Micro- and Macroeconomic Impacts of a Place-Based Industrial Policy

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May 30, 2022

Abstract

We investigate the impact of a set of place-based subsidies introduced in Turkey. These policies were introduced in 2012 with the aim of spurring investment and reducing regional income inequality, and include a mix of investment tax credits and reduced mandatory social security contributions. Using firm-level balance-sheet data along with data on the domestic production network, we first assess the direct and indirect impacts of the 2012 subsidy program. We find an increase in economic activity in industry-province pairs that were the focus of the subsidy program, and positive spillovers to the suppliers and customers of subsidized firms. With the aid of a dynamic multi-region, multi-industry general equilibrium model, we then assess the program's aggregate impacts. We find that subsidies reduced regional real wage inequality, but only modestly. These modest effects are due to the ability of households to migrate in response to the subsidy program and input-output linkages that traverse subsidy regions within Turkey.

JEL Codes: D57, F16, H25, J38, R12

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1 Introduction

Incomes differ markedly within countries. In the United States, for instance, 2020 income per capita in the richest metro area (Midland, Texas) was more than four times greater than in the poorest (McAllen, Texas).[1] In Turkey, the focus of this paper, differences in economic activity are at least as stark.[2] While some of the spatial differences in income per capita reflect variation in workers' human capital, a large portion is due to inequality in economic opportunities. These differences are pervasive, highly persistent, and, when left unchecked, undermine social cohesion (Tabellini, 2010; Algan and Cahuc, 2014).

In response to these types of disparities, governments have implemented a wide range of place-based subsidies. But to what extent do these policies benefit those residing in the targeted region? As is well appreciated, place-based subsidies may (by increasing local land prices) benefit landowners (who may or may not reside within the targeted area.) Less well appreciated, since firms' customer and supplier networks extend beyond their localities, and since finding and developing relationships with new trading partners is costly, place-based policies may benefit firms outside of the regions that governments target. Finally, to the extent that workers may migrate in response to the introduction of place-based policies, shifts in labor supply may mitigate some of the place-based policy's impact on regional income inequality.

This paper examines the impact of a prominent place-based policy. In 2012, with Law 2012/3305, the Turkish government introduced a new system of investment subsidies. With levels of generosity varying by province, and with eligibility varying by industry, firms could benefit from a combination of reduced corporate income tax rate, social security payment assistance, and interest rate subsidies on private loans. In the context of Law 2012/3305, we ask: To what extent did this subsidy system increase economic activity among firms directly impacted by the scheme? Second, how large were spillovers, through the production network, to the suppliers and customers of firms who were directly impacted: To what extent do spillovers extend to customers and suppliers beyond the regions targeted by the Turkish government? Finally, what were the aggregate short-run and long-run implications of the subsidy scheme: To what extent did the new subsidies reduce inequality between the relatively poor southeast and the relatively prosperous west of the country?

We address these questions with detailed data on firms' take-up of individual subsidy items; their revenues, investment, employment, and other balance-sheet information; and their customer and supplier relationships. We supplement these data with information on migration flows across

[1]These figures are taken from the Local Area Personal Income dataset (Bureau of Economic Analysis, 2021). Per capita income in the two metropolitan areas are \$124,667 and \$31,153, respectively.

[2]In 2020, GDP per capita in İstanbul, in the northwest of the country, was 4.8 times greater than in Şanlıurfa, a province bordering Syria in the southeast (Turkish Statistical Institute, 2021a). Throughout the paper, we apply a Turkish alphabet to write Turkish cities and provinces.

regions. Each of these pieces of information is critical. Data on statutory subsidy rates, subsidy take-up, and firm-level measures of economic activity are necessary to evaluate the direct firm-level impact of the new subsidy scheme. Data on buyer-supplier relationships allow us to track indirect spillovers throughout the production network. Data on migration are critical towards understanding whether worker flows act as a countervailing force of the new subsidies on regional wage inequality.

We begin our analysis by considering the time paths of revenues, employment, and firm counts at the industry and province level, comparing economic activity in province-industry pairs with differential exposure to the subsidies. We first check for pre-trends: We confirm that industry-province pairs eligible for exceptionally generous subsidies after the subsidies were introduced did not systematically grow quickly (or slowly) in the years prior to 2012. We then document that industry-province pairs receiving high levels of subsidization had exceptionally strong growth in firm entry, employment, and revenues. Next, we exploit our firm-level balance-sheet data, assessing whether subsidized firms directly increased their revenues, employment, and productivity: At the firm-level, we find that a 5 percentage point increase in the investment tax credit subsidy rate corresponds to a 16.0 percent increase in revenues, an 8.3 percent increase in employment, and a 3.2 decrease in marginal costs.[3] We then explore how the spillover effects develop and propagate over the firm network. The indirect effects through the production network are sizable, though meaningfully smaller than the direct effects. A 5 percentage point increase in the fraction of a firm's suppliers and customers who are subsidized corresponds to a 0.3 percent decrease in its marginal costs.

In the final step of our analysis, we explore the aggregate implications of the 2012 subsidy program. To do so, we calibrate the dynamic multi-region multi-industry general equilibrium model introduced by Caliendo et al. (2019). We find that the subsidy program was only modestly successful in reducing inequality between the relatively under-developed and more prosperous portions of the country. According to our benchmark calibration, in which we apply our micro regressions to calibrate the impact of subsidization on firms' marginal costs, the subsidy program accounts for (in the long run, as of 2036) a 0.1% reduction in real wage inequality between provinces receiving the most generous and least generous investment subsidies. Domestic trade flows and migration severely mitigate the extent to which the subsidy program reduces inter-province inequality. Absent migration across subsidy regions, the subsidy program would have reduced real wage inequality by 2.0%. Absent both domestic trade flows and domestic migration, the subsidies would have reduced real wage inequality by 4.1%. Moreover, the policy's impact varies considerably over the short and long run. In the short run, the countervailing effect of migration is limited. In the years

[3]This 5 percentage point difference corresponds, for firms in eligible industries, to the difference in investment tax credits received in regions with the most and least generous subsidies.

immediately after the introduction of the subsidy program, regional real wage inequality declines by as much as 0.6%, three times larger than the long-run impact. We consider a second calibration, in which we match moments based on industry-by-subsidy region revenues. Here, we find substantially larger impacts for the reforms on regional real wage inequality — 2.2% as opposed to 0.1%. However, in this calibration as well, the reform's effects are substantially greater in the short run than in the long run and are greatly muted due to trade and migration linkages.

Our work contributes to and builds on three related literatures: one which evaluates the direct impact of place-based policies on firms' activity, a second which investigates spillovers within production networks, and a third which examines trade and migration flow responses to broader policy reforms (looking beyond place-based policies). Neumark and Simpson (2015) review the first of these literatures, concluding that policies' measured impact are sensitive to their precise design. Among the papers that Neumark and Simpson review, Bernini and Pellegrini (2011); Givord et al. (2013); Busso et al. (2013); and Criscuolo et al. (2019) assess the impact of place-based subsidies in, respectively, Italy, France, the United States, and the United Kingdom.[4] While the design and implementation of these place-based policies differ — the investment subsidies provided by Law L488 in Italy are determined via a region-specific quota, unlike in other countries; the French subsidies favor firms with fewer than 50 employees, and so on — all four papers find positive employment effects for treated firms. As far as we are aware, we are the first to examine the direct firm impacts or the general equilibrium impacts of Law 2012/3305 in Turkey.[5] We are also the first to use a dynamic general equilibrium model with trade and migration to assess the policy's short-run and long-run general equilibrium spillovers.[6]

[4]More recent work assessing the productivity and heterogeneous welfare impacts of place-based policies includes Fajgelbaum and Gaubert (2020); Slattery and Zidar (2020); and Gaubert et al. (2021). In a developing economy context, Chaurey (2017), Lu et al. (2019), and Kim et al. (2021) study, respectively, place-based policies in India, China, and South Korea, finding positive impacts of the introduction of place-based subsidies on investment and employment. Also relevant, given that non-targeted decreases in state and local taxes may have similar impacts to that of a place-based policy, are papers which examine the effect of within-country differences in state and local taxes on firm creation, investment, and employment decisions (e.g., Giroud and Rauh, 2019 and Fajgelbaum et al., 2019.)

[5]Sungur (2019) describes the 2012 subsidy program, then demonstrates that investment has increased faster in more heavily subsidized regions. However, since investment growth had been faster in heavily subsidized regions, even before the implementation of the 2012 subsidy program, these aggregate trends documented by Sungur (2019) are difficult to parse. Our work additionally builds on Sungur (2019) through its use of firm-level data, through its exploration of the propagation of the benefits of subsidization via the production network, and through its assessment of the general equilibrium impacts of the subsidy program.

[6]Exceptional within the literature on place-based policies, Kline and Moretti (2014) examine the long-run impacts of the Tennessee Valley Authority (TVA), a large-scale public infrastructure program introduced in 1933. They develop and estimate a spatial general equilibrium model, with the particular goal of identifying local agglomeration economies. Our model, both in its aims and its components, differs from the model in Kline and Moretti (2014). Our model abstracts from agglomeration economies as they model it, but incorporates features leading economic activity to cluster in certain locations: costly trade of material inputs and costs to migrate across industries and regions. Another unique feature of our framework: we conduct a joint analysis of the short- and long-run impacts of the place-based policy that we study within the same model.

Second, our work relates to a large literature exploring spillovers within production networks in general, and within Turkish production networks in particular. Barrot and Sauvagnat (2016) and Carvalho et al. (2020), respectively, consider the effect of spillovers between customers and suppliers following from natural disasters in the United States and Japan. Demir et al. (2020) explore the impact of (foreign) demand shocks to firms' suppliers, customers, and workers, while Demir et al. (2022) study spillovers of increases in import tariffs within the domestic production network. Our contribution, relative to this second literature, is to investigate the propagation of subsidy-induced shocks among firms within buyer-supplier network.[7]

Third, we build on a literature seeking to understand the general equilibrium trade and migration responses to policy reforms (or to other shocks). Within this literature, Caliendo et al. (2019) analyze shifts in employment across U.S. states and industries in response to the "China shock" (Autor et al., 2013); Monras (2020) explores U.S. inter-industry, inter-state employment shifts in response to migration induced by the 1995 Mexican peso crisis; while Caliendo et al. (2021) study the impacts of EU enlargement on migration and trade.[8] We apply these methods to address a new question—to understand the internal migration flow responses and overall welfare impacts of a prominent place-based policy in a newly industrialized economy.

In Section 2 of this paper, we discuss the features of the 2012 regional subsidy scheme salient for our analysis. We then introduce our dataset in Section 3. Section 4 examines the impact of the subsidy program on subsidized industries' and firms' economic activity, then discusses how subsidies propagate via the production network. Section 5 quantifies the impact of the subsidy program on regional real wage inequality. Section 6 concludes.[9]

[7]Without looking directly at firm-to-firm links, but seeking to understand spillovers among firms within the same region, Greenstone et al. (2010) assess the impact of the entry of a large subsidized manufacturing plant on already present establishments. They find substantial TFP gains over the medium term (approximately 5 years) for incumbent plants within counties that received a large entrant (compared to counties which just lost out on hosting), but with substantial heterogeneity in the estimated effects. Closer to the current paper, Etzel et al. (2021) study the introduction of a place-based policy in Germany, one which aimed at increasing manufacturing investment and employment in the relatively low-income East Germany. Like Greenstone et al. (2010), Etzel et al. (2021) find considerable within-region spillovers. They employ county-to-county trade flow data to test for spillovers across regions, and find that these spillovers are of modest import. Finally, in the context of place-based subsidies introduced in Japan in the 1980s and 1990s, LaPoint and Sakabe (2022) examine spillovers *within* firms, among establishments located in areas eligible to receive a subsidy and those located in un-targeted areas.

[8]See also Artuç et al. (2010) and Caliendo et al. (2018), who develop the theoretic foundations for Caliendo et al. (2019, 2021).

[9]In the appendices, we provide additional information on our dataset (Appendix A) and regarding the 2012 subsidy program (Appendix B). We present our production function estimates in Appendix C, sensitivity analyses to Section 4 in Appendix D, and review the Caliendo et al. (2019) model with which we quantify the aggregate impacts of the subsidy program in Appendix E.

2 Institutional Background

Enacted on June 19, 2012, the "Decision on State Aid in Investments" (Law 2012/3305) is a system of investment support subsidies introduced by the Turkish government.[10] According to the Turkish Ministry of Trade, the aims of the investment scheme are to: "(i) steer savings into high value-added investments, (ii) boost production and employment, (iii) encourage large scale and strategic investments with high R&D content for increased international competitiveness, (iv) increase foreign direct investments, (v) reduce regional development disparities, and (vi) promote investments for clustering and environment protection."[11]

The investment subsidy system contains multiple components, each emphasizing different sectors or regions and applying different incentive instruments. The key variation in the program design is both industry and province-specific. First, the Turkish government partitioned the country into six "subsidy regions," determining the generosity of the individual subsidy items for firms in eligible industries. Figure 1 presents a map of the six regions, with Region 1 receiving the lowest and Region 6 receiving the highest level of support. Region 1 includes the four most populous provinces — İstanbul, Ankara, İzmir, and Bursa — while Region 6 is largely within the east and southeast of the country. Second, for each province, the Turkish government designated only certain sets of industries to be eligible for subsidization. These industries are primarily those in the agriculture, mining, manufacturing, and wholesale sectors, with slight variation across provinces in the exact set of industries that are eligible.[12,13]

[10] Even though Law 2012/3305 was introduced in June of 2012, subsidies were retroactively applied back to January 2012.

[11] See `https://www.sec.gov/Archives/edgar/data/869687/000119312520247247/d30195dex99d.htm` . Accessed November 14, 2021.

[12] While we could not find any published government explanation for why these particular industries were chosen, they are consistent with the theoretical predictions of Liu (2019). In the presence of market imperfections, Liu (2019) argues that developing economy subsidies should target relatively upstream industries (which coincide with the industries that the Turkish government has targeted).

[13] We list the correspondence between provinces and industries in Appendix B.1. The source material for these correspondences are at `https://www.resmigazete.gov.tr/eskiler/2012/06/20120619-1-2.xls`. Accessed November 14, 2021.

Figure 1: Turkish Subsidy Regions

Notes: Source: KPMG (2018).

Several complementary investment incentives were offered to firms in designated industry-province pairs. Qualified investment projects benefit from:[14,15]

- VAT and customs duties exemptions on machinery and equipment purchased as part of the investment project;

- investment tax credits, ranging from 15 percent of the value of the investment project in Region 1 to 50 percent in Region 6;[16,17]

[14] See `https://www.trade.gov.tr/investment/schemes/regional-investments`. Accessed November 14, 2021.

[15] To qualify, the capital investments must exceed a threshold amount, with the size of the threshold varying by region and industry. For most industries, the minimum investment threshold is 500 thousand TL in Region 6, and up to 4 million TL in Region 1. See `https://trade.gov.tr/data/5b8f8bcd13b8761f041fe88c/9781b45b7769515c32b157910f46cdfd.pdf`. Accessed November 14, 2021. As a result, subsidy take-up will be greater for larger firms. While interesting, we do not consider this source of heterogeneity in this paper.

[16] These investment tax credits are deducted from firms' corporate tax obligations. These tax credits are deducted over a number of years, with the speed at which firms receive subsidies also varying by region.

[17] In addition to the regional subsidy program introduced in 2012, Turkey has 258 (as of 2021) "Organized Industrial Zones" (OIZs), special economic zones of much smaller geographies. See `https://www.invest.gov.tr/en/investmentguide/pages/investment-zones.aspx` (accessed November 14, 2021). As of 2021, approximately 2 million individuals worked in an OIZ. The first OIZ was introduced in 1960, with the number of OIZs increasing steadily over the last six decades (Cansız, 2010). While the OIZ program precedes and is largely independent of the region-based subsidies introduced in 2012, the subsidies associated with

- for additional employment created by the investment project, support for the employer's mandatory contribution of their employees' social security payments, ranging from two years after the initiation of the project in Region 1, to 10 years in Region 6;
- for additional employment created by the investment project, support for the employee's contribution of their own social security payments in Region 6 only; and
- support on interest rates (for loans obtained from banks or other private financial institutions to finance the project-related investments), ranging from no support in Regions 1 and 2 to either (a) 7 percentage points for Lira-denominated loans or (b) 2 percentage points for foreign-currency-denominated loans in Region 6.

To receive these subsidies, eligible firms must apply to the Turkish Ministry of Industry and Technology. Firms must demonstrate that their investment project satisfies the rules within Law 2012/3305, applying for an "investment incentive certificate." This certificate describes the subsidy items from which the firm can benefit. Certificates are "open" while the project has been approved but before the investments have been made, and "closed" once the proposed project has been completed. While the project is open, firms benefit from VAT and Customs Tax exemptions and interest rate support. Firms receive investment tax credits and social security support only after the certificate is closed.[18]

While there are multiple types of subsidies that firms may receive, in practice these subsidies are bundled with one another. In our analysis, below, we use the investment tax credit rate — the percentage point credit in corporate taxes linked to the firm's investment — as our primary measure of firm subsidization. In sensitivity analyses, we consider other measures — the number of years of support for employers' mandatory contributions of social security payments, or a whether the firm has a "closed" subsidy certificate (irrespective of the level of generosity). We will find that our estimated relationships between firms' economic activity and the subsidies they receive are invariant to the measure of subsidization we use.

In Table 1, we explore differences in pre-plan economic conditions across the six subsidy regions. Consistent with the stated motivation of the 2012 subsidy program to reduce regional disparities, the more highly subsidized regions had (as of 2011) lower GDP per capita, less than

Law 2012/3305 are slightly more generous in OIZs. The generosity levels that we list in this section correspond to those outside of OIZs. In Appendix B.2, we list the subsidy rates in both OIZs and outside of OIZs. In our firm-level and industry-level analysis, the statutory generosity rates that we apply refer to those levels in OIZs.

[18]In Appendix B.3, we provide estimates of government expenditures on investment tax credits and rebates for employers' and employees' mandatory social security contributions, the two most prominent elements of the subsidy program. We estimate that expenditures on these two subsidy items were approximately 10.2 billion TL in 2018 (in 2010 prices), amounting to approximately 0.55% of GDP in that year. (According to TürkStat, the Turkish Statistical Institute, nominal GDP was 3.76 trillion TL in 2018, equivalent to 1.85 trillion TL in 2010 prices.)

one-third as high in Region 6 as in Region 1. In the years (and decades) prior to the subsidy program, migration within Turkey occurred from the relatively poor Central, Eastern, and Southeastern Anatolia (in Regions 3, 4, 5, and 6) to the large urban centers: İstanbul, İzmir, and Ankara (in Region 1.) Finally, at least in the half-decade prior to the introduction of the subsidy program, GDP per capita growth rates were larger in Regions 5 and 6 relative to Regions 1 and 2. These pre-treatment differences in levels and trends are a threat to identifying the impact of the subsidy program, as it is *a priori* plausible that the government's subsidy program was targeted towards province-industry pairs that were growing exceptionally quickly in the pre-policy period and would have continued to grow faster than average absent the subsidy program. We discuss the issue of pre-trends in Section 4, after introducing our main datasets in the following section.

Table 1: Pre-policy Differences in Subsidy Regions

	Region						
	1	2	3	4	5	6	Nationwide
Population (millions)	30.4	11.2	9.8	7.9	6.6	8.8	74.7
Net Migration Rate (%)	0.86	0.07	-0.33	-0.60	-1.09	-1.24	—
GDP Per Capita (, 000 TL)	27.36	16.54	14.95	13.38	11.23	8.30	18.95
GDP Per Capita Growth Rate (%)	1.5	2.0	2.2	3.4	3.9	3.7	2.3

Notes: The data for this table come from Turkish Statistical Institute (2021a,b,c). The first three rows list values as of 2011. The final row lists average (annual) growth rates between 2006 and 2011. All values are reported as 2010 Turkish Liras (TL). As of January 2010, the TL to US dollar exchange rate was 1.50 to 1.

3 Data Sources and Summary Statistics

We merge four firm- and employee-level datasets from the Entrepreneur Information System (EIS) of the Turkish Ministry of Industry and Technology. (In addition, below, when discussing the aggregate implications of the subsidy program in Section 5, we apply information from the World Input-Output Database, from Timmer et al., 2015, 2016.) Our firm-level datasets include: (a) firm balance-sheet data, spanning 2006 to 2018; (b) data on subsidization take-up rates, from 2012 to 2018; (c) the firm-to-firm production network, from 2006 to 2018; and (d) linked employer-employee data, from 2012 to 2018. Since many of our balance-sheet variables are recorded only for firms with at least 20 employees, our main analysis will be restricted to these firms. In Appendices A.1 and A.2, we describe our dataset in greater detail. We assess how closely aggregates based on our EIS data align with those in public-use aggregate datasets in Appendix A.3.

While incredibly rich and detailed, there are two important limitations of these micro data. First, the EIS data only cover firms and employees in the formal economy; i.e., those workers who are registered in the social security system. As of 2017, approximately 34 percent of workers were informal (though, since formal-sector workers earn considerably more than their counterparts in the informal sector, informal workers comprise a substantially smaller share of the aggregate wage bill); see Figure 21 and Figure 51 of Acar and Carpio (2019). Compounding this limitation, the share of formal-sector workers varies considerably by industry and region, with a greater share of informal workers in agriculture and in the southeast of the country, and a greater share of formal workers in western provinces; see Figures 24 and Figure 25 of Acar and Carpio (2019). Thus, our data miss a substantial fraction of economic activity, with the under-representation systematically varying with firms' subsidy eligibility. A second limitation: With the exception of the number of workers, the balance-sheet data we have access to are at the firm level and not at the establishment level. (For subsidized firms, we *do* observe the location and industry of the establishment through which the firm applied for the subsidy.) So, in interpreting firm-level relationships between subsidization and firm-level activity, we have to be mindful that some firms may operate multiple establishments with different levels of exposure to the subsidy program. Both limitations can be overcome, albeit imperfectly. Regarding the first limitation, in Appendix A.4 we construct estimates of informality by province and industry. We apply these estimates of informality when computing aggregate trade or migration flows across industry-subsidy region pairs — in Figures 2 and 3 in this section and in the calibration of our Section 5 model — from the micro data. Regarding the second limitation, we demonstrate that our evaluation of the subsidy's impact on firm activity is robust to excluding firms with establishments in multiple industry-province pairs.

Table 2 presents summary statistics related to the firm balance-sheet data. Among the firms in our sample, the median firm-year observation had 35 employees, with revenues of 4.2 million Turkish Lira (equivalent to approximately 2.8 million 2010 US dollars), and 900 thousand Turkish Lira in plant, property, and equipment (henceforth "PPE") capital.

Table 2: Descriptive Statistics: Firm-Level Balance-Sheet Variables

					Percentile				
		N	Mean	SD	25	50	75	95	99
(1)	Employment	945,657	88.26	339.33	24.50	35.25	63.75	272.00	931.25
(2)	Wage-Bill (millions TL)	945,657	1.60	9.80	0.26	0.43	0.94	4.91	19.93
(3)	Real Sales (millions TL)	945,657	28.93	346.94	1.51	4.15	12.45	70.50	344.00
(4)	PPE Capital (millions TL)	945,657	11.39	169.68	0.24	0.90	3.28	25.06	149.62
(5)	$\Delta \log(\text{PPE})$	824,448	0.11	0.50	-0.08	0.00	0.18	0.97	2.51

Notes: All values are reported as 2010 Turkish Liras (TL). The sample includes firms with at least 20 employees.

Second, we measure subsidy take-up rates in Table 3. We consider three separate measures of firm subsidization: the fraction of subsidized firms (rows 1 through 3), the average investment tax credit ratio (rows 4 through 6), and the number of years for which the firm receives social security support (rows 7 through 9). The third row describes observations of those who were statutorily eligible to receive a subsidy: These are observations after 2012 where the firm belonged to a subsidized industry-province pair. According to this row, 14.4% of the observations could (feasibly, according to Law 2012/3305) receive a subsidy. Among the 14.4%, 4.6% of observations correspond to a firm which had successfully applied for the subsidy (row 1). An even smaller fraction of firms, 2.2% of the sample, has a closed subsidy certificate (row 2). Rows 4 through 6 consider investment tax credit rates. The statutory investment tax credit rate ranges up to 50% for firms in the sixth subsidy region (row 6). However, both because many firms were ineligible to receive a subsidy and because investment tax credits were less generous in the lowered-numbered regions, the average investment tax credit rate that firms were able to receive is much lower: 3.3%. Again, since not all eligible firms received a subsidy, the average investment tax credit received was even lower, at 1.5%. Finally, as with the investment tax credit measure, our measure of employment subsidization — here, the number of years that the Turkish government would defray — is also highly skewed (rows 7 through 9).

Table 3: Descriptive Statistics: Subsidy Take-up

		Mean	SD	Percentile 90	Percentile 95	Percentile 99	Max
(1)	Firms with either an open or closed certificate	0.046	0.210	0	0	1	1
(2)	Firms with closed certificate	0.022	0.148	0	0	1	1
(3)	Eligible to Receive Subsidy	0.144	0.351	1	1	1	1
(4)	Investment Tax Credit Ratio	0.015	0.074	0	0	0.4	0.6
(5)	Investment Tax Credit Ratio, with Closed Certificate	0.008	0.055	0	0	0.4	0.6
(6)	Investment Tax Credit: Statutory	0.033	0.088	0.15	0.25	0.4	0.5
(7)	Social Security Employer Premium–Years of Support Received	0.263	1.382	0	0	7	12
(8)	Social Security Employer Premium–Years of Support Received, with Closed Certificate	0.137	1.021	0	0	7	12
(9)	Social Security Employer Premium Duration–Years of Support: Statutory	0.560	1.608	2	5	7	10

Notes: The sample includes firms with at least 20 employees. For firms not receiving a subsidy, the Investment Tax Credit Ratio in the fourth row and the Social Security Employer Premium in the seventh row is set equal to 0. For firms without a closed subsidy certificate, the Investment Tax Credit Ratio in the fifth row and the Social Security Employer Premium in the eighth row is set equal to 0. Our measures of statutory rates of subsidy generosity refer to those outside of Organized Industrial Zones (see footnote 17). For this reason, the maximum value of the statutory investment tax credit rate is less than the maximum value of the investment tax credit ratios received. N=945,657.

Our third database measures information on firms' domestic customers and suppliers. According to Table 4, the median firm in our dataset had 9 suppliers and 6 customers. Consistent with other studies of production networks (Bernard et al., 2019; Carvalho et al., 2020), the degree distribution is highly skewed, with fatter tails in the number of customers than in the number of suppliers. A small number of firms have a disproportionate number of suppliers and (in particular) customers. There are a substantial number of inter-firm relationships that exist within and traverse subsidy regions. Approximately 30% ($\approx 6.0/20.2$) of relationships occur across subsidy regions.

Table 4: Descriptive Statistics: Firm-to-Firm Production Network

				Percentile					
		Mean	SD	25	50	75	90	95	99
(1)	Number of suppliers	20.2	41.2	3	9	22	46	72	171
(2)	Number of customers	20.2	72.7	1	6	18	46	79	210
(3)	Number of suppliers in the same subsidy region	14.2	31.4	2	6	15	33	53	132
(4)	Number of customers in the same subsidy region	14.2	55.7	1	4	12	32	56	154
(5)	Number of suppliers in the same province	10.0	21.6	1	4	11	23	38	92
(6)	Number of customers in the same province	10.0	38.2	0	2	9	23	40	110

Notes: The sample includes firms with at least 20 employees. N=945,657.

Central to our analysis of the aggregate effects of the subsidy program are measures of linkages across the six subsidy regions. In the remainder of this section, we depict these linkages. In Figure 2, we report the trade flows across region pairs for each product in our sample. (This figure applies combinations of 2-digit NACE industries, in accordance with the calibration of our Section 5 model.) The shading with each panel depicts the share of the destination region's purchases that are sourced from each of the six regions. In the aggregate, 62% of shipment value occurs within subsidy regions. However, downstream firms' reliance on inputs sourced from other subsidy regions varies considerably: For downstream firms located in Region 1, 75% of shipment value is sourced from suppliers located in Region 1. For downstream firms located elsewhere, 36% of shipment value is sourced from suppliers within the same subsidy region. Taken together, a substantial fraction of each region's purchases are sourced either within-region or from provinces in (the most developed) Region 1.

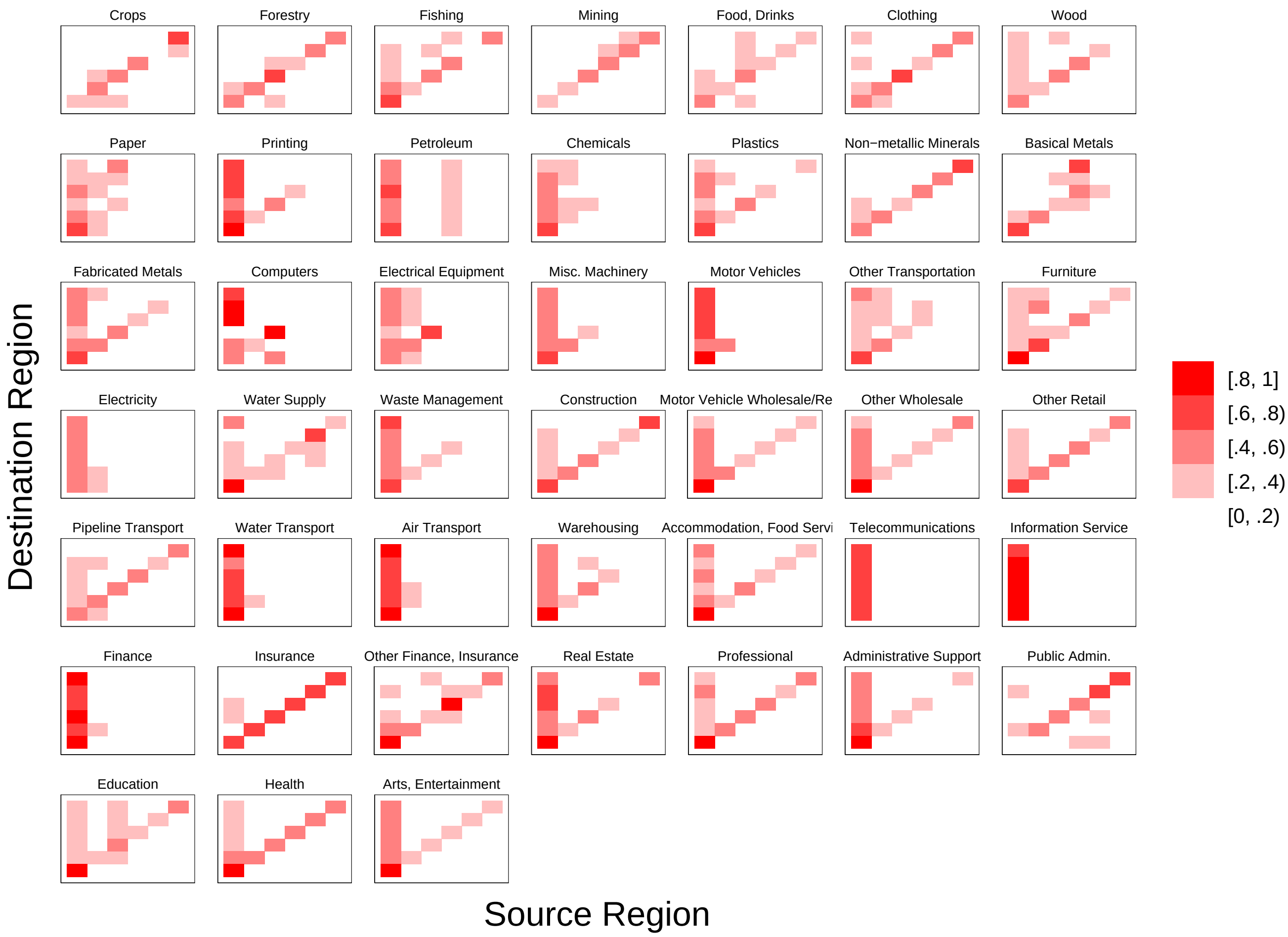

Figure 2: Intermediate Input Flows
Notes: Each panel displays, for a separate commodity, the share of the destination region purchases that come from each source region. Regions are sorted from left to right and bottom to top. This figure uses data from 2012. Within each panel, there are six rows and six columns. Region 1 is in the leftmost column and bottom-most row in each figure; Region 6 is the rightmost column and topmost row in each figure.

Figure 3 depicts labor flows across pairs of subsidy region-industry pairs. The shading within each cell corresponds to the share of individuals in a particular source region-industry pair who end up in each destination region-industry pair. The dark diagonal within this figure indicates that workers tend to switch region-industry pairs infrequently. Indeed, for the average source industry-region pair, 4.4% of workers transition to a different destination industry region-pair, with 2.0% of workers switching regions from one year to the next.[19]

[19]The former figure excludes individuals who are transitioning into or out of non-employment. The latter figure is somewhat larger than the inter-state migration rate (1.5%) observed in the US (Kaplan and Schulhofer-Wohl, 2012).

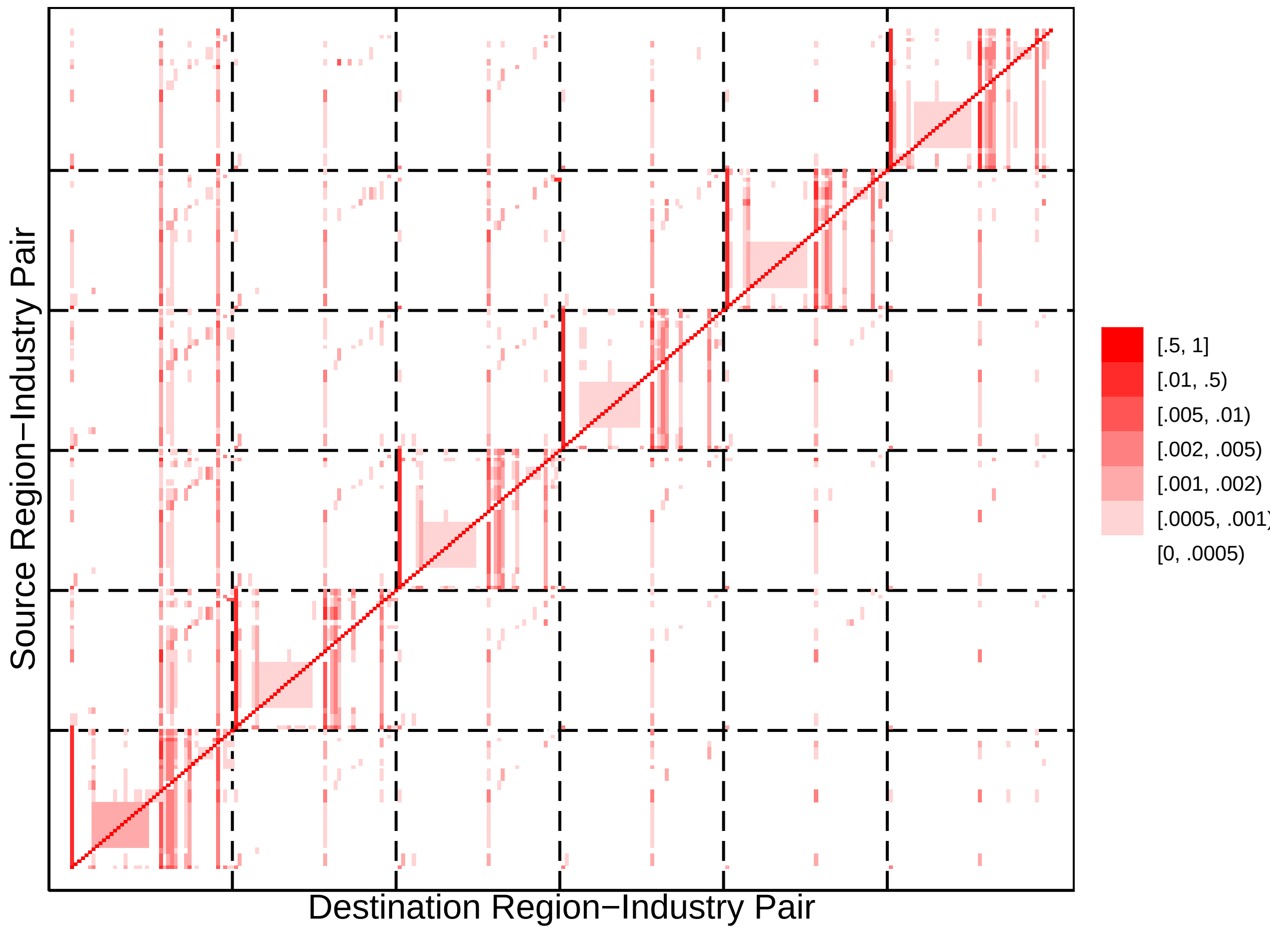

Figure 3: Labor flows

Notes: This figure presents flows of workers across region-industry pairs, between 2011 and 2012. Region-industry pairs are sorted by regions first, then by industries, with Region 1 and the first industry ("Non-Employment") listed in the leftmost column (and bottom row) and Region 6 and the final industry ("Education") listed in the rightmost column (and top row). Dashed lines demarcate each of the six subsidy regions. The shading represents the share of 2011 individuals for a given source region-industry pair who, in 2012, move to the destination region-industry pair.

To summarize, these descriptive statistics indicate that subsidization rates are skewed — concentrated in certain industries and geographies — and that there are considerable trade and migration linkages across the country's six subsidy regions.

4 Direct and Indirect Microeconomic Effects

In this section, we examine the microeconomic impacts of the 2012 subsidy program. In Section 4.1, we describe our empirical setup. We present the relationship between subsidization and economic activity: at the industry-province level in Section 4.2 and at the firm level in Section 4.3. Finally, in Section 4.4 we assess spillovers from subsidized firms to their customers, to their suppliers, or to workers in their local labor market.

4.1 Set-up

Our main empirical setup to detect direct effects is a difference-in-difference type regression:

$$y_{pnt} = \beta_{pn} + \beta_{nt} + \beta_1 S_{pnt} + \varepsilon_{pnt} \ . \tag{1}$$

Here, y_{pnt} is some measure of economic activity in a given province-industry pair *p*-*n* in year t. We will compare this measure of economic activity to the level of subsidization, S_{pnt}, at that given point in time. We use industry-province and industry-year fixed effects to control for the overall scale of economic activity in the province-industry pair or for macroeconomic shocks that differentially impact different types of industries.

In interpreting β_1 as a causal estimator of the effect of the subsidy program on economic activity, we face two challenges. First, it is possible that the industry-province pairs most exposed to the subsidy program were growing relatively quickly (or relatively slowly) in the years prior to the introduction of the subsidies. (Our Table 1 finding that heavily subsidized regions, Regions 5 and 6, had relatively fast GDP per capita growth in the five years prior to introduction of Law 2012/3305 lends credence to this concern.) A second challenge is that not every firm eligible to receive subsidies actually applied. To the extent — when comparing firms (or industry-province pairs) within the same industry and subsidy region — firms more likely to select into the program would have grown exceptionally slowly absent the new policy, OLS estimates of Equation 1 will lead us understate the policy's impact on economic activity.

In Section 4.2, we discuss our instrumental variables strategy to confront the second of these two challenges. Regarding the first, we explore the issue of pre-trends with an amended version of Equation 1, described by:

$$y_{pnt} - y_{pn,2011} = \beta_{nt} + \beta_{pt} + \beta_{1t} \widetilde{S}_{pn} + \varepsilon_{pnt} \ . \tag{2}$$

The aim of this regression is to compare industry-province pairs' pre-policy growth rates to their post-2012 subsidization levels. Equation 2 differs from Equation 1 in four ways. First, given that the aim of Equation 2 is to compare pre-policy growth rates with post-2012 subsidization — and not to compare contemporaneous subsidization and economic activity as in Equation 1 — we replace S_{pnt} with $\widetilde{S}_{pn}$: the statutory investment tax credit rate available post 2012 in province p and industry n. Second, the coefficients that we estimate β_{1t} are allowed to vary by year; this permits the construction of "event-study" plots. Third, given that $\widetilde{S}_{pn}$ is a time-invariant measure, Equation 2 omits the industry-province fixed effects that were present in Equation 1. Fourth, since we have modified our coefficient estimate β_{1t} to vary by year, we include province-year fixed effects as well.

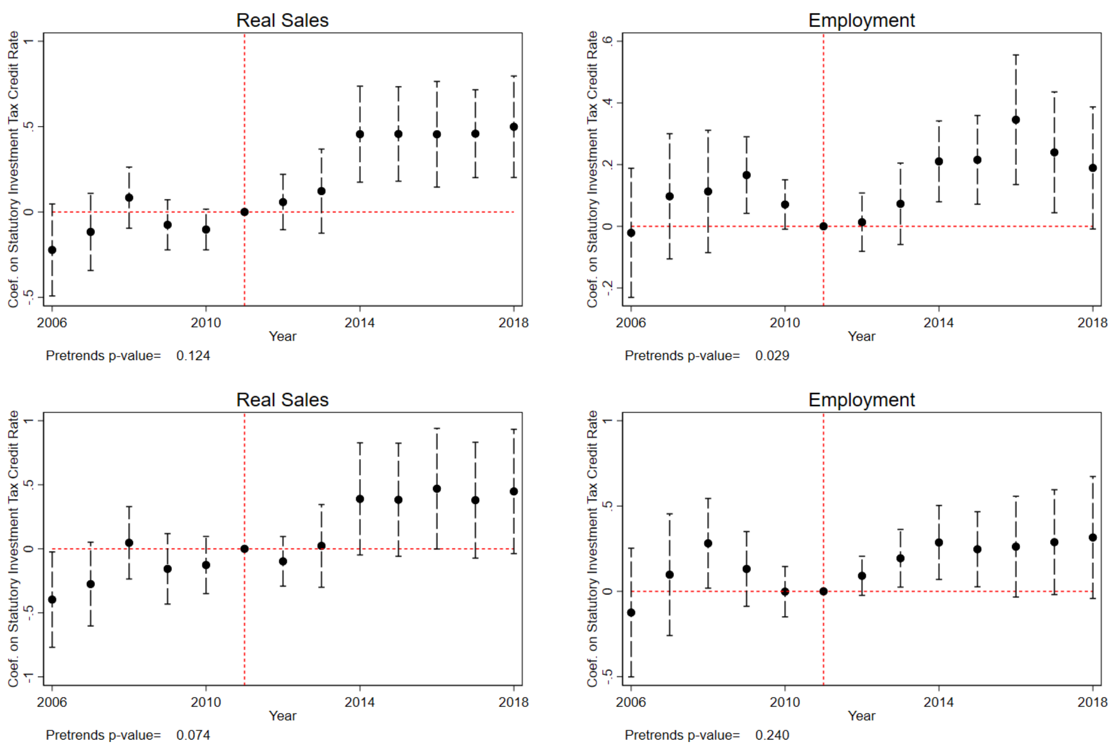

Figure 4: Examination of pre-trends
Notes: Within each panel, we plot estimates of β_{1t}. The dashed lines give 1.96-standard-error confidence intervals, with standard errors clustered by province-year. The sample includes all industry-province pairs for which there are at least 5 firms within the cell every year within the sample period. The top row of panels weights cells according to average firm-count within the sample period; the bottom row of panels weights province-industry pairs equally.

Figure 4 presents our estimates of β_{1t} with two alternate measures of activity: the logarithm of real sales ("revenues") in the industry-province pair, and the logarithm of the number of employed workers in the industry-province pair. In the top panels, we weight province-industry pairs according to the average firm count within the sample period; in the bottom row of panels, province-industry pairs are weighted equally. In three of the four specifications, we cannot reject the null hypothesis that $\beta_{1t} = 0$ for each year between 2006 and 2010. We can reject this null hypothesis in one of the four specifications — with employment as the measure of economic activity and weighting by firm counts. Here, the most heavily subsidized province-industry pairs had exceptionally quick employment growth between 2006 and 2009 and exceptionally slow employment growth between 2009 and 2011.

4.2 Industry-Level Comparisons

Having examined the issue of pre-trends, we return to our baseline specification (Equation 1) and compare contemporaneous measures of economic activity to measures of subsidization.

In columns (1) though (4) of Table 5, we present OLS estimates of the relationship between revenues and subsidization. We consider two measures of subsidization: the average investment tax credit rate received by firms in province p and industry n (columns 1 and 3), as well as the fraction of firms with a closed subsidy certificate (columns 2 and 4). In all four specifications, we find that subsidization significantly increases industry-province revenues. A 5 percentage point increase in the average investment tax credit rate — approximately equal to the end-of-sample difference in average investment tax credit rates between Region 6 and Region 1 — corresponds to a 5.7% increase in industry-province level revenues (column 3).

Not all firms that are eligible for a subsidy actually apply: There is substantial heterogeneity in subsidy take-up rates both among firms within the same industry-province pair and across industry-province pairs with identical levels of statutory eligibility and generosity.[20] To the extent that firms differ in their propensity to seek and successfully receive a subsidy certificate, and that these differences are correlated with future economic success, our OLS estimates may present a biased estimate of the effect of the subsidy program on economic growth. For this reason, we instrument firm (or industry-province) subsidy take-up with measures of subsidy eligibility and generosity. For regressions with the investment tax credit rates received by firms, we instrument by the statutory investment tax credit rate available for firms in the province-industry. For regressions with the share of firms who have received the subsidy as our measure of S_{pnt}, we choose the dichotomous measure of whether the province-industry pair was eligible to receive subsidies as our instrument.[21]

[20]To give one example of the incomplete and heterogeneous subsidy take-up rates, consider Diyarbakır and Batman — two provinces in the sixth subsidy region. These two provinces had, respectively, 24% and 38% of their rubber and plastics manufacturing firms with a closed subsidy certificate by the end of the sample.

[21]Conceivably, one could choose the statutory investment tax credit rate as an instrument for the share of firms receiving a subsidy. Our results are robust to this alternate instrument choice.

Table 5: Industry-Province Level Observations

Panel A: OLS Estimates	(1)	(2)	(3)	(4)
Investment Tax Credit Rate	1.029***		1.146***	
	(0.220)		(0.279)	
Closed Certificate		0.401***		0.512***
		(0.114)		(0.131)
N	221,790	221,790	221,366	221,366
Year FEs	Yes	Yes	No	No
Industry× Year FEs	No	No	Yes	Yes
R^2	0.888	0.888	0.915	0.920
Panel B: IV Estimates	**(5)**	**(6)**	**(7)**	**(8)**
Investment Tax Credit Rate	3.534***		8.934***	
	(1.015)		(1.610)	
Closed Certificate		1.200		1.948
		(0.736)		(2.084)
N	221,790	196,787	221,366	196,273
Year FEs	Yes	Yes	No	No
Industry× Year FEs	No	No	Yes	Yes
	First Stage			
Statutory investment tax credit rate	0.061***		0.075***	
	(0.004)		(0.007)	
Eligible for subsidy?		0.023***		0.023***
		(0.002)		(0.005)

Notes: This dependent variable equals log revenues for the province*NACE (4-digit)*year. All specifications additionally include province-industry fixed effects. The "Closed Certificate" refers to the fraction of firms within the industry-province pair with a "closed" subsidy certificate. The Investment Tax Credit Rate is the average investment tax credit rate for the firms with a subsidy license in the province*NACE pair in a year. Standard errors are clustered at the province level.

Columns (5) though (8) of Table 5 present our IV estimates. In general, our estimates of the subsidy's effect on province-industry revenues are larger, and somewhat less precisely estimated. Among the explanations for these larger coefficient estimates, one possibility is that the industry-provinces who had exceptionally high subsidy take-up rates — relative to other industry-province with similar levels of eligibility and generosity — had relatively low growth rates. Alternatively, the realized subsidization levels could be mismeasured, with such measurement error leading to attenuation of the true effect of subsidization on industry activity.[22,23]

So far, we have demonstrated that the 2012 policy led to increased economic activity in the most heavily subsidized industry-province pairs. These industry-level relationships reflect the direct firm-level impact of the subsidies along with spillovers that exist among firms in the same province and spillovers among firms across provinces. In Sections 4.3 and 4.4, we apply our firm-level balance-sheet and production data to unpack the industry-level impacts uncovered in this section.

4.3 Direct Effects on Subsidized Firms

In this section, we examine the direct effect of the subsidy scheme on firms' revenues, employment, and productivity.

We consider regressions of the form:

$$y_{ft} \quad = \quad \beta_f + \beta_{nt} + \beta_1 S_{ft} + \varepsilon_{ft} \ . \tag{3}$$

Here, y_{ft} is a measure of firm-level activity in year t. We regress this variable against a measure of firm subsidization in year t (S_{ft}), industry-year fixed effects (β_{nt}), and firm fixed effects β_f. In certain specifications, we replace industry-year fixed effects with year fixed effects.[24] Since we employ firm fixed effects, and since firms' eligibility experiences a one-time shift in 2012, our

[22] In their analysis of the UK Regional Selective Assistant Program's effect on manufacturing employment, Criscuolo et al. (2019) report similar discrepancies between OLS and IV regression results, with IV estimates exceeding OLS estimates by a factor of 7; see their table 4. However, there are at least two relevant differences between the approaches in our papers. In Criscuolo et al. (2019), subsidization varies according to geography, not geography-by-industry as in our paper. Further, the instrument in Criscuolo et al. (2019) exploits plausibly exogenous changes in subsidy rules as an instrument for regions' eligibility for subsidization. For these reasons, our explanations for the differences between OLS and IV estimates will differ from those in Criscuolo et al. (2019).

[23] In Appendix D, we present estimates of Equation 1 with two alternate measures of economic activity: total employment and the number of firms. We find that a 5 percentage point increase in the investment tax credit rate leads to a 20% increase in the number of firms (column 7 of Table 24). As with Table 5, our IV estimates are both less precisely estimated and imply a higher impact of subsidization. In contrast to our results with revenues and firm counts, our estimates of the relationship between industry-province employment and subsidization are somewhat sensitive to the specification we apply. Although most specifications yield a positive relationship between the two variables, our IV regressions with year (and without year$\times$industry fixed effects) imply a negative relationship between employment and subsidization.

[24] In Appendix D, we consider regressions in which we replace firm fixed effects with industry-province fixed effects and balance-sheet variables. The results are similar to those presented in Tables 6, 7, and 8 below. In addition, we re-estimate Equation 3 with two additional variables: the firm's wage-bill and their real investment. We find that expenditures on labor are increasing in subsidization levels. In contrast, the sign of the relationship between investment and subsidization — when instrumented with statutory subsidy eligibility and generosity — is sensitive to the precise specification we apply. Finally, we re-estimate equation 3 with an alternate measure of subsidization for S_{ft}—the number of years for which the firm is relieved from making social security contributions. Our conclusions in this section are unchanged.

sample includes only firms who were present both before and after 2012. As with our industry-level regressions, in certain specifications we instrument firms' received subsidies with variables measuring the statutory subsidy rates firms are eligible to receive.

Table 6 presents the relationship between subsidization and firm revenues. Overall, more generous subsidization leads to greater revenues. Comparing the first four columns – or the sixth through ninth columns – the relationship for firm revenues and subsidization is stronger for firms with "closed" subsidy certificates. These are the firms who have completed the subsidized investment, and who are able to receive the complete suite of subsidies from the Turkish government. Furthermore, consistent with our industry level-regressions, comparisons of the first five and final five columns indicate that IV specifications lead to a stronger estimated relationship between subsidies and revenues.[25] The results from our preferred specification (column 7) indicate that a 5 percentage point increase in the investment tax credit rate — approximately equal to the difference, in 2018, in average subsidy levels between Region 6 and Region 1 — corresponds to a 16.0 percent increase in revenues.

[25] For firms that operate in multiple industry-province pairs, we apply the following procedure to define the instrument. For firms which receive a subsidy, we observe the industry-province pair through which the firm applied for the subsidy. For these firms, we define the instrument based on the statutory rate in the industry-province pair of the firm's application. For firms which do not receive a subsidy, we define the statutory rate in the industry-province pair of the firm's headquarters. In Appendix D, we re-estimate our firm-level regressions for the subsample of firms who have all of their establishments in a single industry-province pair. The regression results for this subsample are similar to those in our benchmark sample

Table 6: The Impact of the Subsidy Program on Firm Revenues

	OLS				
	(1)	(2)	(3)	(4)	(5)
Investment Tax Credit Rate	0.919***	0.852***			
	(0.079)	(0.073)			
Inv. Tax Credit Rate + Closed Certificate			1.117***	1.075***	
			(0.082)	(0.083)	
Closed Certificate					0.354***
					(0.030)
N	909,085	909,085	890,629	890,629	890,629
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
R^2	0.833	0.837	0.834	0.838	0.840
	IV				
	(6)	(7)	(8)	(9)	(10)
Investment Tax Credit Rate	2.607***	3.194***			
	(0.467)	(0.559)			
Inv. Tax Credit Rate + Closed Certificate			3.723***	5.093***	
			(0.797)	(1.172)	
Closed Certificate					2.361***
					(0.815)
N	870,557	870,557	852,000	851,507	851,507
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
	First Stage				
Statutory investment tax credit rate	0.142***	0.136***	0.091***	0.081***	
	(0.010)	(0.019)	(0.009)	(0.016)	
Eligible for Subsidy?					0.0176***
					(0.056)

Notes: The dependent variable is log revenues at the firm-year level. All regressions include province-industry fixed effects and firm fixed effects. Standard errors are clustered at the province level.

Table 7 presents corresponding results for employment. Here, too, subsidies lead to increased economic activity, both in the OLS and IV estimations. As with the estimates in Table 6 (and Table 8, below), the estimates of the relationship between subsidization and economic activity are larger when the firm's subsidy certificate is "closed" (compare columns 1, 2, 6, and 7 to columns 3, 4, 8, and 9). This accords with the timing at which subsidies are received: First firms submit an application, then they begin an investment project when their certificate is "open", and only then receive the full suite of subsidies. According to column 7 of this table, a 5 percentage point increase in investment tax credits received leads to a 8.3 percent increase in firm employment.

Table 7: The Impact of the Subsidy Program on Firm Employment

	OLS				
	(1)	(2)	(3)	(4)	(5)
Investment Tax Credit Rate	1.107*** (0.092)	1.058*** (0.085)			
Inv. Tax Credit Rate + Closed Certificate			1.409*** (0.095)	1.370*** (0.093)	
Closed Certificate					0.471*** (0.031)
N	913,112	913,112	894,052	894,052	894,052
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
R^2	0.847	0.853	0.850	0.856	0.856
	IV				
	(6)	(7)	(8)	(9)	(10)
Investment Tax Credit Rate	1.485*** (0.417)	1.651*** (0.573)			
Inv. Tax Credit Rate + Closed Certificate			2.058*** (0.630)	2.722*** (0.882)	
Closed Certificate					1.263*** (0.281)
N	874,654	874,188	855,488	855,008	855,008
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
	First Stage				
Statutory investment tax credit rate	0.143*** (0.010)	0.139*** (0.020)	0.093*** (0.009)	0.084*** (0.016)	
Eligible for Subsidy?					0.180*** (0.057)

Notes: The dependent variable is log (Employment) at the firm-year level. All regressions include province-industry fixed effects and firm fixed effects. Standard errors are clustered at the province level.

Table 8: The Impact of the Subsidy Program on Firm TFP

	OLS				
	(1)	(2)	(3)	(4)	(5)
Investment Tax	-0.037	-0.064***			
Credit Rate	0.025	0.023			
Inv. Tax Credit Rate			-0.017	-0.040	
+ Closed Certificate			0.037	0.034	
Closed Certificate					-0.022
					(0.014)
N	851,592	851,592	834,403	834,403	834,403
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
R^2	0.618	0.631	0.623	0.636	0.636
	IV				
	(6)	(7)	(8)	(9)	(10)
Investment Tax	0.989***	0.649***			
Credit Rate	(0.153)	(0.220)			
Inv. Tax Credit Rate			1.520***	1.065***	
+ Closed Certificate			(0.237)	(0.393)	
Closed Certificate					0.285***
					(0.267)
N	815,855	815,377	798,558	798,071	798,072
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
	First Stage				
Statutory investment	0.143***	0.139***	0.093***	0.083***	
tax credit rate	(0.010)	(0.019)	(0.009)	(0.016)	
Eligible for					0.029*
Subsidy?					(0.017)

Notes: The dependent variable is log(TFP) at the firm-year level, estimated using Ackerberg et al. (2015). All regressions include province-industry fixed effects and firm fixed effects. Standard errors are clustered at the province level.

Finally, Table 8 records the effect of the investment subsidies on firms' total factor productivity.[26] According to our IV specifications, a 5 percentage point increase in investment tax credit ratios leads to a 3.2 percent increase in TFP (column 7 of Table 8). There are a number of possible mechanisms through which the subsidies may increase firm-level TFP. First, subsidization entails a direct reduction in the effective rental price of capital and wage rate that subsidized firms pay. Thus, the subsidy program led to a reduction in firms' marginal cost of production. Since

[26]We estimate TFP for each 2-digit NACE industry, using the estimator developed by Ackerberg et al. (2015). Appendix C describes our specification in greater detail, then presents the estimated production function parameters.

our measure of TFP is a residual of firms' revenues and their unit input costs, the subsidy program may have led to an increase in measured productivity (revenue productivity, "TFPR", in the nomenclature of Foster et al. (2008)) even without altering their true efficiency in measuring inputs into outputs.[27] A second possibility, (un-modeled) frictions – to capital or labor markets – have been leading to inefficient scales of production, especially in the southeast of the country. To the extent that the subsidy program relaxed credit constraints, they may have increased firm efficiency. While understanding the precise mechanism through which the subsidies increase firm productivity is necessary to address many interesting economic questions, it is less salient for the purposes of evaluating the impact of the subsidy program on regional wage inequality.

4.4 Indirect Effects via the Production Network and Local Labor Markets

In this section, we examine spillovers in the effects of the subsidy program along input-output relationships and within firms' local labor markets. There are two purposes of this section. First, we are inherently interested in documenting how the subsidies spill over to the customers or suppliers of subsidized firms. Second, in the calibration of our general equilibrium model in the following section, a key input will be the impact of subsidization on productivity. To the extent that (i) firms' own subsidization status is correlated with their suppliers' and customers' subsidization, and that (ii) counterparties' subsidization leads to higher TFP, our Table 8 estimates from the previous section would suffer from omitted variable bias. For a similar reason, we include an additional control for the wages in the firms' local labor market. The average wage rate paid by firms in a given industry-province pair may respond to the share of firms receiving a subsidy, and may affect individual firms' total factor productivity.

We amend the regression specifications from Equation 3 to include information on the share of the firm's customers or suppliers who have received a subsidy:

$$\begin{aligned} y_{ft} \;&=\; \beta_f + \beta_{nt} + \beta_1 S_{ft} + \beta_2 \cdot w_{npt} \\ &\quad + \beta_{\text{up}} s^{\text{upstream}}_{\vartheta \to ft} + \beta_{\text{down}} s^{\text{downstream}}_{f \to \vartheta, t} + \varepsilon_{ft} \; . \end{aligned} \tag{4}$$

In Equation 4, y_{ft} refers to a firm-year level activity measure (either log revenues, log employment, log investment, or TFP), $s^{\text{upstream}}_{\vartheta \to f}$ equals the share of firm f's intermediate input expenditures that are sourced from subsidized firms, $s^{\text{downstream}}_{\vartheta \to f}$ equals the share of firm f's intermediate input sales that are sold to subsidized firms, and w_{npt} equals the average daily wage in firm f's local

[27] Foster et al. (2008) contrast TFPR with "technical efficiency." The latter characterizes the rate at which firms transform physical inputs into physical outputs. The former relates firms' ability to transform expenditures on inputs into revenues. Differing productivity measures may be more or less salient, depending on the context and question at hand. In terms of understanding the differential welfare impacts of the subsidy program, a task we turn to in Section 5, TFPR provides the relevant measure of productivity.

labor market (i.e., the average wage paid by firms in industry n and province p in year t). In addition, we include province-industry fixed effects and controls for firm activity as of 2012. In certain specifications, we include firm fixed effects.

Tables 9 and 10 present our estimates of Equation 4. First, controlling for suppliers' and customers' subsidization and wages in the firms' local labor market yields slightly smaller estimates of the productivity gains from subsidization (compare the estimates in columns 7 and 8 of Table 10 to those in columns 6 and 7 of Table 8). Second, firms with more subsidized customers have higher revenues, employment, investment, and TFP. The relationship between the share of a firm's suppliers who are subsidized and their economic activity is sensitive to the activity measure, however, with most specifications yielding a positive estimated relationship. According to our IV estimates, a 5 percentage point increase in the fraction of a firm's suppliers and customers who are subsidized implies an increase in revenues of 0.7%, an increase in employment of 0.6%, a decrease in investment of 0.1%, and a decrease in marginal costs of 0.3%.[28]

[28]To compute these numbers, multiply the 0.05 with the sum of β_2 and β_2. For instance, 0.9% ($\approx 5 \cdot (0.025 + 0.071)$).

Table 9: The Impact of the Subsidy Program on Firm Activity: OLS Estimates

Dependent Variable	Revenues		Employment	
	(1)	(2)	(3)	(4)
Investment Tax Credit	0.723***	0.668***	0.911***	0.886***
Rate	(0.046)	(0.041)	(0.095)	(0.103)
Weight of subsidized	0.073***	0.030**	0.095***	0.077***
firms in total sales	(0.014)	(0.012)	(0.012)	(0.011)
Weight of subsidized	0.092***	0.091***	0.032**	0.024*
firms in total purchases	(0.014)	(0.013)	(0.016)	(0.014)
Log daily wage	0.053***	0.035***	-0.004	0.008
	(0.011)	(0.010)	(0.007)	(0.007)
N	838,608	838,608	839,562	839,562
Year FEs	Yes	No	Yes	No
Year× Industry FEs	No	Yes	No	Yes
R^2	0.847	0.851	0.877	0.880

Dependent Variable	Investment		TFP	
	(5)	(6)	(7)	(8)
Investment Tax Credit	0.394***	0.352***	-0.097***	-0.126***
Rate	(0.063)	(0.055)	(0.030)	(0.029)
Weight of subsidized firms in total sales	0.028***	0.025***	0.002	-0.011
	(0.009)	(0.009)	(0.008)	(0.008)
Weight of subsidized firms in total purchases	-0.014	-0.044***	0.057***	0.034***
	(0.012)	(0.013)	(0.011)	(0.011)
Log daily wage	0.009	0.003	-0.013*	-0.008
	(0.012)	(0.008)	(0.007)	(0.006)
N	741,842	741,842	784,732	784,732
Year FEs	Yes	No	Yes	No
Year× Industry FEs	No	Yes	No	Yes
R^2	0.331	0.342	0.645	0.655

Notes: All regressions include province-industry fixed effects and firm fixed effects. Standard errors are clustered at the province level.

Table 10: The Impact of the Subsidy Program on Firm Activity: IV Estimates

	Revenues		Employment		Investment		TFP	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Investment Tax Credit	2.235***	2.488***	0.995*	0.719	1.571***	-0.634*	1.054***	0.668***
Rate	(0.370)	(0.646)	(0.502)	(0.766)	(0.422)	(0.342)	(0.222)	(0.190)
Weight of subsidized	0.067***	0.025**	0.095***	0.077***	0.022**	0.028***	-0.003	-0.013*
firms in total sales	(0.014)	(0.012)	(0.012)	(0.010)	(0.009)	(0.008)	(0.008)	(0.007)
Weight of subsidized	0.065***	0.071***	0.031**	0.026**	-0.034***	-0.033**	0.035**	0.025**
firms in total purchases	(0.013)	(0.012)	(0.015)	(0.011)	(0.011)	(0.013)	(0.014)	(0.012)
Log daily wage	0.049***	0.035***	-0.005	0.008	0.006	0.003	-0.016**	-0.008
	(0.009)	(0.009)	(0.006)	(0.007)	(0.011)	(0.009)	(0.006)	(0.005)
N	785,579	785,220	786,545	786,187	699,951	699,627	735,915	735,531
Year FEs	Yes	No	Yes	No	Yes	No	Yes	No
Year× Industry FEs	No	Yes	No	Yes	No	Yes	No	Yes
First-Stage Estimates								
Statutory investment tax	0.131***	0.117***	0.131***	0.117***	0.132***	0.117***	0.131***	0.117***
credit rate	(0.011)	(0.021)	(0.011)	(0.021)	(0.011)	(0.020)	(0.011)	(0.020)
Weight of subsidized	0.003**	0.002*	0.003**	0.002*	0.004**	0.002**	0.003*	0.002
firms in total sales	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Weight of subsidized	0.016***	0.010***	0.016***	0.010***	0.016***	0.010***	0.017***	0.011***
firms in total purchases	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
Log daily wage	0.002	-0.001	0.002	-0.001	0.002	-0.001	0.002	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Notes: All regressions include province-industry fixed effects and firm fixed effects. Standard errors are clustered at the province level.

5 Aggregate Implications

In this section, we examine the aggregate implications of the 2012 subsidy program. We focus on the impact of the reforms on regional real wage inequality. There are, indeed, other metrics to evaluate the effectiveness of the subsidy reforms: the costs of these subsidies, whether the reforms increased aggregate economic activity relative to these costs, and whether the reforms reduced overall wage inequality (including wage inequality within regions). However, as we have discussed earlier, a primary goal of the 2012 policy was to reduce the gap between the relatively low-wage southeast and the rest of the country, and so this is our primary object of interest.[29]

In this section, we review and calibrate the model of Caliendo et al. (2019). This is a dynamic general equilibrium model with trade and migration across regions. Despite the large state space — with many industries and multiple regions—Caliendo et al. (2019) present a method (which they call "dynamic hat algebra") allowing one to measure the effects of exogenous policy changes on migration, wages, welfare, and other economic objects of interest. In addition to its tractability, the Caliendo et al. (2019) model is ideally suited to appraise the short-run and long-run spatial spillovers resulting from increased subsidization concentrated in the eastern provinces of the country. Even if — as we have documented in the previous section — the subsidy program spurred investment in targeted regions, domestic trade flows and migration may blunt the policy's impact on inter-regional real wage inequality. A dynamic general equilibrium model is necessary to quantify the importance of these countervailing forces.

5.1 Overview

The model features firms and households, each residing in a given region and tied to a particular industry. Households supply their labor and use their labor earnings to consume; they may also abstain from working. Households neither borrow nor save. Each period, households decide how much of each industry's product to consume and whether to migrate to a different industry-region pair. Firms produce using labor, structures (tied to the region in which the firm resides), and material inputs. Firms' output are sold to consumers and to firms in other provinces. Both migration and flows of intermediate goods across industries and geographies are costly: Households face a utility cost of switching the industry and region in which they are employed. Shipments of intermediate goods across regions are subject to iceberg trade costs. Finally, a third class of economic agents, rentiers, receive rental income from structures and use this income to consume. Appendix E delineates the model in much greater detail, spelling out household preferences, firm production

[29] Gaubert et al. (2021) discuss the motivations for place-based redistributive policies. Broadly, there are two classes of motivations: improving the equity-efficiency trade-offs involved in place-blind redistributive policies, and a *per se* societal goal for limiting poverty within distressed areas.

functions, market-clearing conditions, and the equilibrium definition.

These model ingredients allow one to explore the different channels through which subsidies may dissipate across geographies or industries. First, subsidization of firms in a particular region will lead to in-migration from unsubsidized regions, partially offsetting the real wage gains from the subsidy-induced increase in labor demand. Second, input-output linkages imply that shocks increase factor demands in both the directly affected industry-region pair and in industry-regions that are upstream or downstream of the subsidized firms. Third, subsidization pushes up rental prices in the affected region. To the extent that structures are owned by rentiers located elsewhere in the country, subsidies targeting one region will increase income — and, as a result, consumption, labor demand, and real wages — elsewhere in the country.

5.2 Calibration

We use this model to understand the impact of the 2012 subsidy program. In particular, we solve for the "baseline" model economy — with the observed subsidy program in place – and compare it to a "counterfactual" economy in which investment subsidies were not increased. Table 11 summarizes the moments and data sources necessary to compute the "baseline" and "counterfactual" economies. Critically, however, Caliendo et al. (2019)'s "dynamic hat algebra" method circumvents the need to pin down (i) the productivity level of the industry-region pair at each point in time, (ii) the utility costs of switching industries and regions, and (iii) the iceberg trade costs of trading goods across regions.

Table 11: Overview of Calibration

	Moment	Data Source and Description
(1)	Subsidy Take-up and generosity	Avg. share of firms with closed certificates, or Investment tax credits received
(2)	Direct productivity effect of subsidy on firm productivity	Table 10, Column 8
(3)	Trade flows across regions and industries	See Figure 2
(4)	Labor flows across regions and industries	See Figure 3
(5)	Labor costs, value added, and gross output by industry and region	Turkish National Input-Output Tables from the World Input-Output Database
(6)	Consumption preference shares by industry and region	Turkish National Input-Output Tables from the World Input-Output Database
(7)	Materials purchases by upstream industry×downstream industry×destination region	Turkish National Input-Output Tables from the World Input-Output Database

Notes: This table gives a brief description of the data series used to calibrate the Caliendo et al. (2019) model. For additional detail, see Appendix E.2.

We do not model the costs associated with the subsidy program. To the extent that the introduction of new subsidies prompts the national government to raise taxes, borrow, or reduce government expenditures, there will be countervailing effects relative to the ones reported here. So long as these countervailing effects manifest uniformly across geographies (e.g., the prompted tax increases are neither location- nor industry-specific), our results on regional inequality will be unaffected by modeling the policy-related costs.

Of particular importance for our calibration is the direct impact of the subsidy program on productivity within each subsidy region and industry at each point in time from 2012 onward. We pursue two complementary strategies to infer this critical set of parameters.

Relating Subsidy Take-up to Productivity

Within the context of our model, we view the reforms as leading to a reduction in the per unit cost of hiring labor or renting capital that subsidized firms pay. These lower input costs are equivalent, in the Caliendo et al. (2019) model, as a decrease in subsidized firms' marginal costs or, equivalently, an increase in their total factor productivity. In our primary approach to calibrate the direct impact of the subsidy program, we combine information on subsidy take-up rates and the relationship between subsidization and firm productivity to identify how much the 2012 subsidy program increased productivity in each region-industry pair. While our regressions in Section 4 focused on investment tax credits as the measure of firm subsidization, we emphasize that subsidies to capital investment and hiring labor are bundled with one another and so the subsidy program applies both to capital and labor.[30]

[30]One key abstraction of our model: firms' input choices in the Caliendo et al. (2019) model are static. In practice, firms make dynamic capital investment decisions. Kleinman et al. (2021) extend the Caliendo et al. (2019) model in studying dynamic capital investment within multi-region, multi-industry models with trade and migration linkages. Suppose we amended our analysis to allow some portion of land and structures to be fixed, and some portion that can be augmented via costly investment. We hypothesize that, in this amended model, the reforms would lead to greater increases in labor demand in the targeted regions, and greater migration and real wage impacts than what we report here.

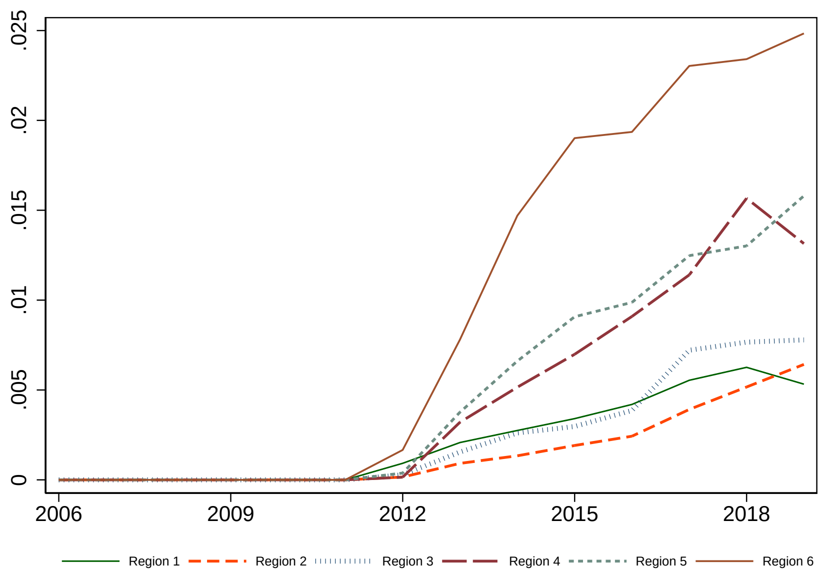

Figure 5: Investment Subsidies
Notes: The plot gives the average investment tax credit rates for each region and year. See Appendix Figure D.3 for investment tax credit subsidy levels by industry and region in 2018.

Figure 5 presents the time path of investment subsidies by region.[31] The time series within the plot give the product of subsidy take-up rates multiplied by investment tax credits for firms successfully applying for the credit. From 2012 on through the remainder of our sample, statutory subsidy generosity is constant. Instead, the fraction of firms who received investment tax credits increased from 2012 to 2016, before leveling off in the remainder of our sample. Regions 5 and 6 benefited the most from the subsidy program, with Regions 1, 2, and 3 receiving the lowest levels of subsidization.[32] To infer the direct productivity impact of the subsidy program, we multiply these time series by 0.668 (see column 8 of Table 10) — the incremental productivity gain from

[31] In our calibration, we assign the productivity increases in a region-industry pair on the basis of averages within the cell, abstracting from the substantial heterogeneity which exists in subsidy take-up rates (and productivity gains from subsidies) within industry-region pairs. (Moreover, these within-industry×region differences exist partly on the basis of observable firm characteristics. For example, firms with more employees are more likely to successfully apply for a subsidy.) While interesting, these differences are not of first order-importance for our analysis of regional income inequality.

[32] In Appendix D.3, we supplement Figure 5 with two additional figures. First, we plot average investment tax credits received by industry and subsidy region at the end of our sample period. According to this figure, subsidization was greatest in construction (NACE=b), transportation manufacturing (NACE=c29, c30), sewage, waste collection and waste management (NACE=e37, e38, e39), with subsidization uniformly higher in Regions 5 and 6 relative to Regions 1 and 2. Second, we plot average investment tax credits received among firms in the formal economy. (Figure 5 presents a weighted average of subsidization in the informal economy — firms who were ineligible to receive subsidies — and that in the formal economy.) There our measures of subsidization are greater by a factor of 2-3, with the biggest discrepancy in Region 6 (a region in which informal-sector firms are over-represented).

the investment tax credit.[33,34]

Matching Observed Revenues Growth to That in Our Calibrated Model

One concern, when applying our Section 4.4 estimates on the impact of subsidization on firm-level TFP to our model, is that there are potentially spillovers across treated and untreated firms, leading us to violate the "stable unit treatment value assumption" (SUTVA) (Angrist et al., 1996). We directly control for subsidization of the firms' customers or suppliers, to potentially account for TFP spillovers across firms sharing production links, and average wages in the firm's province-year-industry, to account for the possibility that the subsidy bid up wages in the firms' local labor market (and thus lowered the firm's TFP.) While the inclusion of these controls mitigate these SUTVA-related concerns, it is possible that there are other unobserved spillovers that we are not able to control for.

As an alternate strategy to estimate the direct productivity impact of the subsidy program, we consider an "indirect inference" approach. We regress (i) industry-region level revenues against subsidy measures in our data; and (ii) industry-region level revenues and subsidy measures in our model. From (i) and (ii) each, we have a single regression coefficient. We choose calibrated value of the "productivity gain from subsidization" to exactly match (i) and (ii).

In more detail, to perform our moment-matching exercise, we consider regressions of the form.

$$y_{rnt} \quad = \quad \beta_{rn} + \beta_{rt} + \beta_1 S_{rnt} + \varepsilon_{rnt} \ . \tag{5}$$

Here, r denotes a subsidy region, n denotes a 2-digit industry (or a combination of 2-digit industries),[35] and t denotes a year. Furthermore, y_{rnt} measures either log revenues in region r,

[33] Our counterfactual exercises require, as inputs, expected values for TFP trajectories beyond the end of our sample period. We assume that in years after 2018 the subsidy levels (and, consequently, the direct productivity impacts of the subsidy program) are equal to their 2018 values.

[34] Absent in our calibration are any direct TFP spillovers across firms via input-output linkages, spillovers which are explored in Bazzi et al. (2017). In our analysis, TFP increases for subsidized firms. These subsidies then lower marginal costs — through lower materials prices — for those downstream of the subsidized firms, and increase demand for those that are upstream. But these subsidies do not increase, in our model, TFP of unsubsidized firms. Including these spillovers in our analysis will magnify the overall impact of the subsidies on aggregate real wages, but will (depending on how they are modeled) have an ambiguous impact on regional inequality. Since a large fraction of domestic trade flows occurs across subsidy regions, TFP gains that occur via spillovers may benefit both heavily subsidized and less subsidized regions.

We also exclude the related possibility of firm TFP increasing in the density of activity. Existing work (e.g., Greenstone et al., 2010; Fajgelbaum et al., 2019) highlights these spillovers as a potential rationale for place-based policies. Because we find that the subsidy program induced a reallocation of activity from Regions 1 and 2 to Regions 5 and 6, by doing so, we are understating impacts of the subsidies on real wage inequality.

[35] See Appendix E.3 for the list of industries.

industry n, and year t, or the counterfactual impact of the subsidy program on industry n, region r, and time t revenues. In different regression specifications, we use different subsidy measures (either average investment tax credits received or statutory investment tax credit rates) and either weight observations according to the number of firms in the industry-region pair or weight all observations equally.[36]

In Table 12, we present our estimates of Equation 5. Panel A presents results from industry-level data. In all specifications, subsidization is associated with higher revenues. According to column 3, which we will consider our preferred specification, a 10 percent increase in investment tax credits received is associated with a 36.6 percent increase in revenues in the region-industry pair.

Panel B presents counterfactual impacts from our model, in which we feed in exogenous productivity changes in industry-region pairs to be proportional to investment tax credits received in the industry-province pair. We choose the constant of proportionality so that the impact of subsidization on revenues — according to the specification given in column 3 of Table 12 — exactly matches what we observed in panel A (in column 3).[37] To match the industry-geography level revenue gains from subsidization — i.e., to match columns 3 and 11 in Table 12 — we require that a 1 percent increase in the investment tax credits received leads to a 3.64 percent increase in firm-level TFP (as opposed to the 0.67 percent increase that we discussed in the previous subsection).

[36] In Appendix D.3, we consider an alternate set of regressions, using provinces and 2-digit industries as opposed to regions or a combination of 2-digit industries, as our unit of observation.

[37] We assume that agents did not anticipate, in 2011 or before, the subsidy program being enacted in 2012. As a result, the counterfactual impact of the subsidy program on revenues were 0 for $t = \{2006, ..., 2011\}$.

Table 12: Estimates of Equation 5

Panel A: Data	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Investment Tax	3.256***		3.662***		1.268*		1.303	
Credit Rate	(0.253)		(0.521)		0.512		(0.722)	
Statutory Inv.		0.329**		0.978***		0.188		1.046***
Tax Credit Rate		(0.116)		(0.136)		(0.113)		(0.209)
Weight Observations?	Yes	Yes	Yes	Yes	No	No	No	No
Year FEs	Yes	Yes	No	No	Yes	Yes	No	No
Industry× Year FEs	No	No	Yes	Yes	No	No	Yes	Yes
N	3,404	3,404	3,404	3,404	3,404	3,404	3,404	3,404
R^2	0.988	0.988	0.996	0.996	0.956	0.956	0.977	0.977
Panel B: Counterfactual	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Investment Tax	2.336**		3.662***		2.741***		3.231***	
Credit Rate	(0.704)		(0.488)		(0.435)		(0.357)	
Statutory Inv.		0.170		0.627**		0.393**		0.781***
Tax Credit Rate		(0.158)		(0.199)		(0.141)		(0.139)
Weight Observations?	Yes	Yes	Yes	Yes	No	No	No	No
Year FEs	Yes	Yes	No	No	Yes	Yes	No	No
Industry× Year FEs	No	No	Yes	Yes	No	No	Yes	Yes
N	3,404	3,404	3,404	3,404	3,404	3,404	3,404	3,404
R^2	0.858	0.809	0.899	0.838	0.853	0.670	0.901	0.752

Notes: All regressions additionally include region-industry fixed effects. Standard errors are clustered at the region level.

5.3 Aggregate Impacts on Employment and Real Wages

In this section, we report the results from our calibrated model. We begin with the calibration in which the impacts of the 2012 subsidy program on productivity are calibrated using our Section 4.4 regressions. We then apply the "indirect-inference" approach to calibrate the relationship between subsidization and firm productivity. The section closes with a brief description of additional sensitivity analyses.

Our first set of results assesses the effect of the subsidy program on migration and employment by region. Figure 6 displays the model-implied labor force in each region in our baseline calibration relative to a calibration in which the subsidy program had not been enacted. According to this figure, the subsidy program is responsible for a 1.6 percent increase in employment in Region 6, a 2.6 percent increase in employment in Region 5, a 0.1 percent decrease in employment in Region

2, and a 0.7 percent decrease in employment in Region 1. Most of these changes in population by region occur by 2020, eight years after the introduction of the investment subsidy scheme. However, net migration continues well into the late 2020s. In the right panel, we plot employment by subsidy region. Across all regions, the subsidy program increased labor demand, with the greatest increase in the size of employed individuals taking place in Regions 5 and 6.

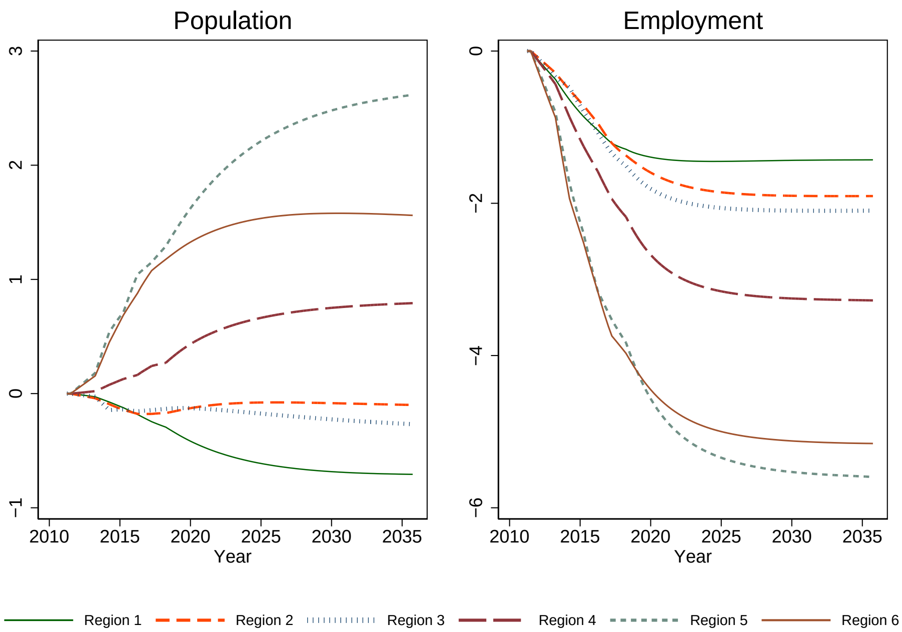

Figure 6: Migration and Employment Effects of the 2012 Subsidy Program
Notes: This figure presents, according to the benchmark calibration, the employment effect of the subsidy reforms. It describes the employment in each region relative to a counterfactual economy without the subsidy reforms.

Our second set of results considers the impact of the subsidies on real wages in each subsidy region. In the top left panel of Figure 7, we present the results for the benchmark calibration, with domestic input-output linkages, migration, and structures. The 2012 subsidy scheme increased wages most in Regions 5 and 6 (the most heavily subsidized regions) and the least in Regions 1 and 2. Five years into the subsidy program, real wage inequality (between Region 6 and Region 1) decreased by 0.5 percent. This inequality reduction dissipates in subsequent years, as the investment subsidies slow down the (already occurring) migration from southeastern to western Turkey. As of 2036, we forecast that the investment subsidies will have reduced regional inequality by only 0.1 percent.

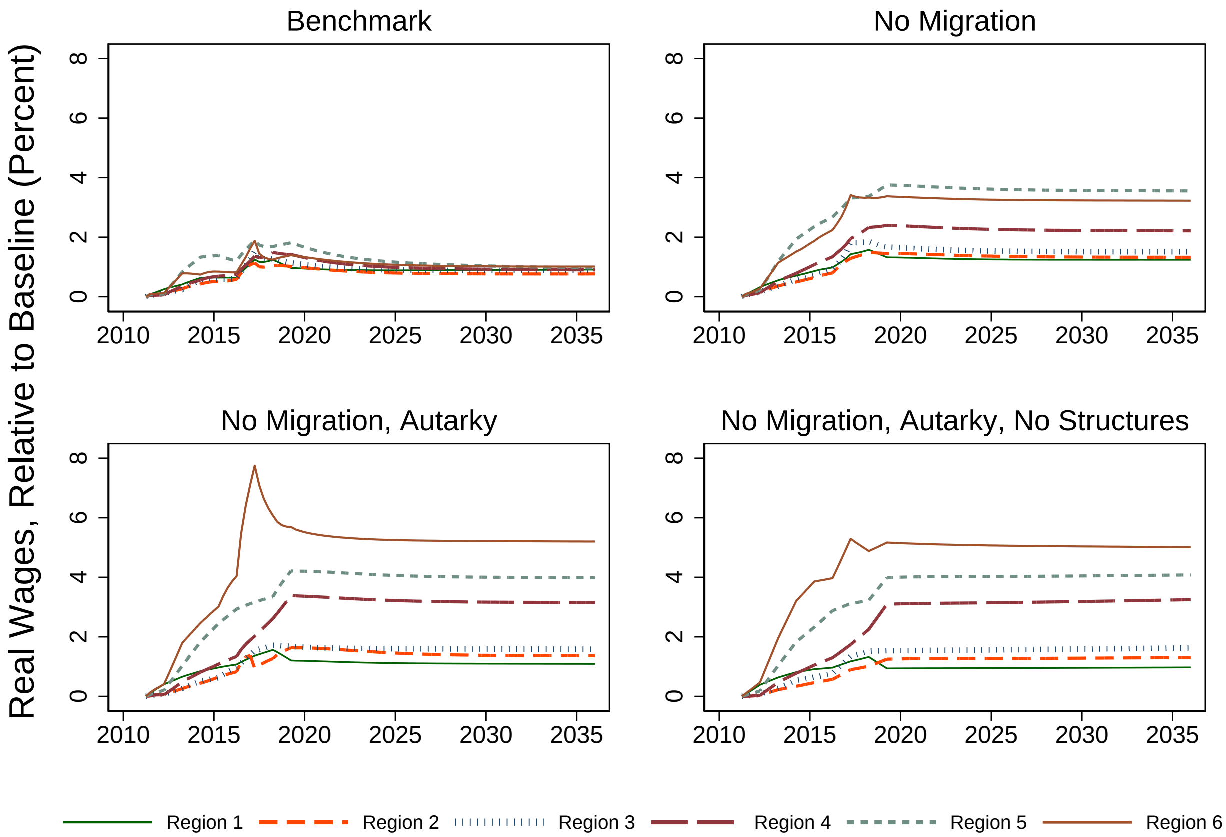

Figure 7: Real Wage Effects of the 2012 Subsidy Program
Notes: Each of the four panels display real wage trajectories for a separate model calibration. Real wages within each region are averages among employed individuals, using baseline industries employment to weight within each region. Compared to the top left panel, in the top right panel, our calibration imposes that workers may not migrate across subsidy regions (they may still move across industries within their regions). In the bottom left panel, we additionally impose that there are no material goods purchases across subsidy regions (input-output linkages still exist within regions). Finally, in the bottom right panel, we set the structures' share in value added to be equal to 0. See Figure 1 or Appendix E.3 for the lists of provinces within each of the 6 subsidy regions.

With the aim of understanding why the policy had such modest impacts on real wages, we consider three additional calibrations of our model. In these three calibrations, we progressively restrict channels through which subsidies in one region may spill over to others. In our second calibration (labeled "No Migration" in Figure 7), we restrict migration across provinces. In the third (labeled "No Migration, Autarky"), we additionally restrict inter-regional trade flows. In the fourth and final calibration (labeled "No Migration, Autarky, No Structures"), we parameterize firms' production functions so that the cost share of structures in value added is equal to 0, thereby eliminating rents earned by absentee rentiers. Each of the alternate calibrations is to highlight the importance of trade, migration, and capital rent spillovers in shaping the policy's ability to reduce regional inequality.

Comparing the top two panels of Figure 7 highlights the role of migration: In the top right panel, we consider an alternate calibration in which individuals are allowed to switch industries but not regions. Here, our calibrated model suggests that the investment subsidies will have reduced Region 6 versus Region 1 real wage inequality by 1.2 percent as of 2016, 2.0 percent as of 2026, and 2.0 percent as of 2036.[38]

The bottom panels of this figure assess calibration in which both trade flows and worker flows occur only within subsidy regions (bottom left panel) and, additionally, in which rentiers receive no income from renting structures (bottom right panel). In a world without trade flows across regions, this calibration indicates that the impact of the subsidy program on real wage inequality (now between Region 6 and Region 1) would have been even greater: 2.8 percent, 4.1 percent, and 4.1 percent as of 2016, 2026, and 2036, respectively (see the bottom left panel). Comparing the bottom left and bottom right panels of Figure 7 indicates that income spillovers due to rentiers' profits from structures play a minimal role.

In sum, we find that the 2012 policy had a modest impact on regional real wage inequality, especially in the long run. Migration and trade flows that traverse Turkey's six subsidy regions are a key reason why this policy had such a modest impact. These results highlight the limits of a common approach in the place-based literature to study spillovers: applying progressively larger regional and industry definitions in difference-in-difference setups. While a large fraction of spillovers tend to occur among nearby provinces, we show that a substantial portion of migration and flows span Turkey.

Alternate Calibration of the Effects of the 2012 Policy on Regions' Real Wages

Figure 8 presents the real wage effects of the subsidy program using our "indirect inference" approach to calibrate the impact of investment tax credits received on firm productivity. As this calibration imposes a larger effect of subsidization on productivity, we find larger effects on real wages in Figure 8 than in Figure 7. According to the top left panel of Figure 8, the subsidization led to a decrease in real wage inequality (between Region 6 and Region 1, as of 2036) of approximately 2.2 percentage points. Besides the larger overall impacts, our main conclusions from

[38]The fact that a substantial portion of the potential real wage gains induced by the subsidies are dissipated through migration to subsidized areas (this could be a combination of reduced out-migration and in-migration) raises interesting questions about the Turkish government's views on desired outcomes of the program. Namely, would it find a "quantity" rather than "price" response—stemmed depopulation in place of reductions in per capital income gaps—acceptable, and at what rate would it be willing to trade the two off for one another? Such a trade-off is plausible. There is some evidence that the government believes İstanbul congestion is socially costly and might want to relieve migratory pressure (Milliyet, 2022). Further, to the extent that agglomeration economies, at least on the margin, were stronger in poorer regions than in wealthier ones, limiting migration might be an additional benefit.

Figure 7 also pertain to Figure 8: The impacts of the 2012 policy on regional real wage inequality are larger in the short run than in the long run. Spillovers across regions due to migration and trade are both important in limiting the effectiveness of the subsidies on reducing regional inequality.

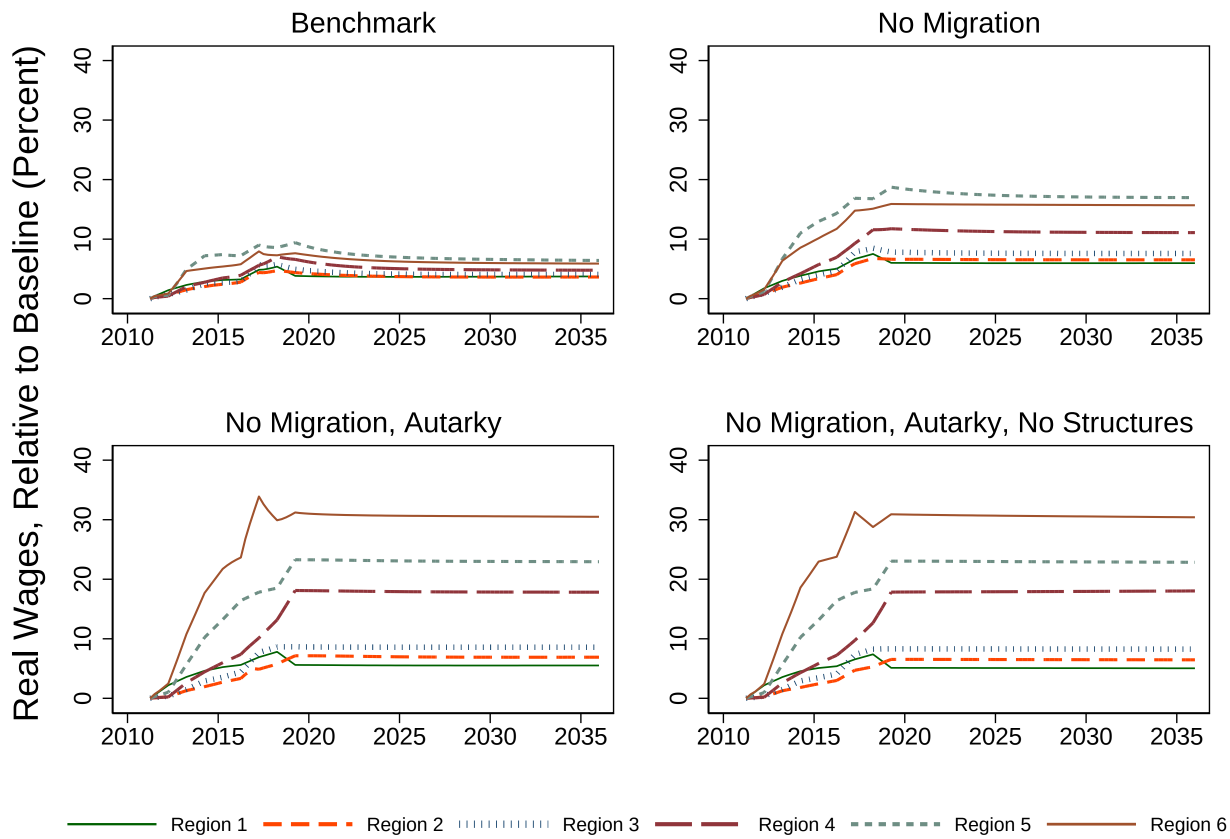

Figure 8: Real Wage Effects of the 2012 Subsidy Program
Notes: See the notes for Figure 7. In contrast to that figure, here we apply an indirect inference approach to calibrate the direct productivity gains from subsidization.

Additional Sensitivity Analyses

In this subsection, we briefly describe additional sensitivity analyses that are collected in Appendix D.3.

In Figure 16, we plot the impact of the subsidy program on regions' real wages, under an alternate calibration in which the share of firms with a closed subsidy certificate measures the level of subsidization across industries and subsidy regions. Our main results regarding (i) the effect of the subsidy program on real wage inequality, (ii) differences between long-run and short-run impacts, and (iii) differences between the "benchmark" calibration and the calibrations without migration, without inter-regional materials trade flows, or without structures are robust to this alternate measure of firm subsidization.

In the same appendix, in Figure 18 we illustrate the importance of accounting for informality. That is, when we compute average investment tax credits received, trade and worker flows across subsidy region-by-industry pairs, we re-calibrate our model assuming (incorrectly) that the share of firms and employment in the informal sector are equal to 0. We find that the real wage impacts of the subsidy program are considerably larger, primarily because this calibration ignores the roughly 30% of the economy that is ineligible to receive subsidies. However, again, we find that the impact of the subsidy program on regional real wage inequality is modest, again due to trade and worker flows that traverse subsidy regions.

5.4 Out of Sample Predictions

In conducting our counterfactual exercises, our primary inputs were the time paths of investment tax credits by industry and subsidy region and the link between investment tax credits received and total factor productivity. We used our model to examine the impact of the subsidy program — through their reduction on firms' unit labor and capital rental costs — on real wages within each industry and subsidy region. In this section, we assess the model's ability to match two sets of non-targeted variables. We examine the counterfactual exercise's predictions for the impact of the subsidy program on employment and revenues, comparing the time paths of these variables to those observed in our data. The overlap between the model-implied counterfactual effects on employment and revenues and those observed in the data serves as a diagnostic on our model and its calibration. Since our "indirect inference" approach to identify the link between investment tax credits and firm productivity relies on the relationship between industry-region revenues and subsidization, we only assess counterfactual effects based on our firm-regression-based calibration.

Figure 9 presents our main comparison. Within this comparison, we group industries as "subsidized" (if their average investment tax credit rate received is greater than 1.0% in 2016-2018) or, otherwise, "unsubsidized."[39] For each set of industries, for each subsidy region, we compute the counterfactual sales growth (left panel) or employment growth (right panel), comparing 2011 to 2016-2018. According to our model, subsidized firms in the 6th subsidy region increased their employment by 6.3%, and their revenues by 8.3%. In contrast, subsidized firms in the first subsidy region had sales growth of 1.8%, and employment growth by 1.5%. We compare these counterfac-

[39] The list of subsidized industries includes crops (NACE= "a01"), fishing (NACE= "a03"), the mining sector (NACE="b"), the waste management sector (NACE = "e"), accommodation and food services (NACE= "i"), and the education sector (NACE= "p"). In addition, all industries within the manufacturing sector (NACE= "c") with the exception of paper manufacturing (NACE="c17"), printing and reproduction of recorded media (NACE="c18"), and rubber and plastics manufacturing (NACE="22") have an average investment tax credit rate greater than 1.0%.

tual sales and employment growth to its counterpart in the data. To compute this data counterpart, we regress industry-region pair log revenues against industry-region fixed effects and year fixed effects. From this regression, we compute the average residual (from 2016 to 2018) for each region, separately for "subsidized" and "unsubsidized" industries. Overall, we find a strong relationship between this average residual and the model counterfactual. However, the difference in growth rates between subsidized industries in Regions 5 and 6 and other region-industry pairs is substantially greater in the data — with effects approximately four times as large — than according to our model calibration.

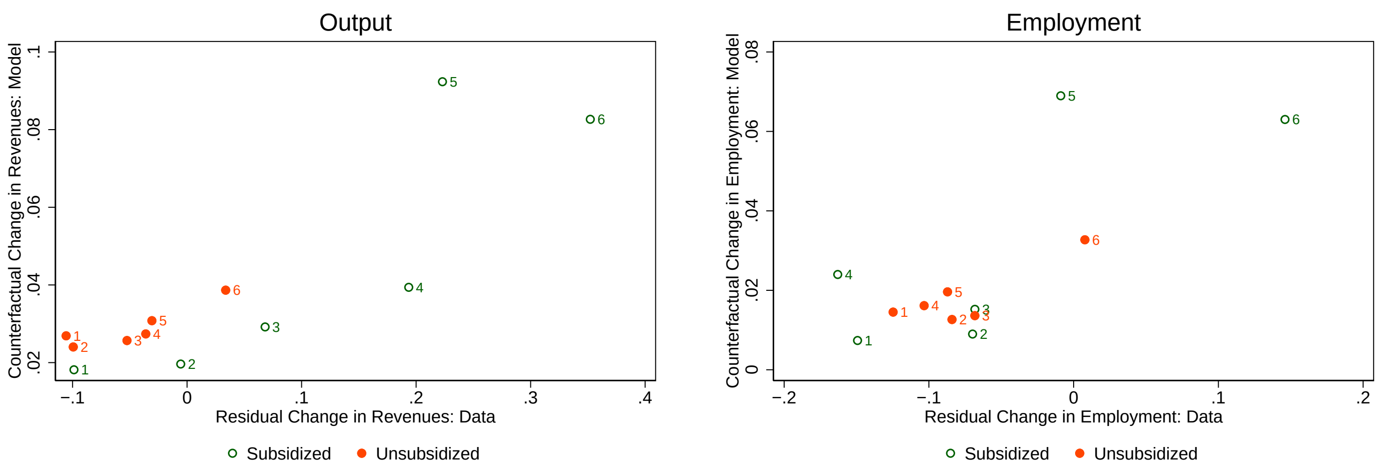

Figure 9: Subsidization, Employment, and Revenues: Model Counterfactuals and Data
Notes: Within each panel, the vertical axis gives the increase — as of 2016-2018, relative to 2011 — in revenues (or employment), relative to a counterfactual economy in which the subsidy program had not been enacted. The horizontal axis gives the average residuals, from a regression with log revenues (or log employment) as the dependent variable and industry-by-subsidy-region pair and year fixed effects as the covariates.

6 Conclusion

In this paper we study the introduction of place-based policies in Turkey. These new subsidies were aimed at promoting investment activity, particularly in the relatively impoverished southeast of the country. We find that each 5 percentage point increase in investment tax credit subsidy rates led to firms' revenues, employment, and TFPR being higher by 10.5%, 6.9%, and 3.5%, respectively. However, our general equilibrium analysis reveals that the 2012 subsidy program had only a modest impact on inter-regional wage inequality.

There are several caveats to these conclusions. First, as with any piece of research focused on a single historical episode, there are potentially limits to the generalizability of the paper's conclusions to other environments. Among the many unique features of the backdrop to our study, the period after the subsidies were introduced coincided with a large influx of refugees due to the 2010s Syrian Civil War and a significant devaluation of its currency, with the impacts of these events likely differing by geography and industry.[40,41] Given these unique aspects, a similarly designed set of investment subsidies may conceivably have a different impact in other countries. Second, the calibration of our Section 5 model requires information on subsidy take-up rates. To understand the long-run impact of the subsidy program, we necessarily extrapolated take-up rates beyond the end of our sample period. We assumed a leveling off of the fraction of firms who received subsidies from the Turkish government. But alternate assumptions, including a continued increase in subsidization, are both reasonable and would lead to an alternate assessment on the policy's long-run impact.

While these issues are certainly valid, many of the lessons from our analysis may prove useful under other assumptions and in other contexts. Inter-regional spillovers — migration, input-output linkages, and landlords' ownership of structures in regions other than where they reside — limit the extent to which the place-based policy specifically benefited the targeted region. We argued, further, that the effects may differ in the short and long run. In the short run, there is relatively little migration across regions. In the long run, however, increases in labor supply to more heavily subsidized regions mute the impact of the subsidy program on inter-regional real wage inequality. Since considerable inter-regional trade and migration flows are a common feature, these insights on the short- and long-run impacts' of place-based policies on regional income inequality are likely to be universal.

[40] Between January 2007 and January 2012, the Turkish Lira lost approximately 30 percent of its value relative to the US dollar. In the following seven years, from January 2012 to January 2019, the value of the Lira depreciated from 1.83 to the US dollar to 5.47 to the US dollar, a three-fold increase.

[41] As of 2018, there were 3.3 million Syrian refugees living in Turkey (Del Carpio et al., 2018).

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A Data

In this section, we discuss our data sources and data cleaning procedures (Appendix A.1 and A.2). In Appendix A.3, we then compare aggregates computed from our micro data sources to those in publicly available datasets. Much of the discrepancy between the two arises due to the lack of information on informal-economy workers in our micro datasets. In Appendix A.4, we compute the share of employment that is informal in each industry-region cell, then re-compare aggregates from our micro data sources to those in publicly available datasets. Finally, in Appendix A.5 we discuss how we compute labor flows across industry-by-subsidy region pairs.

A.1 Details on Entrepreneur Information System (EIS)

The Entrepreneur Information System (EIS) is administered by the Ministry of Science, Industry and Technology in Turkey as of 2014. Data from seven public institutions (Ministry of Customs and Trade, Revenue Administration (GIB), Social Security Institution (SGK), Small and Medium Enterprises Development and Support Administration (KOSGEB), Turkish Statistical Institute (TÜİK), Turkish Patent Institute (TPI) and the Scientific and Technological Research Council of Turkey (TÜBİTAK) are brought together in the EIS by the Ministry. In this study, we use the following data sets from the EIS: the "Entrepreneurship Registry Microdata Set," the "Workplace Registry Microdata Set," and the "Balance Sheet Micro Dataset." While calculating the indirect effects and detailed employment effects, we also use the "Declaration-Buying/Selling (BA/BS) Micro Dataset" and the "Employee Micro Dataset."The EIS includes data for Turkish manufacturing and service companies and excludes the finance sector. Information on the agriculture sector and public personnel is not included in the EIS.

Table 13 lists the number of firms in our sample by year and industry. There are 202,014 unique firms in our sample, and 945,657 firm-year observations. At the beginning of the sample, approximately 69% of the firms in our sample are headquartered in Region 1; slightly less than 3% of the sample are from Region 6. The number of firms in the sample has grown by 5.8% per year, with faster growth in Regions 5 and 6 and slower growth in Region 1. By the end of the sample, 6% of the firms were headquartered in Region 6, 63% in Region 1.

Table 13: Firm Counts

Year\Region	1	2	3	4	5	6	Total
2006	32,489	5,282	3,728	2,451	1,554	1,265	46,769
2007	35,467	5,998	4,388	3,134	1,945	1,656	52,588
2008	38,036	6,381	4,824	3,592	2,326	2,123	57,282
2009	35,337	6,242	4,875	3,622	2,411	2,267	54,754
2010	38,554	7,017	5,438	4,132	2,731	2,806	60,678
2011	42,925	7,937	6,219	4,674	3,054	3,159	67,968
2012	46,763	8,980	7,123	5,255	3,521	3,974	75,616
2013	50,055	9,332	7,415	5,184	3,487	4,016	79,489
2014	52,765	9,843	7,924	5,457	3,611	4,480	84,080
2015	56,526	10,946	8,651	5,887	3,911	4,610	90,531
2016	55,765	11,128	8,516	5,784	3,941	4,717	89,851
2017	56,805	11,480	8,982	5,942	4,138	5,191	92,538
2018	57,407	11,492	9,055	5,990	4,157	5,412	93,513
Total	127,082	24,601	19,356	13,471	9,605	12,105	202,014

A.2 Data Cleaning Procedures

To ensure the soundness of the study, some observations are excluded from the sample following a number of criteria. The data of companies with missing, negative or zero total assets, sales, and long-term and tangible assets are excluded from the analysis. In addition, the data of companies whose short-term and long-term liabilities, current assets, total bank loans, payments, other liabilities and long-term debts are negative are also removed from the sample. Apart from these, the variables with outlier observations are winsorized at 1%, 2% or 5% levels, when necessary.

A.3 Auditing the Micro Data

In this section, we evaluate the coverage of the micro datasets listed in Appendix A.1. These firm and worker datasets measure activity only in the formal economy, and thus may miss a substantial fraction economic activity. Furthermore, the coverage of our micro data may vary with geography (with greater coverage in the larger cities and in the west) and industry (with greater coverage in the non-agricultural sectors of the economy). Our goal, for now, is to gauge the severity of these coverage issues. In future drafts, we aim to use the discrepancies to better calibrate our dynamic general equilibrium model.

We provide two sets of comparisons. In the first, we compare province-level employment in our micro data to its counterpart in aggregate datasets compiled by TürkStat (the Turkish Statistical Institute). In the second comparison, we compare industry-level output and factor shares according to our micro data to aggregate statistics derived from the Socio-Economic Accounts from the World

Input-Output Database (WIOD).

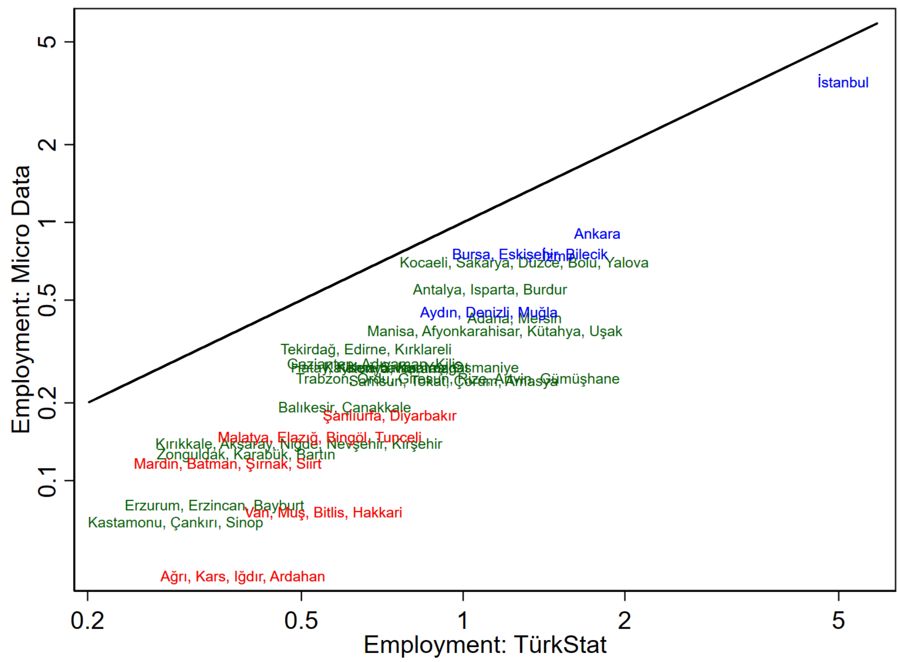

Figure 10: Comparison of Micro to Aggregate Data: Province Employment

Notes: The values on each axis are millions of workers. Groups of provinces overlapping with the least-heavily subsidized Region 1 are colored in blue; groups of provinces overlapping with the most-heavily subsidized Region 6 are colored in red. All other groups of provinces are colored in green.

In our first comparison, we aggregate the total employment among the firms in our micro data, summing across the firms within (groups of) provinces. We compare this employment figure to the number of employed individuals measured in TürkStat. Figure 10 presents this comparison for a single year, in 2014. Since our dataset omits informal-economy workers, the number of workers in our dataset is consistently below that in the aggregate dataset. Furthermore, this relative discrepancy is smaller in the first subsidy region (e.g., Ankara; İstanbul; Bursa, Eskişehir, and Bilecik) than in the sixth subsidy region (e.g., Van, Muş, Bitlis, and Hakkâri; Ağrı, Kars, Iğdır, and Ardahan; and Mardin, Batman, Şırnak, and Siirt).

In our second comparison, we aggregate different output and input measures — total wage compensation, total employment, and total gross output — among the firms in our micro dataset. Using these industry-level measures, we compute, at the industry level, total gross output, total employment, average wages per employee, and the ratio of labor expenditures to gross output. In Figure A.3 we compare these four industry-level measures to their corresponding values in the World Input-Output Database. In addition to the two datasets' disparate treatment of informal economy workers, the World Input-Output Database applies a different industry definition relative to that in our micro dataset. For this reason, low concurrence across the two datasets is less of a concern than in Figure 10. With this caveat in mind, the correlations depicted in the four panels of Figure A.3 are 0.39 (for gross output), 0.30 (for employment), 0.49 (for average wages), and 0.17 (for the labor share.) The Spearman rank correlations are somewhat higher: 0.57, 0.59, 0.53, and 0.15, respectively. The biggest difference in terms of industries' size is in the agriculture sector: According to the WIOD, the gross output of the agricultural sector was 147.8 billion TL as of 2012. Of this, only 12.0 billion TL are recorded in our micro database. For other industries, the difference is less stark. Overall, there are considerable differences in the output measures across the two data sources.

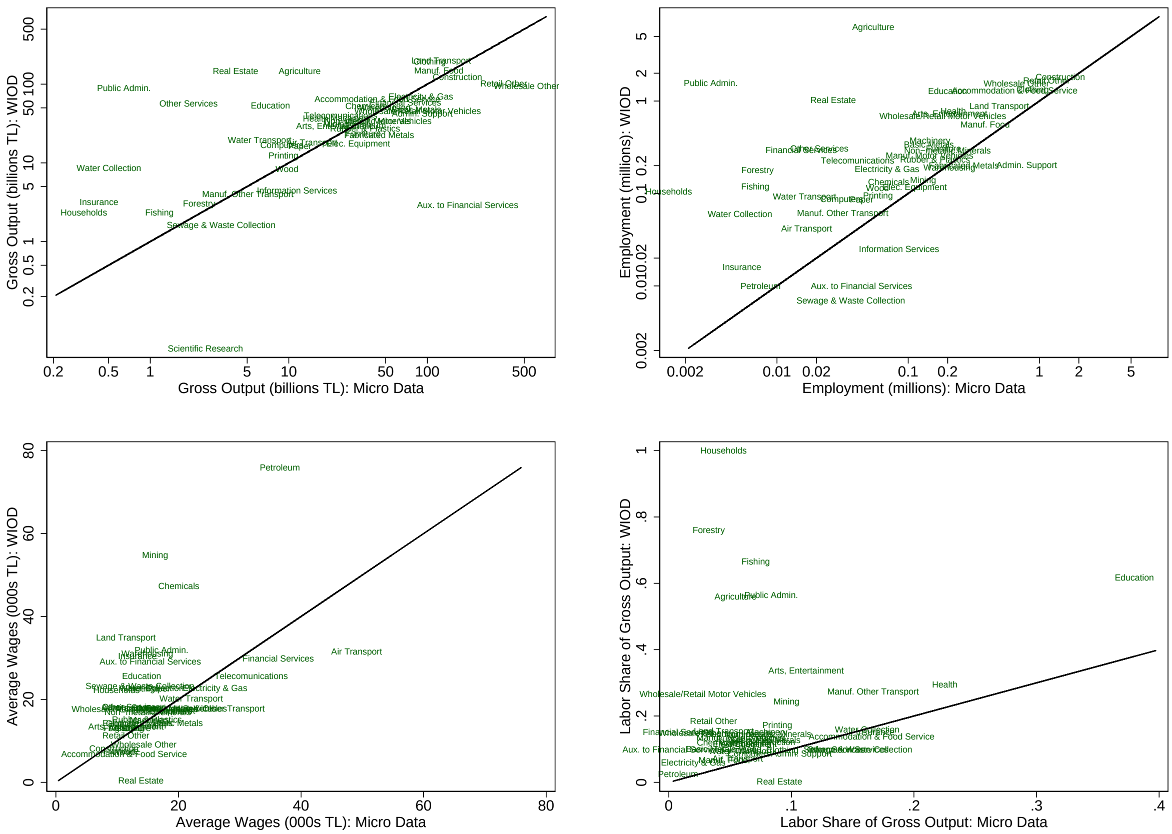

Figure 11: Comparison of Micro to Aggregate Data: Industry Activity
Notes: Values in the top left and bottom left panel are reported in 2010 Turkish Liras.

A.4 Accounting for Informality

In the previous subsection, we documented considerable discrepancies between aggregates computed using the EIS micro data and comparable aggregates from publicly available datasets. We hypothesized that part of this discrepancy was due to the fact that the EIS data captures only the formal economy. In this appendix, drawing on Acar and Carpio (2019), we explain how we estimate informality at the province-industry level. We then reproduce Figure 10, accounting for the lack of data on the informal economy in the EIS data.

Acar and Carpio (2019) provide estimates of the share of employment that is formal — by broad sector and by groups of provinces — as of 2017. We reproduce these estimates in Tables 14 and 15. The formal share is lowest in Ağrı, Kars, Iğdır, and Ardahan (32%) and highest in Ankara (82%). Furthermore, the share of workers in the formal sector is lowest in Agriculture, Forestry and Fishing (17%) and highest in Mining (96%).

Table 14: Formal Share by Sector

Sector	Formal Share
Agriculture, Forestry, Fishing	17.0%
Mining	96.0%
Manufacturing	83.5%
Services, Transport	73.0%
Construction	64.0%
Wholesale, Retail	72.0%
Accommodation, Food	69.0%
Services	82.0%

Notes: This table reproduces Figure 25 of Acar and Carpio (2019). Acar and Carpio (2019) provide two estimates of the formal share for manufacturing — 77% in low/medium-skilled manufacturing and 90% in high-skilled manufacturing — and two estimates of the formal share for services — 69% in low/medium-skilled services and 95% in high-skilled service. For each sector we take the average of these two numbers.

Table 15: Formal Share by NUTS-2 Region

NUTS-2 Region	Formal Share	NUTS-2 Region	Formal Share
İstanbul	79%	Nevşehir, Aksaray, Kırşehir, Niğde, Kırıkkale	62%
Edirne, Tekirdağ, Kırklareli	67%	Kayseri, Sivas, Yozgat	69%
Balıkesir, Çanakkale	61%	Zonguldak, Karabük, Bartın	56%
İzmir	76%	Kastamonu, Çankırı, Sinop	45%
Denizli, Aydın, Muğla	66%	Samsun, Tokat, Çorum, Amasya	55%
Manisa, Afyonkarahisar, Uşak, Kütahya	61%	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane	49%
Bursa, Eskişehir, Bilecik	77%	Erzurum, Erzincan, Bayburt	52%
Kocaeli, Sakarya, Düzce, Bolu, Yalova	71%	Kars, Ağrı, Iğdır, Ardahan	32%
Ankara	82%	Malatya, Elâzığ, Bingöl, Tunceli	51%
Konya, Karaman	58%	Van, Muş, Bitilis, Hakkâri	37%
Antalya, Isparta, Burdur	68%	Adıyaman, Gaziantep, Kilis	61%
Adana, Mersin	60%	Diyarbakır, Şanlıurfa	38%
Hatay, Kahramanmaraş, Osmaniye	58%	Siirt, Mardin, Batman, Şırnak	60%

Notes: This table reproduces Figure 24 of Acar and Carpio (2019).

In addition Acar and Carpio (2019) present trends in the national economy-wide formality rate. Let $\hat{\varphi}_{p,2017}$ refer to Acar and Carpio (2019)'s estimate of the formal share in 2017 in province p and $\hat{\varphi}_{j,2017}$ refer to the corresponding estimate of the formal share in industry j. Our goal is to impute the formal share in an arbitrary year, for each industry-province pair. Call this object $\hat{\varphi}_{pjt}$.

To compute $\hat{\varphi}_{pnt}$ we follow a two-step procedure. In a first step, using $\bar{\varphi}_t$ to denote the economy-wide formal share in year t, we initially set $\check{\varphi}_{pjt} = \hat{\varphi}_{j,2017} \cdot \frac{\bar{\varphi}_t}{\bar{\varphi}_{2017}} = \hat{\varphi}_{j,2017} \cdot \frac{\bar{\varphi}_t}{0.66}$. This initial variable, $\check{\varphi}_{pjt}$, allows us to match formal shares at the industry level, but does not capture any between-province variation. In a second step, using $\overline{\check{\varphi}}_{pjt}$ to refer to the economy-wide average of $\check{\varphi}_{pjt}$, we replace $\check{\varphi}_{pjt}$ with $\hat{\varphi}_{pjt} = \check{\varphi}_{pjt} \cdot \frac{\hat{\varphi}_{p,t}}{\overline{\check{\varphi}}_{pjt}}$. Figure 12 plots the formal employment share by industry and subsidy region. According to this figure, there is heterogeneity in both dimensions: within each region, formal employment shares are higher in mining and lower in agriculture; and within each industry, formal shares are higher in Region 1 and lower in Region 6.

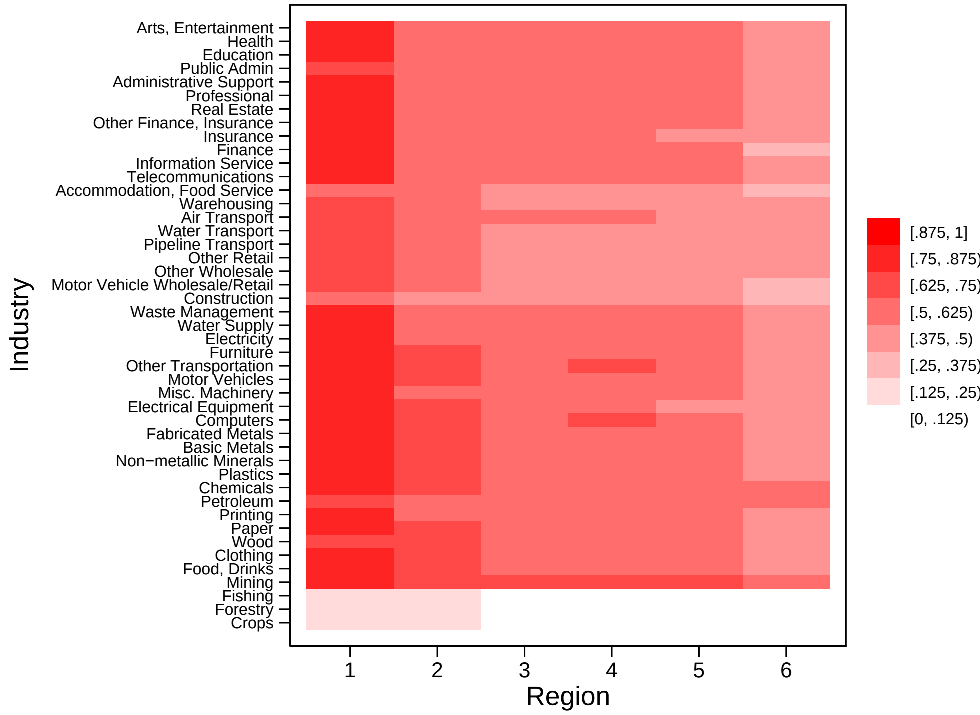

Figure 12: Formal Employment Share by Industry and Region

We reproduce Figure 10 using Acar and Carpio (2019)'s estimates of informality by group of province. For each group of provinces, we divide our measure of the micro data employment by $\left(1-\hat{\varphi}_{p,2014}\right)=\left(1-\hat{\varphi}_{p,2017}\cdot\frac{0.65}{0.66}\right)$, where the $\frac{0.65}{0.66}$ accounts for the fact that formal share increased by 1 percentage point, from 0.65 to 0.66, between 2014 and 2017. We plot the informality-adjusted measure of employment in the EIS micro data against employment in the TürkStat data. When adjusted for differences in the share of formal workers by groups of provinces, the discrepancy between the two measures of employment is substantially smaller in Figure 13 than in Figure 10.

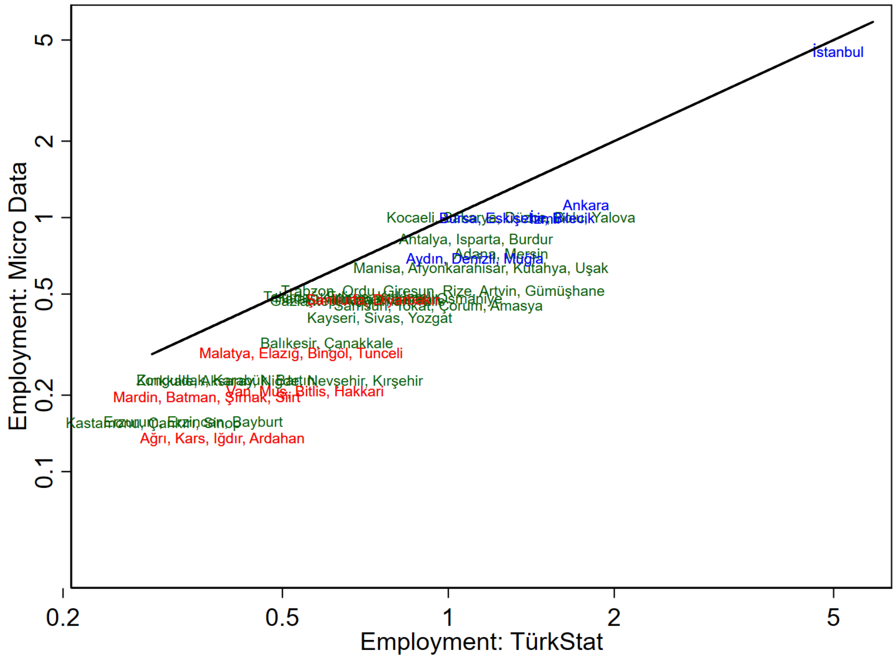

Figure 13: Comparison of Micro to Aggregate Data: Employment by NUTS-2 Geography
Notes: See the notes for Figure 10. In contrast to that figure, we adjust the micro data to account for differences in the share of informality across groups of provinces.

A.5 Imputing Employment Flows

In this section we discuss the construction of Figure 3, the flows of workers across subsidy region-industry cells across subsequent years. In computing these flows, we face two challenges. First, our micro data do not record transitions into or out of non-employment. (The data track individuals across time, permitting measurement of entry to and exit from industries in the formal sector. However, this dataset does not allow one to distinguish whether an individual is not-employed or employed in an informal-sector industry.) Second, to maintain confidentiality, we were permitted by the Ministry of Industry and Technology to disclose flows of workers in slightly aggregated industries.[42] Below, let j denote one of the 45 industries in our baseline sample, and $\tilde{j}$ one of the

[42] When disclosing the data, we were asked to aggregate crops (NACE= a01), forestry (NACE=a02), finishing (NACE=a03), and Mining (NACE=b) into one sector; food, beverage, and tobacco manufacturing (NACE=c10-c12) and textile, apparel, and leather manufacturing (c13-c15) into a second sector; and all other manufacturing (NACE c16-c33) into a third sector. We group electricity, gas, steam, and air conditioning (NACE=e) and construction (NACE=f) into a fourth sector; wholesale and retail (NACE=g) into a fifth sector; transportation and storage (NACE=h) into a sixth sector; accommodation (NACE=i) into a seventh sector; information and communication (NACE=j) into an eighth sector; finance, insurance, and real estate (NACE=k and NACE=l) into a ninth sector; professional, scientific, and technical activities (NACE=m) and administrative and support service activities (NACE=n) into a tenth sector; public administration (NACE=o) into an eleventh sector; education (NACE=p) into a twelfth sector; and human health and social work (NACE=q), arts, entertainment, and recreation (NACE=r), and other services (NACE=q) into a thir-

more aggregated 13 sectors. Let $j=0$ or $\tilde{j}$=0 denote non-employment. Our goal is to compute transition probabilities, $\mu^{nj,ik}$, giving the share of individuals who transition from industry-region pair nj to industry-region pair ik across two subsequent years. Below, use $\mu^{n\widetilde{j},i\widetilde{k}}$ to refer to transition probabilities among broad-sector-by-region pairs.

In a first step, we compute the vector of the share of workers in each region-industry $(n\text{-}j)$ pair. From Eurostat (2021a,b), we retrieve employment-to-population ratios and population (among individuals who are 25-64 years old) by NUTS-2 region. We aggregate NUTS-2 regions' employment-to-population ratios up to our 6-subsidy-region categorization, weighting NUTS-2 regions by population. This yields an expression for the employment-to-population by year and subsidy region. Call this object $\bar{l}_{nt}$. From the EIS, we observe the share of formal-sector national employment in region n and industry j . Call this object l_{njt}. To compute the share of total employment in region n and industry j, we divide l_{njt} by $\hat{\varphi}_{njt}$ (the formal share in subsidy region n and industry j, as computed in Appendix 3.) Call the resulting object $\widehat{l}_{njt}$. Given this, we can compute the share of the adult population employed in region-industry pair n-j as

$$
\begin{aligned}
\widetilde{l}_{njt} &= \bar{l}_{nt} && \text{for } j=0, \text{ and} \\
&= \left(1-\bar{l}_{nt}\right) && \text{for } j=\{1,\ldots J\}.
\end{aligned}
$$

teenth sector.

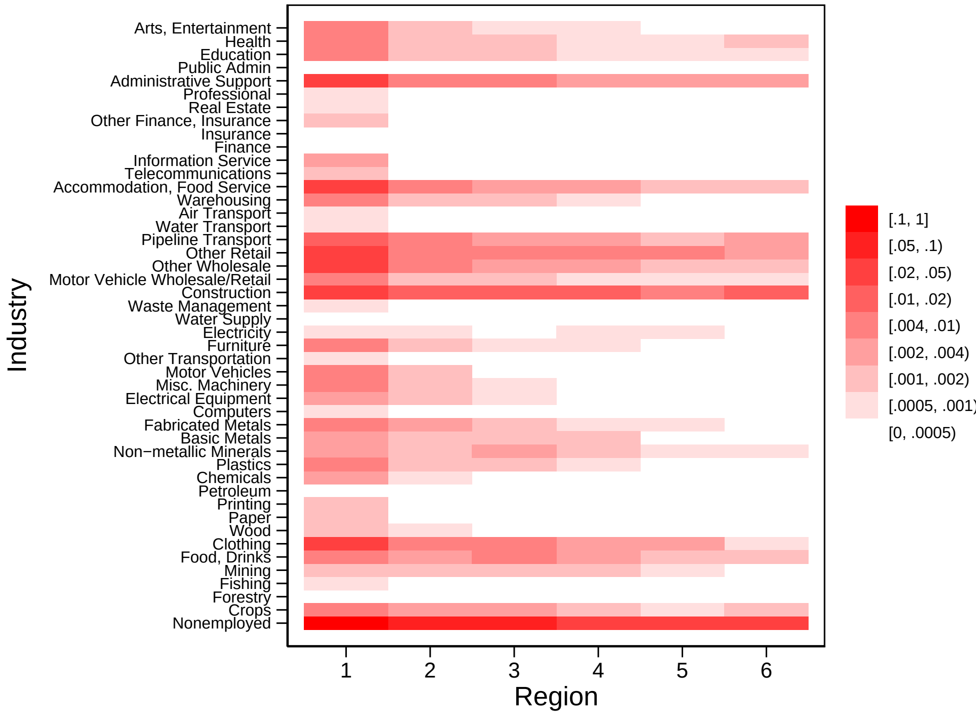

Figure 14: Formal Employment by Industry and Region

Figure 14 plots $\widetilde{l}_{njt}$. Non-employment rates are exceptionally high, at 45.9% nationally (in the plotted year, 2012). Slightly more than half, 50.9%, of the adult population resides in Region 1. Among industries with positive employment, the share of workers are highest in construction, Other Retail (Retail outside of the sale of motor vehicles), Clothing Manufacturing, and Administrative Support.

In a second step, we combine information on $\widetilde{l}_{njt}$ and information on flows of formal-sector workers across region-broad-sector pairs to form our estimates of ${\mu_t}^{nj,ik}$. We consider three cases: whether (a) $n = i$ and $j = k$; whether (b) $n = i$ and $j \neq k$, but industries j and k belong to the same broad sector; or (c) all other cases (either $n \neq i$, or j and k belong to different broad sectors). In case (c), we define ${\mu_t}^{nj,ik} \propto \widetilde{l}_{ikt}{\mu_t}^{n\widetilde{j},i\widetilde{k}}$ where $\sum_{k \in \widetilde{k}} {\mu_t}^{nj,ik} = {\mu_t}^{n\widetilde{j},i\widetilde{k}}$. That is, within each destination sector, the probability of transitioning to a particular industry is proportional to the employment share of that industry. We could have potentially applied this same definition for cases (a) and (b), as well. However, this would have led us to miss a key feature of transition probabilities documented elsewhere, namely that individuals are substantially more likely to stay within the same industry-region pair across subsequent years. For case (b), we set ${\mu_t}^{nj,ik}$ as the 75$^{\text{th}}$ percentile among the ${\mu_t}^{nj,i'k'}$ for which $i' = n$ and $\widetilde{j} \neq \widetilde{k}$. This definition allows for relatively high values for within-industry, within-broad-sector flows. For case (a), we set ${\mu_t}^{nj,ik}$ as the residual probability.

Table 16 summarizes transition probabilities for a single year in our sample, 2012. The takeaway from this table is that flows are considerably higher when $i = n$ and $j = k$, somewhat lower when either $i = n$ or $j = k$, and lower still when neither $i = n$ nor $j = k$. Approximately 89.6% of individuals stay in their same industry-subsidy region pair across years; 8.4%($\approx 0.0019 \cdot \frac{12{,}420}{276}$) switch industries but not regions; and 2.0% switch subsidy regions.[43]

Table 16: Worker Flows Within and Across Industry-Region Pairs

			Percentile			
Type of Flow	N	Mean	25	50	75	90
Same Industry, Same Region ($i = n, j = k$)	276	0.8960	0.8856	0.9026	0.9080	0.9204
Different Industry, Same Region ($i = n, j \neq k$)	12,420	0.0019	0.0000	0.0002	0.0008	0.0017
Same Industry, Different Region ($i \neq n, j = k$)	1,380	0.0004	0.0000	0.0001	0.0003	0.0010
Different Industry, Different Region ($i \neq n, j \neq k$)	62,100	0.0001	0.0000	0.0000	0.0000	0.0001

B Turkish Investment Subsidies

B.1 Subsidized Industries

According to the 2012 subsidy program, only investments within certain industries are eligible. The Turkish government provides a list of industries receiving subsidies at: `https://www.resmigazete.gov.tr/eskiler/2012/06/20120619-1-2.xls`. The column labeled "US-97 Kodu," within the "2A_Sektörler" worksheet refers to the NACE 1.1 code. The second worksheet, labeled "2B_Iller," provides a mapping between provinces and subsidized industries. In this section, we translate and summarize the key elements of these two Excel worksheets.

In Table 17, we provide a mapping between the Turkish government's numbering of subsidized sectors and NACE (version 2) industry codes.

[43] Another check of the validity of our approach: Let μ refer to the 276×276 (where $276 = 46 \cdot 6 = N \cdot (J+1)$) matrix storing transitions across industry-region cells and $\widetilde{\mathbf{l}}$. One check for the validity of our method of imputing elements of μ is to compare $\widetilde{\mathbf{l}}$ to the rows of $\lim_{x \to \infty} \mu^x$. Using values from 2012, the correlation between the elements of $\widetilde{\mathbf{l}}$ and the elements of any row of $\lim_{x \to \infty} \mu^x$ equals 0.98.

Table 17: Mapping Between Turkish Government Industries and NACE Industries

Sector	NACE 2 Industries	Sector	NACE 2 Industries
1	1.41, 1.42, 1.43, 1.44, 1.45, 1.47	26	23
2	3.22	27	24.54
3	10	28	25
4	13	29	25
5	14	30	28
6	15	31	23
7	15.11	32	28.23
8	15.12, 15.20	33	26, 27
9	16	34	26.30
10	17	35	32.50
11	20	36	29
12	20.15	37	33.16
13	20.20	38	30.91, 30.92
14	21.20	39	31, 32.20, 32.30, 32.40, 32.99, 33.20
15	20.42	40	31.09
16	20.51	41	55.10, 55.20, 55.90
17	22.11	42	55.90
18	23	43	52.10
19	23	44	55.10
20	23	45	85
21	23	46	86.10, 86.20, 86.90, 87.20, 87.30, 87.90
22	23	47	
23	23	48	
24	23	49	
25	23	50	

In Table 18, we provide a list of subsidized industries and Turkish provinces.

Table 18: Lists of Subsidized Industries By Province

Code	Province	List of Subsidized Industries
1	Adana	1, 2, 3, 4, 8, 9, 10, 11, 20, 27, 28, 30, 32, 33, 34, 35, 36, 37, 39, 41, 42, 43, 44, 45, 46, 47, 48, 50
2	Adıyaman	1, 2, 3, 4, 5, 8, 9, 10, 11, 18, 27, 28, 30, 32, 33, 34, 35, 36, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
3	Afyonkarahisar	1, 2, 3, 4, 5, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
4	Ağrı	1 through 50
68	Aksaray	1, 2, 3, 4, 5, 9, 10, 11, 26, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 48, 50
5	Amasya	1, 2, 3, 4, 5, 8, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
6	Ankara	1, 2, 3, 4, 8, 9, 10, 14, 22, 27, 30, 32, 33, 34, 35, 36, 37, 39, 41, 42, 43, 44, 45, 46, 48, 50
7	Antalya	1, 2, 3, 9, 10, 13, 14, 15, 24, 27, 30, 32, 33, 34, 35, 37, 39, 41, 42, 43, 44, 45, 46, 48, 50
75	Ardahan	1 through 50
8	Artvin	1, 2, 3, 4, 5, 8, 9, 10, 14, 25, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
9	Aydın	1, 2, 3, 4, 9, 10, 20, 27, 28, 30, 32, 33, 34, 35, 36, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 50
10	Balıkesir	1, 2, 3, 5, 6, 9, 10, 16, 20, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 48, 50
74	Bartın	1, 2, 3, 5, 8, 9, 10, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
72	Batman	1 through 50
69	Bayburt	1, 2, 3, 4, 5, 8, 9, 10, 14, 19, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
11	Bilecik	1, 2, 3, 4, 5, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
12	Bingöl	1 through 50
13	Bitlis	1 through 50
14	Bolu	1, 2, 3, 4, 6, 9, 10, 11, 21, 27, 28, 30, 32, 33, 34, 35, 36, 38, 39, 41, 42, 43, 44, 45, 46, 48, 50
15	Burdur	1, 2, 3, 4, 5, 8, 9, 10, 13, 14, 15, 24, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 48, 50
16	Bursa	1, 2, 3, 4, 6, 9, 10, 14, 20, 27, 29, 30, 32, 33, 34, 35, 36, 39, 41, 42, 43, 44, 45, 46, 47, 48, 50
17	Çanakkale	1, 2, 3, 9, 10, 20, 27, 28, 30, 32, 33, 34, 35, 39, 41, 42, 43, 44, 45, 46, 48, 49, 50
18	Çankırı	1, 2, 3, 4, 5, 8, 9, 10, 14, 16, 17, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

Notes: Continued on the following page.

Table 18 (Continued): Lists of Subsidized Industries By Province

Code	Province	List of Subsidized Industries
19	Çorum	1, 2, 3, 4, 5, 8, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
20	Denizli	1, 2, 3, 4, 6, 9, 10, 20, 27, 28, 30, 32, 33, 34, 35, 36, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 50
21	Diyarbakır	1 through 50
81	Düzce	1, 2, 3, 4, 5, 9, 10, 11, 21, 27, 28, 30, 32, 33, 34, 35, 36, 38, 40, 41, 42, 43, 44, 45, 46, 48, 50
22	Edirne	1, 2, 3, 4, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 50
23	Elâzığ	1, 2, 3, 4, 5, 8, 9, 10, 14, 25, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
24	Erzincan	1, 2, 3, 4, 5, 8, 9, 10, 14, 19, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
25	Erzurum	1, 2, 3, 4, 5, 8, 9, 10, 14, 19, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
26	Eskişehir	1, 2, 3, 4, 9, 10, 14, 20, 27, 29, 30, 32, 33, 34, 35, 36, 39, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50
27	Gaziantep	1, 2, 3, 4, 5, 8, 9, 10, 11, 18, 27, 28, 30, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
28	Giresun	1, 2, 3, 4, 5, 8, 9, 10, 14, 19, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
29	Gümüşhane	1, 2, 3, 4, 5, 8, 9, 10, 14, 19, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
30	Hakkâri	1 through 50
31	Hatay	1, 2, 3, 4, 5, 8, 9, 10, 11, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
76	Iğdır	1 through 50
32	Isparta	1, 2, 3, 4, 6, 9, 10, 12, 13, 14, 15, 24, 27, 28, 30, 32, 33, 34, 35, 36, 37, 39, 41, 42, 43, 44, 45, 46, 48, 50
34	İstanbul	7, 14, 31, 32, 34, 35, 42, 45, 46, 48
35	İzmir	1, 2, 3, 8, 9, 10, 11, 23, 27, 30, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 43, 44, 45, 46, 48, 50
46	Kahramanmaraş	1, 2, 3, 4, 5, 8, 9, 10, 11, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50
78	Karabük	1, 2, 3, 5, 8, 9, 10, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
70	Karaman	1, 2, 3, 5, 8, 9, 10, 11, 24, 27, 28, 30, 32, 33, 34, 35, 36, 38, 40, 41, 42, 43, 44, 45, 46, 48, 50
36	Kars	1 through 50
37	Kastamonu	1, 2, 3, 4, 5, 8, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50

Notes: Continued on the following page.

Table 18 (Continued): Lists of Subsidized Industries By Province

Code	Province	List of Subsidized Industries
38	Kayseri	1, 2, 3, 4, 9, 10, 11, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
79	Kilis	1, 2, 3, 4, 5, 8, 9, 10, 11, 18, 27, 28, 30, 32, 33, 34, 35, 36, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
71	Kırıkkale	1, 2, 3, 4, 5, 9, 10, 11, 17, 26, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 48, 50
39	Kırklareli	1, 2, 3, 4, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 50
40	Kırşehir	1, 2, 3, 4, 5, 9, 10, 11, 17, 26, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 48, 50
41	Kocaeli	1, 2, 3, 4, 9, 10, 11, 17, 21, 27, 30, 32, 33, 34, 35, 36, 38, 39, 41, 42, 43, 44, 45, 46, 48, 50
42	Konya	1, 2, 3, 8, 9, 10, 11, 24, 27, 28, 30, 32, 33, 34, 35, 36, 38, 40, 41, 42, 43, 44, 45, 46, 48, 49, 50
43	Kütahya	1, 2, 3, 4, 5, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50
44	Malatya	1, 2, 3, 4, 5, 8, 9, 10, 14, 25, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
45	Manisa	1, 2, 3, 4, 5, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50
47	Mardin	1 through 50
33	Mersin	1, 2, 3, 4, 5, 8, 9, 10, 11, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
48	Muğla	1, 2, 3, 4, 9, 10, 20, 27, 30, 32, 33, 34, 35, 36, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50
49	Muş	1 through 50
50	Nevşehir	1, 2, 3, 4, 5, 9, 10, 11, 17, 26, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 48, 50
51	Niğde	1, 2, 3, 4, 5, 6, 9, 10, 11, 26, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 48, 50
52	Ordu	1, 2, 3, 4, 5, 8, 9, 10, 14, 19, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
80	Osmaniye	1, 2, 3, 4, 5, 8, 9, 10, 11, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
53	Rize	1, 2, 3, 4, 5, 8, 9, 10, 14, 25, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
54	Sakarya	1, 2, 3, 4, 9, 10, 11, 21, 27, 28, 30, 32, 33, 34, 35, 36, 38, 39, 41, 42, 43, 44, 45, 46, 48, 50
55	Samsun	1, 2, 3, 4, 5, 8, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 37, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
56	Şanlıurfa	1 through 50

Notes: Continued on the following page.

Table 18 (Continued): Lists of Subsidized Industries By Province

Code	Province	List of Subsidized Industries
57	Siirt	1, 2, 3, 4, 5, 8, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50
58	Sinop	1, 2, 3, 4, 5, 9, 10, 11, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50
63	Sivas	1 through 50
73	Şırnak	1 through 50
59	Tekirdağ	1, 2, 3, 4, 6, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 50
60	Tokat	1, 2, 3, 4, 5, 8, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
61	Trabzon	1, 2, 3, 4, 5, 8, 9, 10, 14, 25, 27, 28, 30, 32, 33, 34, 35, 37, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
62	Tunceli	1, 2, 3, 4, 5, 8, 9, 10, 14, 25, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
64	Uşak	1, 2, 3, 4, 5, 6, 9, 10, 14, 20, 27, 28, 30, 32, 33, 34, 35, 36, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
65	Van	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31
77	Yalova	1, 2, 3, 4, 9, 10, 11, 21, 27, 28, 30, 32, 33, 34, 35, 36, 38, 39, 41, 42, 43, 44, 45, 46, 48, 50
66	Yozgat	1, 2, 3, 4, 5, 9, 10, 11, 19, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50
67	Zonguldak	1, 2, 3, 5, 8, 9, 10, 20, 27, 28, 30, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50

Notes: This table provides the correspondence between provinces and subsidized industries. For the correspondence between these 50 industries and NACE 2 codes see Table 17.

B.2 Criteria for Obtaining a Regional Investment Subsidy Certificate

The largest two investment subsidy programs in Turkey are "Regional Investments Subsidies" and "General Investment Subsidies." The latter program predates the 2012 reforms, and mainly provides VAT and customs duty exemptions for investments regardless of the region in which the firm operates. The Regional Investment Subsidy elements vary across regions, and entail eight different support elements. Among these, the VAT exemption, customs tax exemption, corporate tax credit, insurance premium employer share support, and interest expense support are granted to all complying investments to varying degrees across regions, while income tax withholding support and employee's social security premium support are provided only in the sixth region. The distribution of subsidy elements by regions is shown in Table 19.

Table 19: Support Elements of the Regional Investment Subsidy Programs

			Regions					
Support Elements			1	2	3	4	5	6
VAT exemption			✓	✓	✓	✓	✓	✓
Customs duty exemption			✓	✓	✓	✓	✓	✓
Corporate tax deductions	Investment tax credit rate (ITC)	Non-OIZ	15	20	25	30	40	50
		OIZ	20	25	30	40	50	55
	Deduction rate		50	55	60	70	80	90
Employer's national insurance contribution support (years)			2	3	5	6	7	10
Interest expense support	TL loan		No	No	3pp	4pp	5pp	7pp
	FX loan				1pp	1pp	2pp	2pp
	Cap (,000 TL)				500	600	700	900
Employee's national insurance contribution support			No	No	No	No	No	10 years
Income tax withholding support			No	No	No	No	No	10 years

Notes: OIZ refers to an Organized Industrial Zone.

The most important support elements in regional investment subsidies are the corporate tax credit provided by the investment tax credit (ITC), and social security insurance premium supports. How the corporate tax discount rate and investment contribution rate work is explained with the following example: Let's assume that ABC company is in Region 4 and plans to make an investment of 2,000,000 TL. Also, the annual corporate tax base of the company is 500,000 TL, on average. With the usual corporate tax rate, the company should pay 110,000 TL as corporate tax. In this case, where the investment tax credit rate is 30%, the tax deduction rate is 70%. The total tax credit amount is initially 600,000 (2,000,000 x 30%) TL. The company pays 30% of its tax debt for the current year, that is, 33,000 TL. When 77,000 TL of tax credit is deducted from 600,000 TL, 523,000 TL will be transferred to futures years. The company continues to deduct 70% of the corporate tax bill from the remaining 523,000 TL. If the same real income and tax levels are maintained in the following years, the company depletes the tax credit in approximately 8 years.

B.3 Subsidy Expenditures

In this appendix, we provide estimates on government outlays of two of the main components of the Turkish subsidy program: those related to investment tax credits and those related to employment.[44]

[44] Government expenditures on customs duties rebates and interest rate support represent a much smaller share of the total expenditures related to the 2012 subsidy program.

Table 20 presents our estimates of Turkish government expenditures via investment tax credits. To compute this table, we first multiply the total fixed investment with the investment tax credit rate that each firm receives. We then sum across firms in each subsidy region for subsidy documents opened in each year. According to this table, expenditures on investment tax credits were 2.6 billion TL in 2012, increasing to 5.7 billion TL in 2017 and 7.1 billion in 2018. Overall, the investment tax credits were evenly distributed across the six subsidy regions. Regions 1 and 2 had the most firms and economic activity, but lower subsidization rates.

Table 20: Expenditures on Investment Tax Credits

	2012	2013	2014	2015	2016	2017	2018	Total
Region 1	225.5	407.6	320.9	199.7	250.2	1,160.0	1,560.1	4,124.0
Region 2	261.9	887.9	484.3	1,039.4	425.6	793.4	1,450.1	5,342.6
Region 3	581.3	779.0	672.6	513.1	512.6	993.0	1,448.0	5,499.7
Region 4	319.9	525.3	480.4	491.9	389.9	950.2	786.2	3,943.8
Region 5	662.2	740.8	392.7	560.6	496.4	816.0	952.4	4,621.3
Region 6	611.6	1,258.0	555.6	577.1	436.0	1,016.7	873.5	5,328.4
Total	2,662.5	4,598.6	2,906.5	3,381.8	2,510.8	5,729.3	7,070.3	28,859.7

Notes: Values are millions of 2010 TL.

Table 21 reports expenditures on employment subsidies. Translating the number of years (call this yrs_r) of social security support — the variable indicating the level of employment subsidy generosity in each region — to government expenditures requires a simple calculation.[45] In contrast to Table 20, Region 6 received the greatest share of employment subsidies. This reflects both the increased statutory generosity — not only employer-mandated but also employee-mandated social security payments are subsidized in this region — and the fact that mandated social security payments are tied to the *national* minimum wage (which has an outsized effect in the low-wage Region 6).

Combining the two subsidy items, the national government spent approximately 45.9 billion TL on investment tax credits and reduced social security payments, with approximately 63% of these subsidies taking the form of investment tax credits. Annual expenditures more than doubled over the 2012 to 2018 period, going from 5.8 billion TL to 13.0 billion TL. Over the period,

[45] Mandated social security payments are paid both by the employer and by the employee. Those paid by the employer are equal to 15.5% of the national minimum wage, while those paid by the employee are 19% of the national minimum wage. Subsidized firms in all regions receive support for the employer-mandated payment, while those projects in Region 6 additionally receive support for the employee contribution. For each firm (with employment e_f) headquartered in Regions 1 through 5, we compute the employment subsidies received as $sub_f = e_f \cdot 0.155 \cdot mw_t \cdot \frac{1.05^{yrs_r}-1}{0.05}$. For firms in Region 6, we compute the subsidy received as $sub_f = e_f \cdot (0.155+0.19) \cdot mw_t \cdot \frac{1.05^{yrs_r}-1}{0.05}$. In other words, we compute the present-discounted subsidies (discounting at a rate of 5 percent per year over the years over which the subsidies will be received) in proportion to the firm's employment and the national minimum wage at the time at which the subsidy was received. To compute the total subsidies received within each region and year, we sum sub_f across all firms who received a subsidy that year.

the regional composition of subsidy expenditures shifted from the high-subsidy to low-subsidy regions. Region 6 received 29.4% of national government outlays in 2012 and 23.8% in 2018, while Region 1 received 9.3% in 2012 and 17.5% in 2018.

Table 21: Expenditures on Employment Subsidies

	2012	2013	2014	2015	2016	2017	2018	Total
Region 1	167.9	233.4	313.9	163.0	134.9	358.5	351.0	1,722.6
Region 2	110.4	231.4	160.2	178.3	116.2	229.3	239.5	1,265.2
Region 3	240.3	260.3	296.5	175.2	149.5	232.6	279.5	1,633.9
Region 4	153.7	276.0	157.0	138.6	153.3	341.3	607.8	1,827.8
Region 5	267.7	497.7	395.5	275.6	289.2	556.5	623.5	2,905.6
Region 6	635.2	1,343.6	754.0	822.7	895.2	1,502.6	1,721.8	7,675.1
Total	1,575.3	2,842.4	2,077.1	1,753.3	1,738.5	3,220.7	3,823.1	17,030.3

Notes: Values are millions of 2010 TL.

C Production Function Estimates

In this section, we present our production function estimates.

For each 2-digit NACE industry in our sample, we estimate a value-added production function, with labor and capital stocks as the two inputs. We use the firm's wage-bill as the measure of labor inputs and the real value of the capital stock (computed from annual data on capital investment expenditures), using a perpetual inventory method, as the measure of the capital input. We estimate the parameters of industries' production functions using the method introduced by Ackerberg et al. (2015), implementing the STATA command developed by Rovigatti and Mollisi (2016). We assume that labor is free to vary intra-period, use the lag of investment and intermediate input purchases as proxy variables.[46]

To estimate productivity, we require measures of firms' real capital stocks. Unfortunately, because of sizable inflation rates before our sample, the reported book values of capital that exist within the EIS dataset are not reliable. Instead, we compute capital stocks using a perpetual inventory method type procedure. We follow, as closely as possible, the methods outlined in the OECD Manual of Measurement of Capital Stocks, Consumption of Fixed Capital and Capital Services.[47] We define firms' real capital stocks iteratively:

$$K_{f,t+1} = K_{ut} \cdot (1-\delta) + \frac{\Delta PPE_{f,t}}{P_t},$$

[46] While we do not present estimated production function parameters under alternate methodological choices, we show in Section D.2 that the impact of subsidization on firm productivity is robust to varying the set of proxy variables or simply to defining productivity as value added per worker.

[47] See `https://www.oecd.org/sdd/na/1876369.pdf`.

where $\Delta PPE_{f,t}/P_t$ is the real investment by firm t, and δ is the depreciation rate (which we set to 0.0.83). To apply this equation, we need to compute the initial-period capital stocks. Assuming that firms are near a balanced growth path (whereby investment is growing by 4 percent per year) in their first few years of the sample, we can compute the initial-period capital stocks based on the average investment levels in the first few years of the sample:

$$\begin{aligned} K_{f,2006} &= \sum_{\tau=-\infty}^{2005} \frac{\Delta PPE_{f,\tau}}{P_\tau} \cdot (1-\delta)^{2006-\tau} \\ &= \sum_{\tau=-\infty}^{2005} \frac{\overline{\Delta PPE_f}}{P} \cdot (1-0.04)^{2006-\tau} \cdot (1-\delta)^{2006-\tau} \\ &= \frac{\overline{\Delta PPE_f}}{P} \cdot \frac{1}{1-(1-0.04)(1-\delta)}, \end{aligned}$$

where $\frac{\overline{\Delta PPE_f}}{P}$ equals the average real investment in the first five years of the sample. (The second equation follows from the first under the assumption that pre-2006 investment equals a 4-percent deflated average of investment in the first five years of the sample.)

With measures of real capital stocks in hand, we are able to estimate real value added production functions. Table 22 presents our estimated production function parameters. For the median 2-digit industry in our sample, the sum of the coefficients on capital and labor equals 1.06, consistent with slightly increasing returns to scale. The coefficient on capital is approximately one-tenth of that of labor.

Table 22: Production Function Estimates

	Wage-Bill		Capital			
Industry	$\hat{\beta}$	S.E	$\hat{\beta}$	S.E	Count	Firms
1	0.924	(0.007)	0.103	(0.045)	3,086	891
2	1.039	(0.446)	0.180	(0.078)	345	114
3	1.091	(0.005)	0.0969	(0.029)	360	100
5	0.947	(0.043)	0.0212	(0.020)	1,079	234
6	1.459	(2.244)	-0.265	(0.412)	67	11
7	1.074	(0.006)	0.138	(0.037)	1,028	257
8	1.006	(0.000)	0.141	(0.000)	5,652	1,426
9	0.910	(0.381)	0.192	(0.059)	139	57
10	0.848	(0.000)	0.216	(0.000)	28,570	5,305
11	0.928	(0.000)	0.181	(0.000)	1,241	214
12	6.764	(0.462)	-0.255	(0.078)	138	25
13	0.925	(0.000)	0.118	(0.000)	27,170	4,883
14	0.936	(0.000)	0.102	(0.000)	34,755	7,359
15	0.904	(0.002)	0.0838	(0.014)	6,398	1,222
16	1.008	(0.000)	0.0982	(0.000)	4,645	1,093
17	0.921	(0.004)	0.141	(0.028)	5,494	1,023
18	0.873	(0.000)	0.138	(0.000)	3,542	853
19	0.959	(0.075)	0.124	(0.089)	431	94
20	0.955	(0.005)	0.183	(0.033)	6,356	1,262
21	0.947	(0.019)	0.0211	(0.023)	1,347	212
22	0.937	(0.000)	0.137	(0.000)	17,200	3,309
23	0.935	(0.000)	0.158	(0.000)	19,723	3,585
24	0.873	(0.000)	0.198	(0.000)	7,323	1,465
25	0.910	(0.000)	0.148	(0.000)	24,076	5,242
26	0.927	(0.000)	0.148	(0.000)	1,915	431
27	0.960	(0.017)	0.120	(0.020)	9,433	1,859
28	0.917	(0.000)	0.138	(0.000)	19,603	3,905
29	0.915	(0.000)	0.124	(0.000)	8,666	1,515
30	0.938	(0.003)	0.0634	(0.020)	1,704	401
31	0.974	(0.000)	0.0884	(0.000)	13,598	2,953
32	0.949	(0.000)	0.135	(0.000)	5,848	1,287
33	0.939	(0.002)	0.0703	(0.010)	3,993	1,282
35	1.088	(0.019)	0.0849	(0.023)	2,903	723
36	0.943	(0.022)	0.0218	(0.022)	113	39
37	0.816	(0.954)	0.0605	(0.045)	165	51
38	0.816	(0.000)	0.157	(0.000)	2,143	525
39	0.947	(4.312)	0.144	(0.561)	27	11

Notes: Continued on the following page.

Table 22 (Continued): Lists of Subsidized Industries By Province

	Wage-Bill		Capital			
Industry	$\hat{\beta}$	S.E	$\hat{\beta}$	S.E	Count	Firms
41	0.916	(0.000)	0.0856	(0.001)	51,031	18,998
42	0.901	(0.002)	0.127	(0.014)	11,123	3,131
43	0.906	(0.002)	0.0914	(0.012)	16,157	5,652
45	0.952	(0.005)	0.125	(0.032)	15,185	2,946
46	0.956	(0.000)	0.144	(0.000)	78,986	20,231
47	0.847	(0.000)	0.151	(0.000)	59,219	14,850
49	0.938	(0.000)	0.0891	(0.000)	26,753	6,880
50	0.969	(0.032)	0.0122	(0.010)	1,974	490
51	1.069	(0.048)	-0.0264	(0.046)	306	65
52	1.045	(0.003)	0.0606	(0.020)	8,334	2,044
53	0.999	(0.003)	0.0921	(0.021)	1,008	284
55	0.921	(0.002)	0.101	(0.002)	16,820	3,287
56	0.935	(0.000)	0.0845	(0.000)	31,053	7,820
58	0.934	(0.003)	0.162	(0.019)	1,478	383
59	1.025	(0.032)	0.0692	(0.038)	1,039	301
60	1.220	(0.039)	-0.0540	(0.058)	572	154
61	0.976	(0.002)	0.153	(0.012)	1,431	454
62	0.905	(0.000)	0.111	(0.000)	5,048	1,326
63	0.970	(0.002)	0.0590	(0.012)	608	170
64	0.752	(0.020)	0.336	(0.110)	357	80
65	0.846	(0.552)	0.117	(0.067)	49	17
66	1.173	(0.019)	0.0181	(0.020)	2,172	497
68	0.943	(0.026)	0.148	(0.030)	2,757	944
69	0.899	(0.009)	0.0806	(0.009)	1,008	224
70	1.095	(0.001)	0.298	(0.008)	3,000	903
71	0.931	(0.000)	0.0976	(0.000)	11,253	4,134
72	0.883	(6.770)	0.0947	(0.425)	201	70
73	0.960	(0.015)	0.0981	(0.018)	3,607	953
74	1.056	(0.145)	0.0229	(0.016)	1,804	686
75	0.955	(1.129)	-0.0488	(0.044)	95	35
77	0.954	(0.004)	0.140	(0.035)	1,330	448
78	0.979	(0.004)	0.0111	(0.003)	1,510	627
79	1.048	(0.016)	0.0155	(0.006)	3,016	886
80	0.995	(0.000)	0.0316	(0.000)	7,187	1,523
81	0.975	(0.000)	0.0360	(0.000)	16,713	4,244
82	0.914	(0.000)	0.116	(0.000)	3,995	1,155
84	1.082	(0.028)	0.116	(0.027)	137	54

Notes: Continued on the following page.

Table 22 (Continued): Lists of Subsidized Industries By Province

	Wage-Bill		Capital			
Industry	$\hat{\beta}$	S.E	$\hat{\beta}$	S.E	Count	Firms
85	1.012	(0.001)	0.0476	(0.003)	20,913	4,824
86	0.840	(0.000)	0.126	(0.000)	13,666	2,599
87	0.981	(0.010)	0.0658	(0.010)	1,155	295
88	0.906	(0.000)	0.0902	(0.000)	5,331	1,340
90	0.964	(0.008)	0.0466	(0.012)	478	137
91	1.000	(0.023)	0.0180	(0.025)	134	34
92	1.197	(1.738)	0.0919	(0.484)	60	14
93	0.981	(0.019)	0.0620	(0.020)	1,746	521
94	0.910	(0.314)	-0.0327	(0.044)	358	110
95	1.057	(0.000)	0.0646	(0.000)	3,005	618
96	0.969	(0.003)	0.0714	(0.019)	2,410	816
97	1.008	(0.001)	0.0167	(0.005)	14	4

D Sensitivity Analysis Related to Section 4

In this section, we collect sensitivity analyses relative to Section 4.

D.1 Sensitivity Analysis Related to Section 4.2

In Table 5 we analyzed the relationship between revenues and subsidization at the industry-province level. In Tables 23 and 24, we record the analogous relationship with two additional outcome variables: employment and firm counts. The OLS estimates for the relationships among economic activity and subsidization are positive and significant for these two alternate variables. For the IV specifications, the sign of the relationship between employment and subsidization depends on the set of fixed effects that one uses. Including only year fixed effects and industry-province fixed effects yields a negative relationship between subsidization and employment.

Table 23: Industry-Province Level Observations.

Panel A: OLS Estimates	(1)	(2)	(3)	(4)
Investment Tax Credit Rate	0.585***		0.817***	
	(0.179)		(0.207)	
Closed Certificate		0.272***		0.466***
		(0.101)		(0.103)
N	220,153	220,153	219,743	219,743
Year FEs	Yes	Yes	No	No
Industry× Year FEs	No	No	Yes	Yes
R^2	0.889	0.889	0.926	0.926
Panel B: IV Estimates	**(5)**	**(6)**	**(7)**	**(8)**
Investment Tax Credit Rate	-4.153***		3.657***	
	(0.943)		(1.235)	
Closed Certificate		-2.011***		1.461
		(0.663)		(1.748)
N	220,153	195,625	219,743	195,122
Year FEs	Yes	Yes	No	No
Industry× Year FEs	No	No	Yes	Yes
	First Stage			
Statutory investment tax credit rate	0.061***		0.075***	
	(0.004)		(0.007)	
Eligible for Subsidy?		0.023***		0.023***
		(0.002)		(0.005)

Notes: See the notes for Table 5. In contrast to that figure, the outcome variable is the logarithm of total employment in the industry-province pair.

Table 24: Industry-Province Level Observations.

Panel A: OLS Estimates	(1)	(2)	(3)	(4)
Investment Tax Credit Rate	0.704***		0.682***	
	(0.118)		(0.122)	
Closed Certificate		0.258***		0.303***
		(0.071)		(0.065)
N	221,790	221,790	221,366	221,366
Year FEs	Yes	Yes	No	No
Industry× Year FEs	No	No	Yes	Yes
R^2	0.888	0.888	0.915	0.920
Panel B: IV Estimates	**(5)**	**(6)**	**(7)**	**(8)**
Investment Tax Credit Rate	0.945*		4.003***	
	(0.567)		(0.766)	
Closed Certificate		0.376		1.332
		(0.439)		(0.973)
N	221,790	196,787	221,366	196,273
Year FEs	Yes	Yes	No	No
Industry× Year FEs	No	No	Yes	Yes
	First Stage			
Statutory investment tax credit rate	0.061***		0.075***	
	(0.004)		(0.007)	
Eligible for Subsidy?		0.023***		0.023***
		(0.002)		(0.005)

Notes: See the notes for Table 5. In contrast to that figure, the outcome variable is the logarithm of the number of firms in the industry-province pair.

D.2 Sensitivity Analysis Related to Sections 4.3 and 4.4

Additional outcome variables

In this figure, we consider additional estimations of Equation 3 with two alternate dependent variables: (i) the wage-bill, and (ii) the change in the real value of plant, property, and equipment capital.

First, Table 25 considers a second measure of labor inputs: the firms' wage-bill. The coefficient estimates are essentially equal to those given in Table 7, in which we compared firms' employment to subsidization rates.

Table 25: The Impact of the Subsidy Program on Firm Wage-Bill

	OLS				
	(1)	(2)	(3)	(4)	(5)
Investment Tax Credit Rate	1.149*** (0.103)	1.071*** (0.094)			
Inv. Tax Credit Rate + Closed Certificate			1.456*** (0.107)	1.386*** (0.101)	
Closed Certificate					0.477*** (0.033)
N	913,031	913,031	893,977	893,977	893,977
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
R^2	0.881	0.885	0.884	0.888	0.888
	IV				
	(6)	(7)	(8)	(9)	(10)
Investment Tax Credit Rate	1.789*** (0.479)	1.268* (0.651)			
Inv. Tax Credit Rate + Closed Certificate			2.479*** (0.731)	2.056*** (0.978)	
Closed Certificate					1.693** (0.746)
N	874,577	874,111	855,419	854,939	854,941
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
	First Stage				
Statutory investment tax credit rate	0.143*** (0.010)	0.139*** (0.020)	0.093*** (0.009)	0.084*** (0.016)	
Eligible for Subsidy?					0.029* (0.017)

Notes: The dependent variable is log (Wage-Bill) at the firm-year level. Standard errors are clustered at the province level.

Second, Table 26 estimates Equation 3, using the percent change in the firms' plant, property, and equipment capital as the dependent variable. In contrast to the other variables that we consider, the IV relationships that we estimate are sensitive to the sets of fixed effects we apply. Within firms in a given industry-year pair, firms with increased subsidization had *lower* rates of capital investment.

Table 26: The Impact of the Subsidy Program on Firm Investment

	OLS				
	(1)	(2)	(3)	(4)	(5)
Investment Tax	0.434***	0.383***			
Credit Rate	(0.060)	(0.046)			
Inv. Tax Credit Rate			0.367***	0.326***	
+ Closed Certificate			(0.058)	(0.046)	
Closed Certificate					0.114***
					(0.012)
N	808,131	808,131	789,792	789,792	789,792
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
R^2	0.263	0.275	0.268	0.280	0.280
	IV				
	(6)	(7)	(8)	(9)	(10)
Investment Tax	1.421***	-0.683**			
Credit Rate	(0.312)	(0.333)			
Inv. Tax Credit Rate			1.901***	-1.326**	
+ Closed Certificate			(0.518)	(0.512)	
Closed Certificate					-0.085
					(0.234)
N	757,899	775,466	757,392	756,946	756,946
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
	First Stage				
Statutory investment	0.140***	0.132***	0.90***	0.080***	
tax credit rate	(0.010)	(0.019)	(0.010)	(0.016)	
Eligible for					0.026
Subsidy?					(0.017)

Notes: The dependent variable is Δlog(PPE) at the firm-year level. Standard errors are clustered at the province level.

Additional Variable Measuring Subsidization

In Section 4, our primary measures of subsidization were (a) investment tax credits received, or (b) an indicator variable: whether the firm has a closed subsidy certificate. In Table 27, we consider the relationship between firm-level outcomes and an alternate measure of firm subsidization: the number of years for which the firm is relieved of its mandatory contributions to their employees' social security payments. As in Tables 6, 7, and 26, subsidization is positively and significantly related to firm outcomes in all OLS specifications, and in all but one IV specifications. (The negative coefficient in column 10 of Table 27 corresponds to the negative coefficient in column

9 of Table 6.) Furthermore, given that the employment-based measure of firm subsidization is approximately 20 times that of the investment-based measure (compare the fifth and eighth rows of Table 3), the magnitudes depicted in Table 27 are similar to those in Tables 6, 7, and 26. Our finding that the estimated relationships between firm outcomes and subsidization are invariant to the measure of subsidization reflects the fact that the different subsidies tend to be bundled with one another. Firms receiving a successful subsidy application tend to receive both subsidies to new capital investments and those to increasing or retaining employees.

Table 27: The Impact of the Subsidy Program on Firm Outcomes

Panel A: OLS Estimates	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Employment		Investment		Revenues	
SSEP–Years of Support	0.076***	0.073***	0.018***	0.016***	0.061***	0.058***
Received+Closed Certificate	(0.006)	(0.006)	(0.003)	(0.003)	(0.005)	(0.005)
N	894,052	894,052	789,792	789,792	890,629	890,629
Year FEs	Yes	No	Yes	No	Yes	No
Year× Industry FEs	No	Yes	No	Yes	No	Yes
R^2	0.850	0.856	0.268	0.280	0.835	0.840
Panel B: IV Estimates	(7)	(8)	(9)	(10)	(11)	(12)
Dependent Variable	Employment		Investment		Sales	
SSEP–Years of Support	0.122***	0.136**	0.089***	-0.076***	0.218***	0.256***
Received+Closed Certificate	(0.041)	(0.054)	(0.031)	(0.022)	(0.051)	(0.068)
N	855,488	855,008	757,392	756,946	852,000	851,507
Year FEs	Yes	No	Yes	No	Yes	No
Year× Industry FEs	No	Yes	No	Yes	No	Yes
	First Stage					
Statutory Years of Social	0.089***	0.087***	0.087***	0.083***	0.088***	0.084***
Security Support	(0.011)	(0.017)	(0.011)	(0.017)	(0.010)	(0.017)

Notes: SSEP refers to the number of years of support for employer's mandatory contributions to social security premiums. Investment refers to $\Delta \log \text{PPE}$. All regressions additionally include firm fixed effects. Standard errors are clustered at the province level.

Firms with all of their establishments in a single industry-province pair

The sample in our benchmark analysis includes firms that have establishments in multiple industry-province pairs. For firms that receive a subsidy from the Turkish government, we observe the location and industry through which the firm receives the subsidy. However, for unsubsidized multi-establishment firms, there is no clear way to define the instrument: Because there are multiple industries or provinces through which a firm may apply for a subsidy, there are multiple potential statutory rates that one could defensibly apply. For this reason, we consider a robustness exercise in which we compare firm-level measures of economic activity — revenues, employment, and TFPR — to subsidization for the subset of firms with all of their establishments in a single industry-province pair. Overall, we find similar results with this restricted sample, with the effects of subsidization somewhat larger for certain specifications (e.g., most of the specifications with employment and revenues as the outcome variable) and comparable in other specifications (e.g., most of the specifications with TFP as the outcome variable).

Table 28: The Impact of the Subsidy Program on Revenues

	OLS				
	(1)	(2)	(3)	(4)	(5)
Investment Tax	1.031***	0.887***			
Credit Rate	(0.127)	(0.113)			
Inv. Tax Credit Rate			1.475***	1.364***	
+ Closed Certificate			(0.151)	(0.141)	
Closed Certificate					0.493***
					(0.044)
N	446,868	446,868	437,980	437,980	437980
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
R^2	0.864	0.870	0.867	0.874	0.874
	IV				
	(6)	(7)	(8)	(9)	(10)
Investment Tax	2.945***	2.739***			
Credit Rate	(0.569)	(0.594)			
Inv. Tax Credit Rate			4.560***	4.562***	
+ Closed Certificate			(1.031)	(1.076)	
Closed Certificate					2.538***
					(0.804)
N	413,870	413,870	404,933	404,933	404.183
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
	First Stage				
Statutory investment	0.135***	0.156***	0.082***	0.094***	
tax credit rate	(0.009)	(0.016)	(0.009)	(0.014)	
Eligible for					0.035***
Subsidy?					(0.011)

Notes: See the notes for Table 6. In contrast to that table, the sample in the current table includes only firms who have all of their establishment in a single province-industry pair.

Alternate Productivity Measures

In this section, we reproduce Tables 9 and 10 with two alternate measures of productivity. In our benchmark analysis, we estimated a value added production function with labor (measured by the

Table 29: The Impact of the Subsidy Program on Firm Employment

	OLS				
	(1)	(2)	(3)	(4)	(5)
Investment Tax	1.055***	0.952***			
Credit Rate	(0.121)	(0.104)			
Inv. Tax Credit Rate			1.519***	1.401***	
+ Closed Certificate			(0.146)	(0.127)	
Closed Certificate					0.503***
					(0.043)
N	449,887	449,887	440,542	440,542	440,542
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
R^2	0.858	0.866	0.861	0.868	0.868
	IV				
	(6)	(7)	(8)	(9)	(10)
Investment Tax	1.907***	1.530**			
Credit Rate	(0.540)	(0.619)			
Inv. Tax Credit Rate			2.850***	2.579***	
+ Closed Certificate			(0.883)	(0.954)	
Closed Certificate					1.728***
					(0.419)
N	416,214	416,214	407,503	407,503	406,773
Year FEs	Yes	No	Yes	No	No
Year× Industry FEs	No	Yes	No	Yes	Yes
	First Stage				
Statutory investment	0.139***	0.162***	0.085***	0.097***	
tax credit rate	(0.010)	(0.017)	(0.009)	(0.015)	
Eligible for					0.036***
Subsidy?					(0.011)

Notes: See the notes for Table 7. In contrast to that table, the sample in the current table includes only firms who have all of their establishment in a single province-industry pair.

Table 30: The Impact of the Subsidy Program on Firm TFP

	OLS			
	(1)	(2)	(3)	(4)
Investment Tax Credit Rate	0.012 (0.035)	-0.032 (0.033)		
Inv. Tax Credit Rate + Closed Certificate			0.032 (0.055)	-0.010 (0.051)
N	413,932	413,932	405,782	405,782
Year FEs	Yes	No	Yes	No
Year× Industry FEs	No	Yes	No	Yes
R^2	0.618	0.631	0.623	0.636
	IV			
	(5)	(6)	(7)	(8)
Investment Tax Credit Rate	1.164*** (0.174)	0.509** (0.212)		
Inv. Tax Credit Rate + Closed Certificate			1.857*** (0.339)	0.700* (0.380)
N	383,693	382,912	375,522	374,727
Year FEs	Yes	No	Yes	No
Year× Industry FEs	No	Yes	No	Yes
	First Stage			
Statutory investment tax credit rate	0.138*** (0.010)	0.160*** (0.017)	0.084*** (0.009)	0.096*** (0.015)

Notes: See the notes for Table 8. In contrast to that table, the sample in the current table includes only firms who have all of their establishment in a single province-industry pair.

wage-bill) and capital (measured by the real value of the capital stock, computed using a perpetual inventory method type procedure) as the two inputs. We estimated this production function using the estimator introduced in Ackerberg et al. (2015), using investment and intermediate inputs purchases as the two proxy variables. We found a negative relationship — sometimes not statistically significant — between productivity and subsidization in our OLS regressions, but a positive relationship when subsidization is instrumented with statutory subsidy eligibility and generosity. In Table 31, we re-estimate these relationships between subsidization and productivity with two alternate productivity measures: the logarithm of value added per worker, and the logarithm of TFP, wherein only investment is used as a proxy variable. We find little differences between the results presented in Table 31 and those in Tables 9 and 10.

Table 31: The Impact of the Subsidy Program on Firm Activity: IV Estimates

	VA per Worker				TFP, with Investment as a Proxy Variable			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Inv. Tax Credit Rate	-0.314***	-0.369***	0.955**	1.095**	-0.091***	-0.119***	0.995***	0.658***
	(0.067)	(0.059)	(0.451)	(0.513)	(0.030)	(0.028)	(0.217)	(0.189)
Weight of subsidized	0.021**	-0.002	0.016*	-0.005	0.002	-0.011	-0.002	-0.012*
firms in total sales	(0.010)	(0.010)	(0.009)	(0.010)	(0.008)	(0.008)	(0.008)	(0.007)
Weight of subsidized	0.034*	0.026	0.011	0.011	0.058***	0.034***	0.038**	0.026**
firms in total purchases	(0.018)	(0.021)	(0.023)	(0.022)	(0.011)	(0.012)	(0.014)	(0.012)
Log daily wage	0.042***	0.021*	0.039***	0.022**	-0.014*	-0.007	-0.017**	-0.007
	(0.011)	(0.011)	(0.010)	(0.010)	(0.007)	(0.006)	(0.007)	(0.006)
N	731,307	731,307	679,673	679,254	784,732	784,732	735,915	735,531
Year FEs	Yes	No	Yes	No	Yes	No	Yes	No
Year× Industry FEs	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.690	0.699			0.646	0.657		
First Stage Estimates								
Statutory investment tax			0.122***	0.108***			0.131***	0.117***
credit rate			(0.011)	(0.018)			(0.011)	(0.020)
Weight of subsidized			0.003*	0.002			0.003*	0.002
firms in total sales			(0.001)	(0.001)			(0.001)	(0.001)
Weight of subsidized			0.017***	0.010***			0.017***	0.011***
firms in total purchases			(0.003)	(0.002)			(0.003)	(0.002)
Log daily wage			0.001	-0.001			0.002	-0.000
			(0.001)	(0.001)			(0.001)	(0.001)

Notes: All regressions include province-industry fixed effects and firm fixed effects. Standard errors are clustered at the province level.

Specifications without Firm Fixed Effects

In the results we presented in Sections 4.3 and 4.4, our regressions include firm fixed effects. In this section, we provide corresponding results without firm fixed effects. We include, instead, a set of controls, describing the firm in the year prior to the introduction of the subsidy program. These controls are the logarithm of real total assets, an exporter dummy, the bank loans to total asset ratio, the long term debt ratio, and the total debt ratio

D.3 Additional Plots Related to Section 5

In this appendix, we present four additional figures to supplement the analysis in Section 5.

First, Figure D.3 displays the average investment tax credit received by firms, by region and by industry, in 2018. As in Figure 5, investment subsidies differ both because of statutory differences in subsidy generosity as well as the differences in take-up rates across industries and regions. Both take-up rates and subsidy generosity were higher in Region 6 than in other regions, and in manufacturing than in services.

Table 32: The Impact of the Subsidy Program on Firm Activity

Dependent Variable	Revenues		Employment		Investment		TFP	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Investment Tax Credit	-0.036	2.244***	0.204	0.917**	0.380***	0.461**	-0.080**	0.842***
Rate	(0.061)	0.451	(0.185)	(0.419)	(0.027)	(0.189)	(0.037)	(0.163)
Weight of subsidized	0.130***	0.123***	0.159***	0.156***	0.029***	0.029***	0.019***	0.016***
firms in total sales	(0.022)	0.020	(0.024)	(0.024)	(0.004)	(0.004)	(0.006)	(0.006)
Weight of subsidized	0.387***	0.351***	0.012	0.001	-0.058***	-0.060***	0.038**	0.023
firms in total purchases	(0.014)	0.015	(0.037)	(0.040)	(0.007)	(0.008)	(0.017)	(0.017)
Log daily wage	0.091***	0.086***	0.008	0.006	-0.001	-0.001	-0.012**	-0.014**
	(0.012)	0.011	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.006)
N	838,608	836,188	839,562	837,140	741,842	739,578	784,732	782,344
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year× Industry FEs	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.559		0.392		0.037		0.281	
First-Stage Estimates								
Statutory investment		0.161***		0.162***		0.165***		0.160***
tax credit rate		(0.014)		(0.014)		(0.014)		(0.014)
Weight of subsidized		0.002*		0.002*		0.003***		0.002
firms in total sales		(0.001)		(0.001)		(0.001)		(0.001)
Weight of subsidized		0.014***		0.014***		0.014***		0.015***
firms in total purchases		(0.002)		(0.002)		(0.002)		(0.003)
Log daily wage		0.001		0.001		0.001		0.001
		(0.001)		(0.001)		(0.001)		(0.001)

Notes: All regressions include province-industry fixed effects but (in contrast to Tables 9 and 10) exclude firm fixed effects.. Standard errors are clustered at the province level.

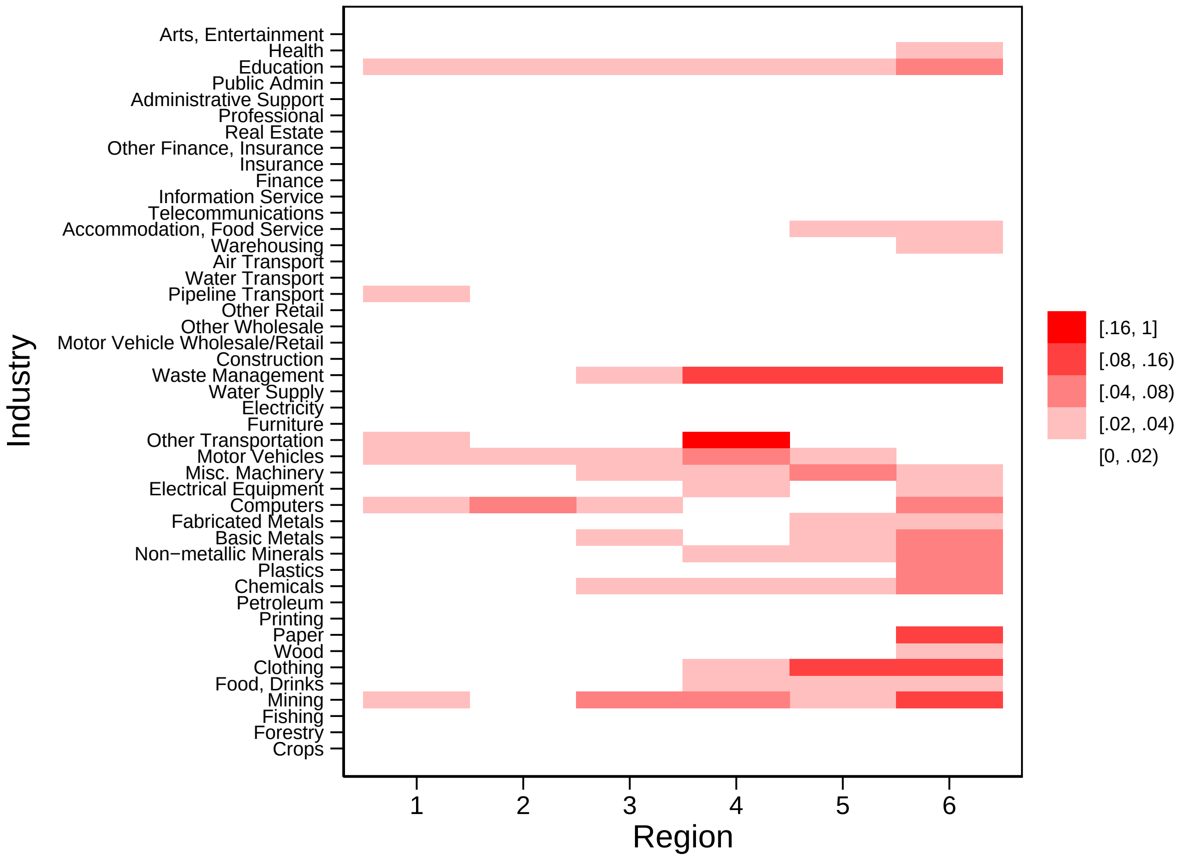

Figure 15: Investment Subsidies

Notes: The plot gives the average investment tax credit for each region and industry.

Second, we assess the sensitivity of our quantification of the 2012 subsidy program to the subsidy measure. In our benchmark analysis, we used the average investment tax credit as our measure subsidy measure. Figure 16 presents the analogue of Figure 7 using the fraction of subsidized firms as our measure. As in Figure 7, Region 5 has the largest real wage increases as a result of the subsidy program, with migration and trade flows substantially mitigating the impact of the policy on inter-regional real wage inequality.

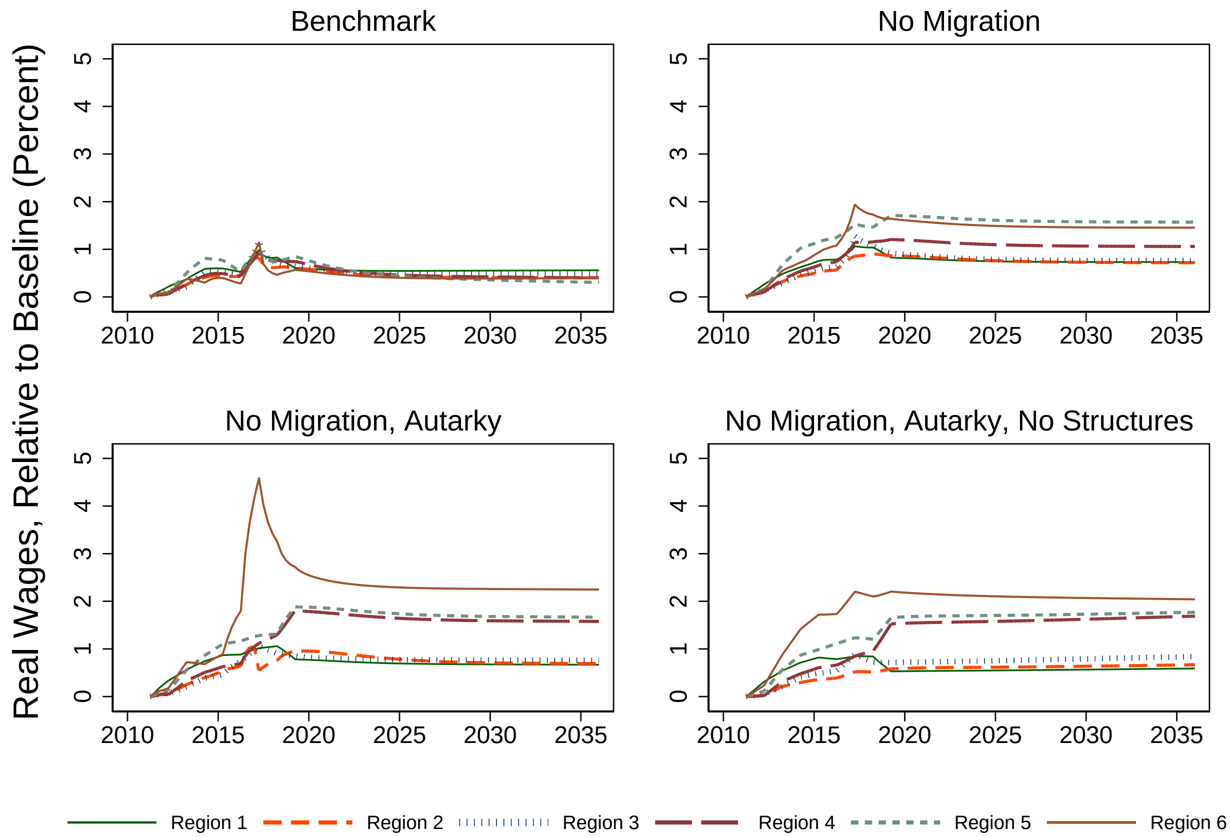

Figure 16: Real Wage Trajectories
Notes: See the notes for Figure 7. In contrast to that figure, here we consider a calibration based on the share of subsidized firms — as opposed to the average investment tax credit received — as our measure of firm subsidization by province-industry year.

Finally, Figure 17 plots average investment tax credits received among firms in the formal economy. (This is the analogue of Figure 5, which presented our measures of subsidization for both formal economy and informal economy firms.) The measures of subsidization that we observe in the raw data pertain only to formal economy firms. To produce Figure 5, we used the fact that informal-economy firms are ineligible to receive investment subsidies and thus divided the average investment tax credits received by the share of workers in each industry-region pair that is employed in the formal economy (using the method discussed in Appendix A.4.) In Figure 17, instead, we plot the investment tax credits received by formal economy firms. These are substantially higher, especially for Region 6: While the 2018 value for average investment tax credits received was 2.5%, here it is 6.0%. In Figure 18, we plot counterfactual wage impacts of the subsidy reform in which we apply the subsidization rates in 17. Here, the implied impacts of the subsidy reform are magnified compared to those in Figure 7.

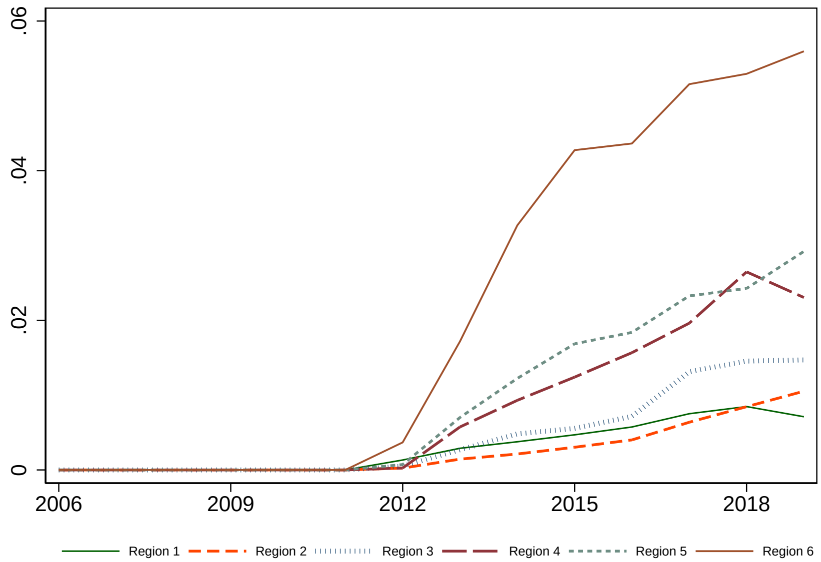

Figure 17: Investment Subsidies
Notes: See the notes of 5. In contrast to that figure, we plot average investment tax credits received only among firms in the formal economy.

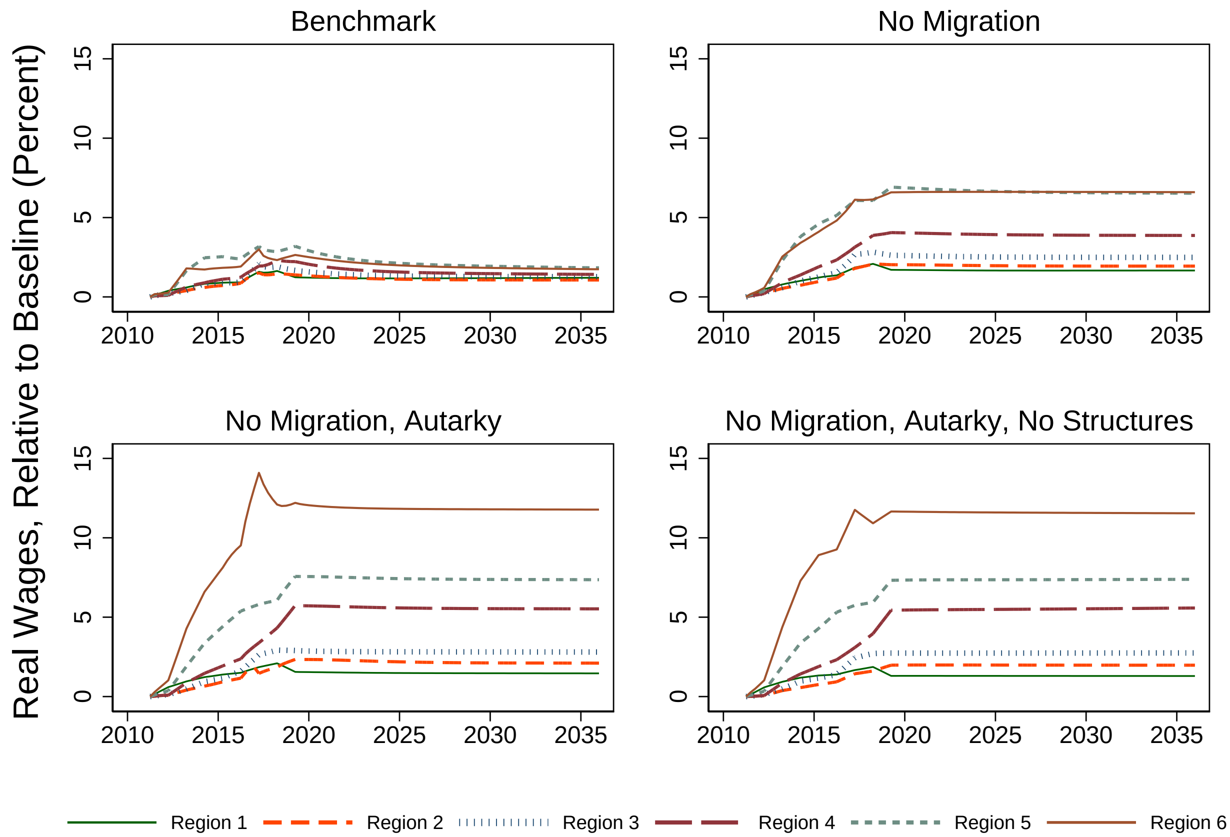

Figure 18: Real Wage Effects of the 2012 Subsidy Program

Notes: See the notes for Figure 7. In contrast to that figure, in our calibration of trade and worker flows across industry-subsidy region pairs and in our calibration of the average investment tax credits received by industry and subsidy region, we do not make any adjustments for firms and employment in the informal economy.

E Description of Caliendo et al. (2019)

E.1 Setup

For the reader's convenience, in this appendix we describe the elements of the Caliendo et al. (2019) framework that are salient for our analysis. The economy consists of intermediate goods producers, households, and rentiers (who own the structures). Both intermediate input producers and households are indexed by the region ($n \in \{1, ...N\}$) in which they reside and the industry ($j \in \{0, 1, ...J\}$) in which they produce/work ($j = 0$ indexes not working), while rentiers are indexed by the region in which they reside. Time is by t.

The innovation of Caliendo et al. (2019)'s *dynamic hat algebra* is to provide a tractable method of determining counterfactual responses to changes in the model's exogenous variables (e.g., changes to trade costs, or changes to productivity) without having to identify these variables' levels at any given point in time.[48] Caliendo et al. (2019) show (in Proposition 3 of their paper) that one can solve for counterfactual dynamic equilibria without knowing the levels of the model's exogenous variables. Specifying the initial allocation of the economy — in terms of labor supplied to different industries and regions, migration and trade shares, and expenditures on each industry-region pair — as well differences in the growth rates of the exogenous variables will suffice.

Households

For each region-industry pair (nj), there is a continuum of households. Within each period, each household earns labor income (w_t^{nj}), and spends this income to purchase the different production goods. (For households who do not work, for whom $j = 0$, their total consumption expenditures equal a constant b^n.) Let $P_t^{nj,k}$ and $c_t^{nj,k}$ respectively denote the unit price and household purchases of the different goods $k \in \{1, \ldots J\}$ in period t. Moreover, each period households may choose to move to another industry-region pair. Migration involves a utility cost $\tau^{nj,ik} + \nu\varepsilon_t^{ik}$; $\tau^{nj,ik}$ equals the systematic, time-invariant utility cost of transitioning from region-industry nj to region-industry ik, while ε_t^{ik} is a type-1 extreme value distributed random variable, independent across individual households, time, and industry-region pairs. We assume — following Caliendo et al. (2019) — that the static utility function is Cobb-Douglas and that the intertemporal elasticity of substitution in consumption equals one, so that the discounted expected utility of a household residing in region-industry pair (nj) equals:

$$U_t^{nj} = \sum_{k=1}^{J} \alpha^k \log\left(c_t^{nj,k}\right) + \max_{\{i,k\}} \beta \mathbb{E}\left[U_{t+1}^{ik} - \tau^{nj,ik} + \nu\varepsilon_t^{ik}\right] . \quad (6)$$

Let $V_t^{nj} \equiv \mathbb{E}\left[U_t^{nj}\right]$ denote the expected lifetime utility of a representative household in industry-region nj, where the expectation is taken over the ε_t^{ik} preference shocks. Given the setup, the expected lifetime utility evolves according to the following system of equations.

$$\begin{aligned} V_t^{nj} &= \sum_{k=1}^{J} \alpha^k \log\left(c_t^{nj,k}\right) + \nu \log\left(\sum_{i=1}^{N}\sum_{k=0}^{J} \exp\left(\beta V_{t+1}^{ik} - \tau^{nj,ik}\right)^{1/\nu}\right) \\ &= \log\left(w_t^{nj}\right) - \sum_{k=1}^{J} \alpha^k \log\left(\frac{P_t^{nk}}{\alpha^k}\right) + \nu \log\left(\sum_{i=1}^{N}\sum_{k=0}^{J} \exp\left(\beta V_{t+1}^{ik} - \tau^{nj,ik}\right)^{1/\nu}\right) , \end{aligned}$$

[48] In static setups, the hat algebra approach — to solve for counterfactual impacts of productivity or trade policy changes — traces back to Jones (1965), and was more recently popularized by Dekle et al. (2007). See Dingel (2018) for brief history.

where w_t^{nj} equals the wage of workers residing in region n and employed in industry j and P_t^{nk} is the ideal price index for households residing in region n and employed in industry k. The first equation follows from the dynamic optimization of the household over its location and industry choices. The second equation follows from the first given the static optimization over consumption choices.

Household utility maximization, over its decision of which region-industry pair to transition to in period $t+1$, yields relatively simple expressions for the probability that a household in move from region-industry pair nj in period t to region-industry pair ik in period $t+1$:

$$\mu_t^{nj,ik} = \frac{\exp\left(\beta V_{t+1}^{ik} - \tau^{nj,ik}\right)^{1/\nu}}{\sum_{m=1}^{N}\sum_{h=0}^{J}\exp\left(\beta V_{t+1}^{mh} - \tau^{nj,mh}\right)^{1/\nu}}\,. \tag{7}$$

This probability is increasing in the continuation value of residing in region-industry pair ik in period $t+1$ and negatively on the systematic utility cost, of $\tau^{nj,ik}$, moving from nj to ik.

Intermediate Goods Producers and Final Goods Producers

With industry j and region n, heterogeneous intermediate goods producers operate in a perfectly competitive environment. They combine labor (l_t^{nj}), structures (h_t^{nj}), and material inputs ($M_t^{nj,nk}$) with the following production function:

$$q_t^{nj} = z^{nj}\left(A_t^{nj}\left(h_t^{nj}\right)^{\xi^n}\left(l_t^{nj}\right)^{1-\xi^n}\right)^{\gamma^{nj}}\prod_{k=1}^{J}\left(M_t^{nj,nk}\right)^{\gamma^{nj,nk}}\,.$$

In this equation, A_t^{nj} equals productivity in region n and industry j in period t, while z^{nj} denotes the idiosyncratic productivity (drawn from a Frechet distribution) of an individual firm within the region and industry. The parameters ξ^n, γ^{nj}, and $\gamma^{nj,nk}$ characterize the importance of structures, labor, and material inputs in production. Given this production function, the marginal cost of production equals:

$$x_t^{nj} = B^{nj}\frac{\left[\left(r^{nj}\right)^{\xi^n}\left(w^{nj}\right)^{1-\xi^n}\right]^{\gamma^{nj}}}{z^{nj}\left(A_t^{nj}\right)^{\gamma^{nj}}}\prod_{k=1}^{J}\left(P_t^{nk}\right)^{\gamma^{nj,nk}}\,.$$

Here, r^{nj} and w^{nj} refer to the rental price of structures and the wage rate in industry-region pair nj, and B^{nj} is a constant which depends on the model's underlying parameters.[49]

Shipments of industry j intermediate inputs from region i to region n incur "iceberg" trade

[49] $B^{nm} = \left[\left(\xi^n\right)^{\xi^n}\left(1-\xi^n\right)^{1-\xi^n}\right]^{-\gamma^{nj}}\prod_{k=1}^{J}\left(\gamma^{nj,nk}\right)^{-\gamma^{nj,nk}}$.

costs $\kappa_{nj,ij}$. So, the price of a unit of the intermediate good in destination region-industry nj equals $x_t^{ij} \cdot \kappa_{nj,ij}$.

Within each region and industry, a final goods producer combines intermediate goods to produce an output that can either be consumed or sold as a material input.

The output for a final goods producer in region n and industry j is given by the following constant elasticity of substitution production function:

$$Q_t^{nj} = \left[\int_{R_+^N} \left[\tilde{q}_t^{nj} \left(z^j \right) \right]^{\left(\frac{\eta^{nj}-1}{\eta^{nj}} \right)} d\phi^j \left(z^j \right) \right]^{\left(\frac{\eta^{nj}}{\eta^{nj}-1} \right)}.$$

Here $\phi \left(z^j \right) \equiv \exp \left[-\sum_{n=1}^N \left(z^{nj} \right)^{-\theta^j} \right]$ is the joint distribution of idiosyncratic productivity levels of the intermediate goods producers from the different supplying regions n.

For each commodity (j), the final goods producer purchases from the intermediate good producer who can deliver at the lowest price. Given the properties of the Frechet distribution, the probability that region i provides the lowest price variety is given by:

$$\pi_t^{nj,ij} = \frac{\left(x_t^{ij} \cdot \kappa_{nj,ij} \right)^{-\theta^j}}{\sum_{m=1}^N \left(x_t^{mj} \cdot \kappa_{nj,mj} \right)^{-\theta^j}}.$$

This is also equal to the share of intermediate input purchases that are sourced from region n. Cost minimization implies that the price of good j in region n at time t is:

$$P_t^{nj} = \Gamma \left(1 + \frac{1 - \eta^{nj}}{\theta^j} \right) \cdot \left(\sum_{i=1}^N \left(x_t^{nj} \cdot \kappa_{nj,ij} \right)^{-\theta^j} \right)^{-1/\theta^j},$$

where $\Gamma()$ is the Gamma function.

Finally, cost minimization on the part of individual intermediate input producers yields the following equations for labor and structures demand in region n industry j:[50]

$$L_t^{nj} = \frac{\gamma^{nj} (1 - \xi^n)}{w_t^{nj}} \cdot \left(\sum_{i=1}^N \pi_t^{ij,nj} X_t^{ij} \right), \text{and} \tag{8}$$

[50]The total stock of structures in each industry-region pair is fixed. See Kleinman et al. (2021) for a related model with dynamic capital investment decisions.

$$H^{nj} = \frac{\gamma^{nj}\xi^{n}}{r_t^{nj}} \cdot \left(\sum_{i=1}^{N} \pi_t^{ij,nj} X_t^{ij} \right). \tag{9}$$

Rentiers, Total Expenditures, and Market Clearing

Within each region n a continuum of rentiers earn income from renting out structures. According to the Caliendo et al. (2019) setup, rentiers send their income from renting structures to a global portfolio. Rentiers in region n receive a share ι^n from this global portfolio. Unlike households, rentiers are not allowed to relocate to other regions. We are now in a position to write out the market-clearing condition for intermediate good j produced in region n:

$$X_t^{nj} = \sum_{k=1}^{J} \sum_{i=1}^{N} \gamma^{nk,nj} \pi_t^{ik,nk} X_t^{ik} + \alpha^j \left(\sum_{k=1}^{J} w_t^{nk} L_t^{nk} + \iota^n \sum_{i=1}^{N} \sum_{k=1}^{J} r_t^{ik} H^{ik} \right). \tag{10}$$

The first sum on Equation 10 equals the total purchases through input-output linkages. The second sum equals total purchases of good j to households or rentiers residing in region n.

Equilibrium Definition

Given a path of productivity levels, A_t^{nj}, an equilibrium of this economy consists of a sequence of wages (w_t^{nj}) and prices (P_t^{nj}), expenditures (X_t^{nj}), trade shares ($\pi_t^{ij,nj}$), and labor allocations (L_t^{nj}) such that:

- Across successive periods, migration rates and initial labor supply determine next period-labor supply:
$$L_{t+1}^{ik} = \sum_{n=1}^{N} \sum_{j=1}^{J} \mu_t^{nj,ik} L_t^{nj}, \tag{11}$$
where $\mu_t^{nj,ik}$ is given by Equation 7;
- Within each period, the markets for structures and labor clear (Equations 8 and 9);
- For each intermediate good j produced in region n, the goods market clears (Equation 10);
- Households choose consumption to maximize period utility and migration to maximize life-time utility, with preferences given by Equation 6; and
- Intermediate input goods producers and final goods producers maximize profits period by period.

E.2 Calibration

Calibration of the model requires information on the time paths of labor flows across industries and subsidy regions, trade flows across regions for each industry, value added in each industry-region pair, employment in each industry-region pair, and productivity changes that are directly due to the subsidy program. Our economy has six regions and 45 industries; we list these industries and regions in Appendix E.3. We record these time paths for t =2011Q1,....2018Q4. While our data are recorded on an annual basis, we follow Caliendo et al. (2019) and set a time period to refer to an individual quarter. In addition, we require parameters governing (i) consumers' preferences, (ii) production function cost shares, (iii) heterogeneity in individual households' preferences over different locations and individual firms' productivity and (iv) the regions in which rentiers' income are spent. These last four sets of parameters are time invariant.

To calibrate our model, we rely on information from the World Input-Output Database and the micro estimates from Section 4.3. The former database is informative about aggregate moments, while the latter will pin down flows of goods across industries and regions and the flows of workers across industries and regions.

Time-Invariant Parameters

The parameters α^k characterize the relative importance of each industry commodity k in consumers' preferences. These parameters are allowed to vary by year. From the 2016 vintage of the World Input-Output Database, for each we compute the sum of the value private household consumption expenditures, consumption expenditures by non-profit organizations serving households, governmental consumption expenditures, and exports. We take data from 2010. We then compute the share of industry k among these total expenditures.

The parameters ξ^n characterize the relative importance of structures, relative to labor, in value added for intermediate goods producers in region n. For the country as a whole, we compute this as one minus the cost share of labor relative to value added. While, in principle, these parameters are allowed to vary by subsidy region, the World Input-Output Database do not capture this geographic variation. As a result, we set ξ^n to be identical across all regions.

The parameters $\gamma^{nj,nk}$ characterize the importance of commodity k in the production of intermediate good j when producing in region n. We set $\gamma^{nj,nk}$ as industry k's share of material input expenditures (from 2010) within the production of commodity j, using the 2016 vintage of the World Input-Output Database. As with ξ^n parameters, while the Caliendo et al. (2019) model permits these parameters to vary by industry, out data do not capture this variation.

We take parameters —θ^j and ν — respectively characterizing the heterogeneity in productivity and individuals' idiosyncratic utility from working in a given industry-region pair from Caliendo et al. (2019). We set $\theta^j = 4.55$ for all industries j and $\nu = 5.3436$. Finally, we set the quarterly discount factor, β, to be 0.99, again following Caliendo et al. (2019).

Finally, we set ι^n — the share of rentier profits accruing to each region — to be proportional to that region's value added: $\iota = [0.60, 0.13, 0.11, 0.07, 0.05, 0.04]$. This approach differs from that in Caliendo et al. (2019), who use observed trade imbalances (measured by Equation 10) to identify ι^n.

Time-Varying Trade and Migration Flows, Value Added, Employment, and Counterfactual TFP

First, we describe how we measure $\pi_t^{nj,ij}$, trade shares across region pairs (i supplying n) for a particular commodity j in quarter t. First, for each year y between 2010 to 2018, we compute the trade flows across subsidy regions for each of the 45 aggregated industries j. We record $\tilde{\pi}_y^{nj,ij}$ as the share of region i's purchases of industry product j coming from region n. For quarter t, we then interpolate the values of $\pi_t^{nj,ij}$ based on the yearly values of $\tilde{\pi}_y^{nj,ij}$.[51]

Next to measure worker flows across industries and provinces, $\mu_t^{nj,ik}$, we utilize information from the Entrepreneur Information System dataset. This dataset records the number of individuals who are engaged in formal employment by industry and province in each year beginning in 2012. For each origin region-industry pair, for each year, we compute the share of workers who end up in each region-industry pair in the subsequent year. Use $\widetilde{\mu}_y^{nj,ik}$ to denote these annual flows in from year y to year $y+1$. Since our model is at the quarter level, we need a couple of simple calculations to compute $\mu_t^{nj,ik}$ from the $\widetilde{\mu}_y^{nj,ik}$. Define $\widetilde{M}_y$ as the matrix with $\widetilde{\mu}_y^{nj,ik}$ in its $j+n(J-1)$, $k+i(J-1)$ element. Then define $\mu_t^{nj,ik}$ as the $j+n(J-1)$, $k+i(J-1)$ element of the matrix given by $\left(\widetilde{M}_y\right)^{1/4}$.

Third, to compute L_t^{nj} for each quarter in our sample, we begin by assigning L_0^{nj} using the number of workers in each industry-region pair from the Entrepreneur Information System dataset, using data from 2012.[52] We then iteratively apply Equation 11, using the values of $\mu_t^{nj,ik}$ described in the previous paragraph.

Finally, to compute the direct productivity impact of the subsidy program, we employ information on subsidy take-up rates and the incremental productivity gain from the subsidy. In our benchmark analysis, we compute the average investment tax credit in each year, subsidy region, and industry. For each quarter t in year y, define I_t^{nj} as this take-up rate. We then multiply this average by 0.697, which is, according to Table 8, the treatment effect on log firm-level productivity

[51] For the first quarter of our sample, we set the first value of $\pi_t^{nj,ij}$ as $\tilde{\pi}_y^{nj,ij}$. We then iteratively define $\pi_t^{nj,ij} = \left(\tilde{\pi}_{y+1}^{nj,ij}/\tilde{\pi}_y^{nj,ij}\right)^{1/4} \cdot \pi_{t-1}^{nj,ij}$, where y refers to the year in which quarter t appears.

[52] This is the first observation according to this dataset. Ideally, we would have taken data from 2010.

of a 100% increase in the investment tax credit. We consider our counterfactual economy to be one in which these subsidies were not implemented, and so where TFP, A_t^{nj},was lower by a factor of exp $\left[0.668 \cdot I_t^{nj}\right]$. In sensitivity analysis, in Appendix D.3, we consider an alternate measure of counterfactual A_t^{nj} based on the fraction of firms in region-industry nj which have newly closed subsidy certificates in year y.

E.3 List of Industries and Provinces

This section lists the 45 industries in the economy of our calibration of Caliendo et al. (2019). It then provides the mapping between Turkey's 81 provinces and the 6 subsidy regions. The Turkish National Input-Output Tables, as collected by the World Input-Output Database, applies an industry classification scheme with 56 industries. The input-output table includes 11 industries with 0 values in all of the data entries. We drop these 11 industries from our analysis.[53] The 45 industries in our analysis include: Crops (NACE A01); Forestry (NACE A02); Fishing (NACE A03); Mining (NACE B); Food, Drinks (NACE C10-C12); Clothing (NACE C13-C15); Wood (NACE C16); Paper (NACE C17); Printing (NACE C18); Petroleum (NACE C19); Chemicals (NACE C20); Plastics (NACE C22); Non-metallic Minerals (NACE C23); Basic Metals (NACE C24); Fabricated Metals (NACE C25); Computers (NACE C26); Electrical Equipment (NACE C27); Misc. Machinery (NACE C28); Motor Vehicles (NACE C29); Other Transportation (NACE C30); Furniture (NACE C31-C32); Electricity (NACE D35); Water Supply (NACE E36); Waste Management (NACE E37-E39); Construction (NACE F); Motor Vehicle Wholesale/Retail (NACE G45); Other Wholesale (NACE G46); Other Retail (NACE G47); Pipeline Transport (NACE H49); Water Transport (NACE H50); Air Transport (NACE H51); Warehousing (NACE H52); Accommodation, Food Service (NACE I); Telecommunications (NACE J61); Information Service (NACE J62, J63); Finance (NACE K64); Insurance (NACE K65); Other Finance, Insurance (NACE K66); Real Estate (NACE L68); Professional (NACE M74-M75); Administrative Support (NACE N); Public Admin. (NACE O84); Education (NACE P85); Health (NACE Q); and Arts, Entertainment (NACE R-S).

The correspondence between provinces and subsidy regions is as follows:

- Region 1: Ankara, Antalya, Bursa, Eskişehir, İstanbul, İzmir, Kocaeli, and Muğla;

[53] They are Pharmaceutical Manufacturing (NACE C21); Repair and installation of machinery and equipment (NACE C33); Postal and courier activities (NACE H53); Publishing activities (NACE J58); Motion picture, video, and television program production and planning (NACE J58-J59); Legal, accounting, and management consultancy activities (NACE M69-M70); Architectural and engineering activities (NACE M71); Advertising and market research (NACE M73); Activities of extraterritorial organizations and bodies NACE (T); Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (NACE U).

- Region 2: Adana, Aydın, Bolu, Çanakkale, Denizli, Edirne, Isparta, Kayseri, Kırklareli, Konya, Sakarya, Tekirdağ, and Yalova;
- Region 3: Balıkesir, Bilecik, Burdur, Gaziantep, Karabük, Karaman, Mersin, Manisa, Samsun, Trabzon, Uşak, and Zonguldak;
- Region 4: Afyonkarahisar, Amasya, Artvin, Bartın, Çorum, Düzce, Elâzığ, Erzincan, Hatay, Kastamonu, Kırıkkale, Kırşehir, Kütahya, Malatya, Nevşehir, Rize, and Sivas;
- Region 5: Adıyaman, Aksaray, Bayburt, Çankırı, Erzurum, Giresun, Gümüşhane, Kahramanmaraş, Kilis, Niğde, Ordu, Osmaniye, Sinop, Tokat, Tunceli, and Yozgat; and
- Region 6: Ağrı, Ardahan, Batman, Bingöl, Bitilis, Diyarbakır, Hakkâri, Iğdır, Kars, Mardin, Muş, Siirt, Şanlıurfa, Şırnak, and Van.