)}{dR}$. Lastly, the fact that refugees can form businesses is captured by a change in the mass of potential entrepreneurs $\frac{dM}{dR}$. Quantifying these channels is outside of the scope of this paper.[46]

[46] Moreover, it is virtually impossible without more data on the number of informal firms and their sizes. Interested reader can look at Ulyssea (2018) to ratio of unregistered firms given a size group can help identify the parameters of a similar model.

The purpose of this model is to show how refugees can lead to an increase in the number of exporter firms without increasing the number of less productive, non-trader firms. The model can achieve this by a combination of two effects. First, entrepreneurial effects of the immigration shock increases firm formation throughout the productivity distribution. Second, the decrease in informal wages due to the informal labor supply increases informal firm entry, has an ambiguous effect on formal non-trader firm entry, and decreases exporter firm entry. There is a set of parameters for which the entrepreneurial effect dominates the labor supply effect for exporter firms; and vice-versa for formal non-trader firms. This can happen, for example, if the marginal non-trader firm is big enough that it hires very few informal workers, hence a decrease in informal wages has only negligible effects on the firm. In contrast, the marginal informal firm hires only informal workers and a decrease in informal wages benefit her immensely. In that scenario, the informalization effect can dominate the entrepeneurial effect.

Providing exact closed form solutions to these claims is infeasible given the integrals in product and labor market clearing conditions. Instead, I provide some comparative statics on Table F.1 and explain the intuition behind each effect.

Table F.1: Comparative Statistics

	w_i	w_f	p	$\overline{\theta_i}$	$\overline{\theta_f}$	$\overline{\theta_x}$
Informal Labor Supply	-	-	-	-	+	+
Product Demand	+	+	+	-	-	+
Entrepreneurial Activity	+	+	-	+	+/-	+/-

An informal labor supply decreases both informal and formal wages w_i, w_f, decreases the price of the domestic product p, decreases the cutoff informal productivity $\overline{\theta_i}$, increases the cutoff formal productivity $\overline{\theta_f}$, and increases the cutoff exporter productivity $\overline{\theta_x}$. The effects on the wages are straightforward and similar to the baseline model. An increase in labor supply decreases informal wages. As formal and informal labor are perfect substitutes, decrease in informal wages necessarily shrings down formal labor demand and reduce formal wages. As firms face lower production costs, they produce more. The increase in domestic good supply lowers its price p. The marginal firm between no entry and informal entry starts making positive profits as its costs go down: $\overline{\theta_i}$ goes down. As the marginal firm between informal and formal sectors hires more informal workers as an informal firm than its formal non-trader version, it benefits more from a decrease in informal wages as an inform firm. Hence the threshold for becoming formal increases: $\overline{\theta_g}$ goes up. Lastly, if the marginally exporter firm hires fewer informal workers than its formal non-exporter version (e.g., because multinational firms push suppliers to abide by local laws), then the decrease in informal wages further pushes the productivity threshold of becoming and exporter further.

Immigrants demanding more domestically produced goods and services increases the demand for goods, which increases its price p. As p increases, workers become effectively more productive, which increases the labor demand, and therefore the wages, in both the informal and formal sectors. The zero-profit making marginal firm starts making profit as price goes up, which lowers the entry threshold $\overline{\theta_i}$.[47]. Similarly, the formal version of the marginal firm between informal and formal sectors produces more. An increase in price benefits the formal firm more, which lowers the threshold of becoming formal. Lastly, the increase in domestic price benefits non-trader firms and does not impact trader firms, which increases the threshold of becoming an exporter.

Immigrants' increasing the mass of potential entrants increases the labor demand, which increases the informal wage w_i and formal wages w_f. More firms produce more goods, which increases the product supply, which then decreases the price of the domestic good p. As the price of the final good goes down and production costs go up, the marginal entrant makes negative profits. Consequently, the threshold for entering the informal sector $\overline{\theta_i}$ increases. The effects on $\overline{\theta_f}$ and $\overline{\theta_x}$ cannot be signed. Consider the marginal trader/non-trader firm $\overline{\theta_x}$. The exporter version is not impacted by the price change, but the non-exporter loses profits. Both are impacted by the increase in wages. However, how much more labor the exporter firm hires depends on the price difference between the international and domestic markets $1 - p$ and the differences in entry costs $E_x - E_i$. If the exporter and non-exporter versions hire similar amounts of people, then the price effect dominates and the threshold for becoming exporter $\overline{\theta_x}$ goes down.

It is worth noting that in this model, both the labor supply and the product demand effects of immigrants decreases the number of exporter firms. However, they differently impact the number of non-trader formal firms. However, only the entrepreneurial activity of refugees can create more exporter firms.

To sum up, the fact that the number of exporter firms increases while non-trader firms do not can be rationalized by a combination of refugees' entrepreneurial activity (which increases firm entry throughout), and the decrease in informal wages due to the informal labor supply, which incentivizes marginal firms to remain unregistered.

[47]The effect via increase in wages is second order

G Alternative Identification Strategies and Contentious Findings

As described in the introduction, several papers investigated the effects of the Syrian refugees on the Turkish labor markets. Using different identification strategies, this literature mostly found inconclusive results. Del Carpio and Wagner (2015); Ceritoglu et al. (2017); Aksu et al. (2022) all document a decline in informal employment among natives as a consequence of the refugee shock, which is the only unchallenged result in this body of work. Del Carpio and Wagner (2015) find an increase in formal employment, but only for low-skill men. However, using the same dataset Akgündüz and Torun (2020) claim instead that high-skill employment (which is mostly formal) has increased. Across men and women, Aksu et al. (2022) argue that refugees lead to an increase in formal employment for men, and a decrease for women. Their results are challenged by Erten and Keskin (2021), who find a decrease in employment only for women and not for men. Using a generalized synthetic control method to adjust for pre-trends, Cengiz and Tekgüç (2022) claim that there was no employment loss among natives due to the refugee shock. Table G.1 summarizes the information on identification strategies, pre-trend adjustments if any, time-periods, and conclusions relevant to this paper.

I argue in the paper that these opposing findings on native employment result from a combination of (1) not separating employment into components that are governed by different economic forces, mainly salaried and non-salaried employment, and (2) not accounting for pre-trends in the IV-DiD design. Here, I provide more evidence to these claims. I first explain the shortcomings of the identification strategies of especially the earlier set of papers on this topic. Then, I explain how my results can help unify otherwise seemingly confounding papers in the literature.

G.1 The pre-trends in the IV-DiD design

The earlier papers in this body of work did not check for, and therefore account for, pre-trends in the data (Del Carpio and Wagner, 2015; Tumen, 2016; Ceritoglu et al., 2017). Consequently, their findings are mostly driven by the bias from the pre-trends. For example, it is true that in the period they looked that, 2010–2013 for Tumen (2016); Ceritoglu et al. (2017) or 2011-2014 for (Del Carpio and Wagner, 2015), the employment rate of low-skill natives has increased more in the southeast regions of Turkey. However, a larger increase was present between 2004–2010, which was missed by these earlier set of papers.

Aksu et al. (2022) is the first paper that checks for, and therefore finds these pre-trends. They employ two strategies to account for these unobserved confounders: (1) controlling for linear trends in a nonsaturated IV regression which results in linear trends being estimated using the post-treatment data, and (2) controlling for aggregate region-year fixed effects. The latter strategy is also subsequently employed by Akgündüz and Torun (2020). In this subsection, I show that these strategies do not reduce the amount of bias in the Turkish setting. In fact, they can even exacerbate the bias. Consequently, these papers find opposing results to each other and to my paper predominantly due to the presence of pre-trends.

Table G.1: Papers studying the effect of Syrian Refugees on Turkish Labor Markets

Paper	Strategy	Pre-trend adjustment	Time-period	Relevant conclusion
Del Carpio and Wagner (2015)	IV-DiD	None	2011 and 2014	Decrease in informal employment and increase in formal employment
Tumen (2016)	DiD	None	2010–2013	Decrease in informal employment and increase in formal employment
Ceritoglu et al. (2017)	DiD	None	2010–2013	Decrease in informal employment and increase in formal employment
Akgündüz et al. (2023)	IV-DiD	Aggregate region-year f.e.	2010–2015	Increase in natives' task complexity of high-skill natives
Erten and Keskin (2021)	IV-DiD	None	2006–2014	No impact among men, decrease in employment among women
Aksu et al. (2022)	IV-DiD	Aggregate region-year f.e. & linear trends using post data	2004–2015	Decrease in informal employment, increase in formal employment for men, decrease in formal employment for women
Cengiz and Tekgüç (2022)	SC	SC	2004–2015	No effect on employment of natives

G.1.1 The pitfalls of controlling for aggregate region-year fixed effects in Turkey

The labor force statistics in Turkey are representative at 26 NUTS-2 level. Let i denote a region at NUTS-2 level. Controlling for aggregate region-year fixed effects boils down to finding/defining broader region categories $k \in K$, and adding interaction terms between K regions and T time periods. We can estimate the following nonparametric event study design to see whether the additional control variables help eliminate the pre-trends in the data.

$$y_{i,t} = \sum_{j \neq 2009} \theta_j (\text{year}_j \times Z_i) + f_k * f_t + f_i + \eta_{i,t} \tag{23}$$

where f_k is an aggregate region indicator, f_i, f_t are region and year fixed effects. Aksu et al. (2022) use two different aggregate region definitions: 12 NUTS-1 regions defined by Turkstat, and a broader 5-region categorization defined by the authors. Following their terminology, I use NUTS-0 to define this categorization. I estimate this equation using NUTS-0 and NUTS-1 region-year fixed effects. I focus on the estimates on formal salaried employment of low-skill men since it is a key outcome in which our papers find opposite results. Figure G.1 shows the results. Panel A displays the event study estimates while controlling for region-year fixed effects at NUTS-0 level, Panel B at NUTS-1 level, and Panel C repeats the design I employ in the main text. Notice that controlling for region-year fixed effects do not eliminate the pre-trend in the data. If anything, they actually increase the bias in the estimates. This can be seen by comparing the estimates before 2010 in Panels A-B with those in Panel C. Using the design with region year fixed effects, a one standard deviation increase in the instrument predicts an increase in formal salaried employment between 2004—2010 by 2 pp, and no change between 2010—2016. Consequently, their IV-DiD design finds that refugees increase natives' formal employment by (1) estimating a null effect in the post period, (2) estimating negative coefficients in the pre-period, and (3) subtracting the null in the post with the negative in the pre-period, which results in a positive estimate. This is unlikely to be attributable to refugees.

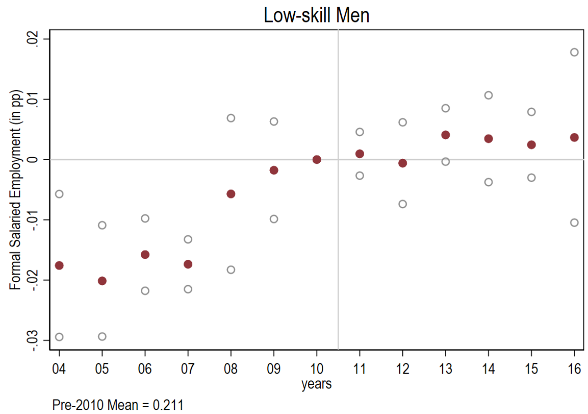
G.1.2 Adjusting for linear trends in a nonsaturated regression

Another approach that Aksu et al. (2022) used is to control for linear trends inside a nonsaturated regression. To be more precise, after defining the inverse-distance share Z_i, Aksu et al. (2022) define a shift-share instrument by interacting the shares with the total number of refugees in Turkey in a given year.

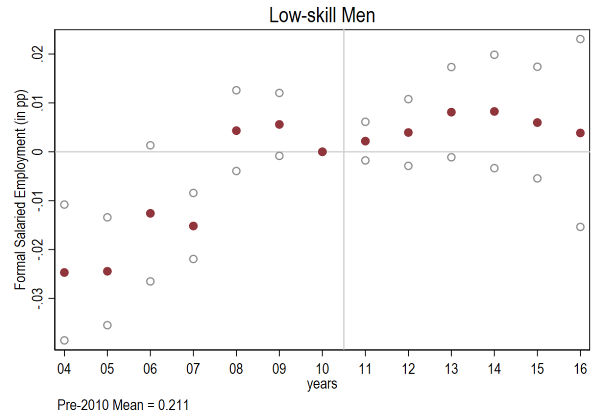
$$Z_{it} = \underbrace{H_t}_{\text{shift}} \times \underbrace{Z_i}_{\text{share}}$$

where H_t denotes the total number of refugees in year t. The idea is that as more refugees come to Turkey (H_t increases), more refugees are distributed across Turkey and the number of refugees per native in each province increases (i.e., R_{it} increases). Then, they use this shift-share instrument

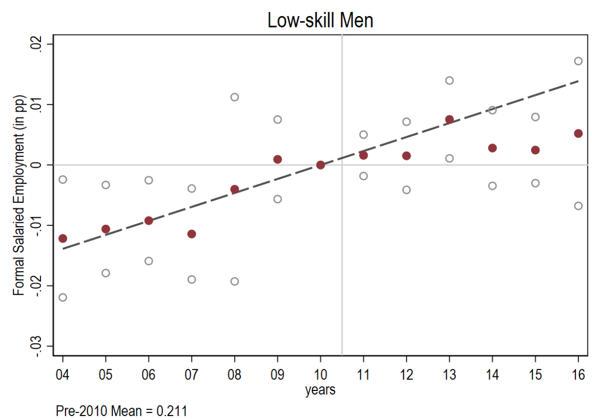
Figure G.1: Comparison of identification strategies in the literature: region*year fixed effects



(a) Nuts0-year fixed effects



(b) Nuts1-year fixed effects



(c) The preferred linear trend method

Notes: NUTS-1 categories are taken from Turkstat, NUTS-0 definitions are taken from Aksu et al. (2022). In the preferred method, the nonparametric estimates are plotted together with the linear trend that is estimated using the parametric event study design.

inside the IV regression:

$$\begin{aligned} y_{it} &= \beta R_{it} + f_i + f_t + f_i * t + \epsilon_{it} \\ R_{it} &= Z_{it} + g_i + g_t + g_i * t + \eta_{it} \end{aligned} \tag{24}$$

where $f_i * t$ is the region-specific linear trend in the structural equation, and $g_i * t$ is the region-specific linear trend in the first stage.

This design has two flaws. First, it estimates the structural linear trend with bias by estimating the slope of the trend using both pre and post treatment data. Second, it also creates a pseudo-treatment in the pre-period by fitting a linear trend in the first stage. I explain these two biases below.

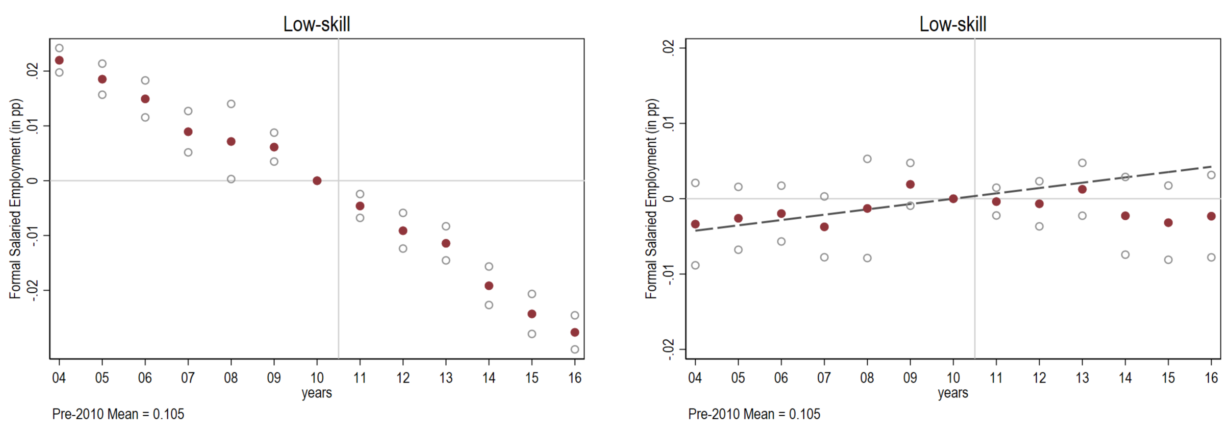
The first issue is not a new problem. The pitfalls of controlling for region-specific linear trends with limited pre-treatment data goes back to Wolfers (2006), who writes: "A major difficulty in difference-in-difference analyses involves separating out preexisting trends from the dynamic effects of a policy shock. [...] This problem —that state specific trends may pick up the effects of a policy and not just pre existing trends— is quite general." This problem is the reason why I follow the strategy employed by Dobkin et al. (2018) and estimate both nonparametric and parametric event-study designs for inference.

To provide visual evidence for this pitfall in the current setting, I estimate the following event study design while controlling for region-specific linear trends inside the nonsaturated regression.

$$y_{i,t} = \sum_{j \neq 2009} \theta_j(\text{year}_j \times Z_i) + f_i * t + f_i + f_t + \eta_{i,t} \tag{25}$$

where $f_i * t$ is the region-specific linear trend. I estimate this equation where the outcome variable is the formal employment of low-skill natives. Figure G.2 compares these estimates with the estimates from the preferred design. Notice that controlling for linear trends in the nonsaturated regression exacerbates the bias.

Figure G.2: Comparison of identification strategies in the literature: linear trend



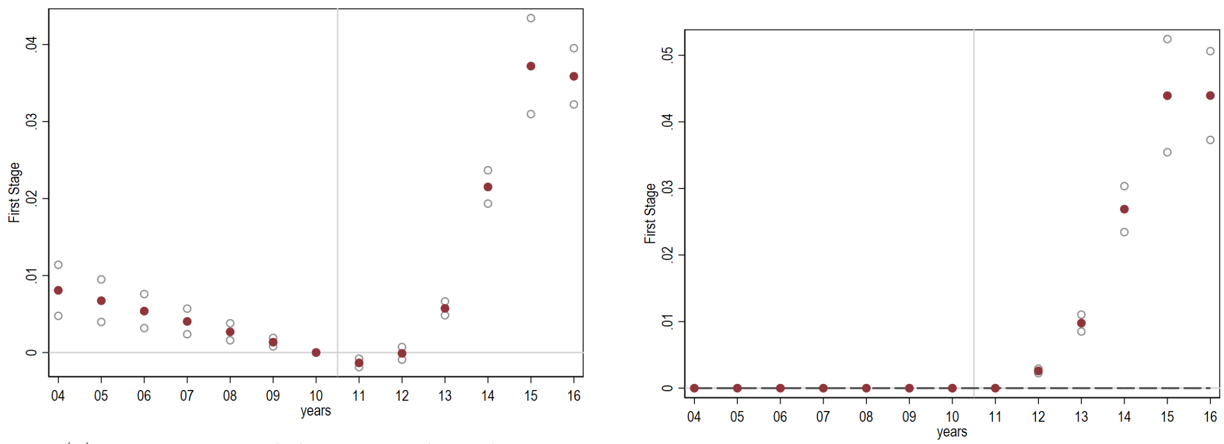
(a) Nonsaturated linear trends

(b) The preferred design

Notes: In Panel A, a different linear trend is estimated for each NUTS-2 region. In the preferred method, the nonparametric estimates are plotted together with the linear trend that is estimated using the parametric event study design.

The second problem appears in the first stage. As the treatment intensity is zero before 2011 and starts monotonically increasing after, the linear trend in the first stage obtains a positive slope. Consequently, the first stage regression estimates a pseudo treatment: a change in the predicted treatment intensity before the treatment begins. To show this, I estimate equation 25 where the outcome variable is the refugee treatment intensity. Figure G.3 compares the nonparametric first stage estimates using both this design in Panel A and the preferred design in Panel B. Notice that controlling for linear trends in a nonsaturated model results in a pseudo first stage in the years before the treatment. In contrast, the preferred strategy correctly estimates a linear trend with a slope of zero.

Figure G.3: Comparison of identification strategies in the literature: first stage estimates



(a) First stage with linear trends within nonsaturated regression

(b) First stage in the preferred design

Notes: In Panel A, a different linear trend is estimated for each NUTS-2 region. In the preferred method, the nonparametric estimates are plotted together with the linear trend that is estimated using the parametric event study design.

G.2 Explaining differences in interpretation of findings

The previous subsection shows the shortcomings of the prior attempts at adjusting for pre-trends in the data. Adjusting for linear trends in a more defensible way yields more directly interpretable estimates, such as refugees' negative effects on low-skill natives' formal and informal salaried employment. Yet, this does not fully explain the wide range of disagreements in the literature. Below I briefly compare my results to two other papers on this domain whose main results I do not disagree with but whose interpretation of the results I disagree with.

Erten and Keskin (2021) argue that refugees hurt only women's employment opportunities and not men's. They support their claim by showing nonparametric event study estimates of the distance instrument's effect on women's and men's overall employment rates. As the instrument does not predict any change in the pre-period in these two outcomes they look at, their estimates are likely consistent. My design replicates their findings. Hence, we differ not in what we find but in our interpretation. For example, we both find that refugees' do not lower men's overall employment rates but they lower women's. They interpret this finding as refugees' impacting only women's labor market opportunities, which is a first stage in their investigation of the effect of women's earnings on gender-based violence. In contrast, I show that men's labor market opportunities are impacted similarly to women's: both lose salaried jobs in the informal and formal sectors. Men's transition to non-salaried employment *hides* refugees' effect on the aggregate employment statistics.

Cengiz and Tekgüç (2022) use a Synthetic Control methodology as opposed to instrumenting for immigrants' location choice. They do not find adverse employment effects of refugees on natives. They conclude that the demand effect of immigrants offset their labor supply effects. It is standard in the literature of immigration to instrument for immigrants' location choice when they can choose where to locate Card (2009). An in depth comparison of SC and IV methodologies in the study of immigration's effect on labor markets is beyond the scope of this paper. However, it is important to highlight that the null result on refugees' effect on natives' overall employment is due to statistical imprecision. Separating the effects across men and women (like Erten and Keskin (2021)), low-skill and high-skill, informal and formal, salaried and non-salaried employment, or industries, all enable the researcher to detect refugees' negative effects on natives employment outcomes.