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

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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 involve a mix of VAT reductions, investment tax credits, and reduced mandated social security contributions. Using firm-level balance-sheet data along with data on the domestic production network, we first assess the direct and indirect impact of the 2012 subsidy reforms. 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 of subsidized firms. With the aid of a dynamic multi-region multi-industry general equilibrium model, we then assess the aggregate impacts of the 2012 subsidy reforms. We find that they 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 reforms and input-output linkages that traverse subsidy regions within Turkey.

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1 Introduction

Incomes differ markedly within countries. In the United States, for instance, 2019 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 VAT exemption, a 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 reforms 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 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

[1] These figures are taken from the 2019 version of the Bureau of Economic Analysis Local Area Personal Income dataset. Per capita income in the two metropolitan areas are $128,766 and $27,415, respectively.

[2] In 2019, the GDP per capita in İstanbul, in the northwest of the country, was more than five times greater than in Ağrı, a province bordering Iran in the east. Throughout the paper, we apply a Turkish alphabet to write Turkish cities and provinces.

production network. Data on migration are critical towards understanding whether worker flows act as a countervailing force of the subsidy reforms 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 subsidy reforms. We find that, following the introduction of the 2012 subsidy reforms, a 5 percentage point increase in investment tax credit subsidies — roughly equal to the difference in the regions with the most and least generous subsidies— leads to a 45 percent increase in revenues. Using our firm and network datasets, we unpack these industry-level changes. We first assess whether subsidized firms directly increased their revenues, productivity, and employment. We then explore how the spillover effects develop and propagate over the firm network. At the firm-level, we find that a 5 percentage point increase in the investment tax credit subsidy rate corresponds to a 10.5 percent increase in revenues, a 6.9 percent increase in employment, and a 3.5 decrease in marginal costs. 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 marginal costs.

In the final step of our analysis, we explore the aggregate implications of the subsidy reforms. 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 reforms were modestly successful in reducing inequality between the relatively under-developed and more prosperous portions of the country. According to our benchmark calibration, the subsidy reforms account for (in the long-run, as of 2036) a 0.2% 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 reforms reduce inter-province inequality. Absent migration across subsidy regions, the reforms would have reduced real wage inequality by 4.6%. Absent both domestic trade flows and domestic migration, the subsidy reforms would have reduced real wage inequality by 9.2%. Moreover, the reform's impact varies considerably over the short and long run. In the short run, the countervailing effect of migration is limited. In the years immediately after the introduction of the subsidy reforms, regional real wage inequality declines by as much as 1.4%, an order of magnitude larger than the long-run impact.

Our work contributes to and builds on to 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 Simspon 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.[3] While the design and implementation of these place-based

[3]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

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 five 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. 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.[4][5]

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. (2020a) explore the impact of (foreign) demand shocks to firms' suppliers, customers, and workers, while Demir et al. (2020b) 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.[6]

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 the 1995 Mexican peso crisis; while Caliendo et al. (2021) study the impacts of EU enlargement on migration and trade.[7] We apply these methods to address a new question—to understand the internal migration

(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.)

[4]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 spatial general equilibrium model, with the particular goal of identifying local agglomeration economies. Our model, both in its aims and its components, differ from the model in Kline and Moretti (2014). Our model abstracts from agglomeration economies, but incorporates trade flows within and across regions and costs to migration across industries and regions. Furthermore, we conduct a joint analysis of the short-and-long-run impacts of the place-based policy that we study.

[5]Sungur (2019) describes the subsidy reforms, 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 reforms, 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 reforms.

[6]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.

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

flow responses and overall welfare impacts of 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 reforms on subsidized industries' and firms' economic activity, then discusses how subsidies propagate via the production network. Section 5 quantifies the impact of the subsidy reforms on inter-regional real wage inequality. Section 6 concludes.[8]

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.[9] 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."[10]

[8] In the appendices, we review the Caliendo et al. (2019) model with which we quantify the aggregate impacts of the subsidy reforms (Appendix A), present sensitivity analyses (Appendix B and Appendix C), provide additional information on the 2012 subsidy reforms (Appendix D) and on our dataset (Appendix E).

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

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

Figure 1: Turkish Subsidy Regions

Notes: Source: KPMG (2018).

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 split 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.[11]

Several complementary investment incentives were offered to firms in designated industry-province pairs. Qualified investment projects benefit from:[12]

- VAT and customs duties exemptions;
- investment tax credits, ranging from 15 percent of the value of the investment project in Region 1

[11]We list the correspondence between provinces and industries in Appendix D.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.

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

to 50 percent in Region 6;[13][14]

- 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;
- 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), 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.[15]

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 reduction 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 simply a measure of whether the firm has a "closed" subsidy certificate (irrespective over the level of generosity).

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

[13]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.

[14]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 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 D.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.

[15]In Appendix D.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 reforms. 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, equivalent to 1.85 trillion TL in 2010 prices.)

in Region 6 as in Region 1. In the years (and decades) prior to the subsidy reforms, 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 subsidy reforms, 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 reforms, as it is *a priori* plausible that the government's subsidy reforms were targeted towards province-industy pairs that were growing exceptionally quickly in the pre-reform period and would have continued to grow faster than average absent the subsidy reforms. We discuss the issue of pre-trends in Section 4, after introducing our main datasets in the following section.

Table 1: Pre-reform 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 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 reforms 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 2012-2018; (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.

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, they comprise substantially smaller share of the aggregate wage bill); see Figures 21 and 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 21 and Figure

24 of Acar and Carpio (2019). A second limitation, with the exception of the number of workers, the balance-sheet data are at the firm level and not the establishment level. (For subsidized firms, we *do* observe the location and industry of the establishment through which the firm applied.) 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 level of exposure to the subsidy reforms. Both limitations can be overcome, albeit imperfectly. Regarding the first limitation, we for now assess the representativeness of our sample in Appendix E.3. 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 4.4 million Turkish Lira (equivalent to approximately 3.1 million 2010 US dollars), and 4.1 million Turkish Lira in plant, property, and equipment capital.

Table 2: Descriptive Statistics: Firm-Level Balance Sheet

				Percentile				
	N	Mean	SD	25	50	75	95	Max
Employment	945,233	87.23	330.68	24.5	35.25	63.75	269.75	45,291.25
Real Sales (millions TL)	945,233	30.25	358.30	1.60	4.41	13.21	74.17	63,034.76
log(PPE)	945,233	8.23	1.54	7.29	8.32	9.35	10.50	10.50
Δlog(PPE)	817,511	0.13	0.78	-0.14	-0.02	0.27	0.80	1.33

Notes: All values are reported 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 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 12.4% of the observations could (feasibly, according to Law 2012/3305) receive a subsidy. Of the 12.4%, 4.5% of observations correspond to a firm which had successfully applied for the subsidy (row 1). An even smaller fraction of firms, 2.3% of the sample, has a closed subsidy certificate (row 2). The statutory investment tax credit rate ranges up to 50% for firms in the sixth subsidy region. 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: 2.8%. 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.

Table 3: Descriptive Statistics: Subsidy Take-up

				Percentile			
	N	Mean	SD	90	95	99	Max
Firms with either an open or closed certificate	945,233	0.045	0.208	0	0	1	1
Firms with closed certificate	945,233	0.023	0.15	0	0	1	1
Eligible to Receive Subsidy	945,233	0.124	0.33	1	1	1	1
Investment Tax Credit Ratio	945,233	0.015	0.073	0	0	0.4	0.6
Investment Tax Credit Ratio, with Closed Certificate	945,233	0.008	0.054	0	0	0.4	0.6
Investment Tax Credit: Statutory	945,233	0.028	0.082	0.15	0.2	0.4	0.5
Social Security Employer Premium: Years	945,233	0.258	1.37	0	0	7	12
Social Security Employer Premium, with Closed Certificate	945,233	0.134	1.01	0	0	7	12
Social Security Employer Premium Duration: Statutory	945,233	0.475	1.50	2	3	7	10

Notes: The sample includes firms with at least 20 employees. Our measures of statutory rates of subsidy generosity refer to those outside of Organized Industrial Zones (see footnote 14). 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.

Our third database measures information on firms' domestic customers and suppliers. According to Table 4, the median firm in our dataset had 23 suppliers and 14 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. The median establishment had 16 suppliers and 10 customers in the same subsidy region.

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

				Percentile				
	N	Mean	SD	50	75	90	95	Max
Number of suppliers	944,753	44.62	91.10	23	50	98	148	9,183
Number of customers	874,685	49.77	192.93	14	44	113	193	23,841
Number of suppliers in the same subsidy region	920,275	32.58	66.27	16	36	73	112	5,827
Number of customers in the same subsidy region	827,995	34.96	135.58	10	30	78	134	18,025
Number of suppliers in the same province	905,490	24.56	46.05	13	28	55	83	4,332
Number of customers in the same province	798,579	25.53	87.85	8	22	57	99	11,816

Notes: The sample includes firms with at least 20 employees.

Central to our analysis of the aggregate effects of the subsidy reforms are measures of linkages across the six subsidy region. In Figure 2, we report the trade flows across region pairs for each product in our sample. The shading with each panel depicts the share of the destination region's purchases that are sourced from each of the six regions. In 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, 79% of shipment value is sourced from suppliers located in Region 1. For downstream firms located elsewhere, 31% 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.[16]

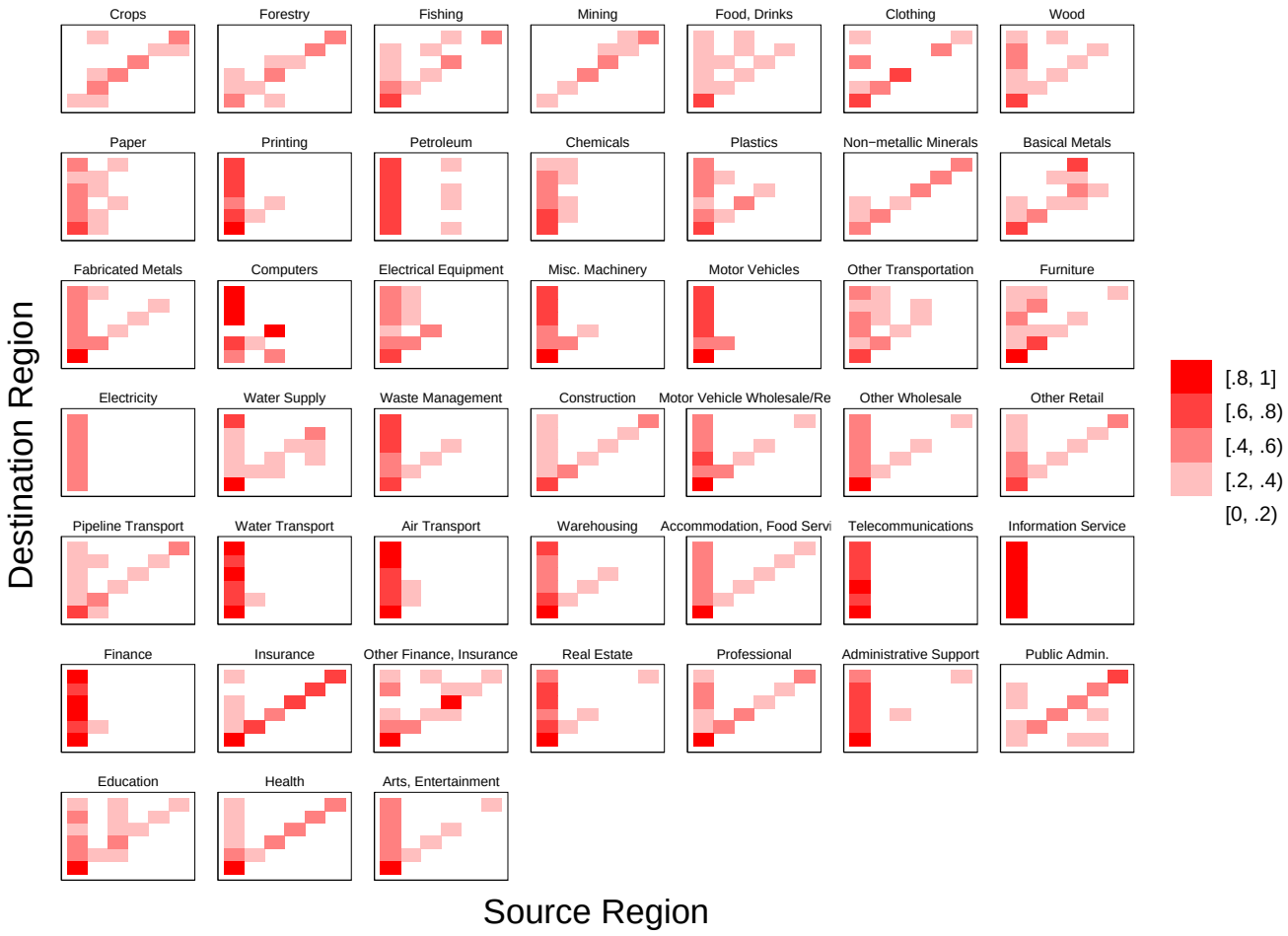

Figure 2: Intermediate Input Flows

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 2010. Within each panel, there are six rows and six columns. Region 1 is in the left-most column and bottom-most row in each figure; Region 6 is the rightmost column and topmost row in each figure.

[16]Our exclusion of informal firms — since they tend to be under-represented in Region 1 — may be leading us to overstate Region 1's importance as a supplier of intermediate inputs. For now, we have not attempted to correct for this.

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 industry-region source pair, fewer than 5.1% of workers transition to a different industry-region pair, with 2.2% of workers switching regions from one year to the next.[17]

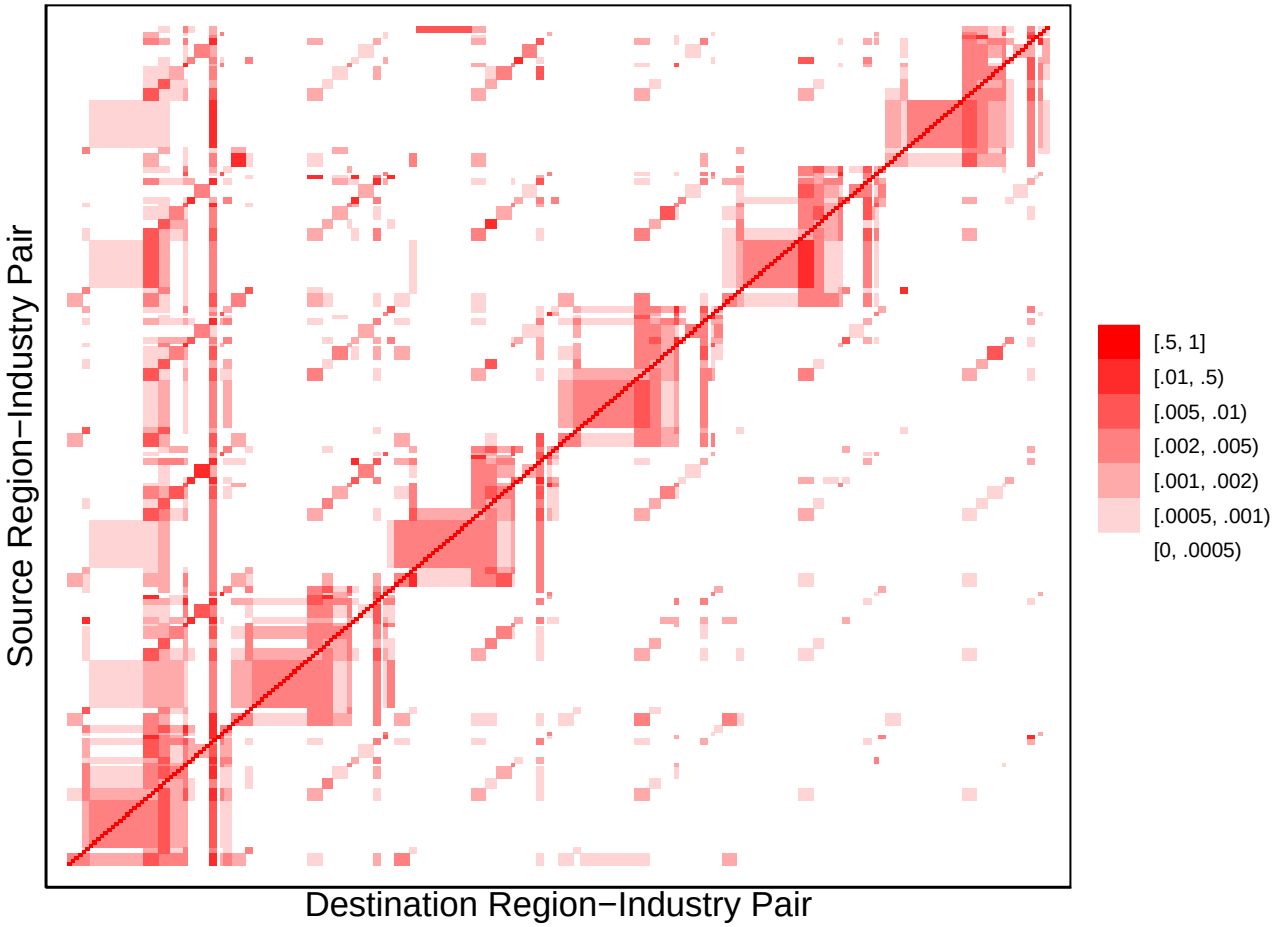

Figure 3: Labor flows

Notes: This figure presents flows of workers across region-industry pairs as of 2012. Region-industry pairs are sorted by regions first, then by industries, with Region 1 and the first industry ("Agriculture") listed in the leftmost column (and bottom row) and Region 6 and the final industry ("Education") listed in the rightmost column (and top row). The shading represents the share of workers for a given source region-industry pair who, in the subsequent year, 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

[17]The latter figure is somewhat larger than the inter-state migration rate (1.5%) observed in the US (Kaplan and Schulhofer-Wohl, 2012).

across the country's six subsidy regions.

4 Direct and Indirect Microeconomic Effects

In this section, we examine the microeconomic impacts of the subsidy reforms. 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 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 at that given point in time. We control for 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 in interpreting β_1 as a causal estimator of the effect of the subsidy reforms on economic activity, we face two challenges. First, it is possible that the industry-province pairs most exposed to subsidy reforms were growing relatively quickly (or relatively slowly) in the years prior to the reforms. (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.

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:

$$y_{pnt} - y_{pn,2011} = \beta_{nt} + \beta_{pt} + \beta_{1t} S_{pn,2018} + \varepsilon_{pnt} \tag{2}$$

The aim of this regression is to compare industry-province pairs' pre-reform growth rates to their post-reform subsidization levels. Equation 2 differs from Equation 1 in four ways. First, given that the aim of Equation 2 is to compare pre-reform growth rates with post-reform subsidization — and not to

compare contemporaneous subsidization and economic activity as in Equation 1 — we replace S_{pnt} with a measure of province-industry's subsidization at the end of the sample: $S_{pn,2018}$. 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 $S_{pn,2018}$ 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.

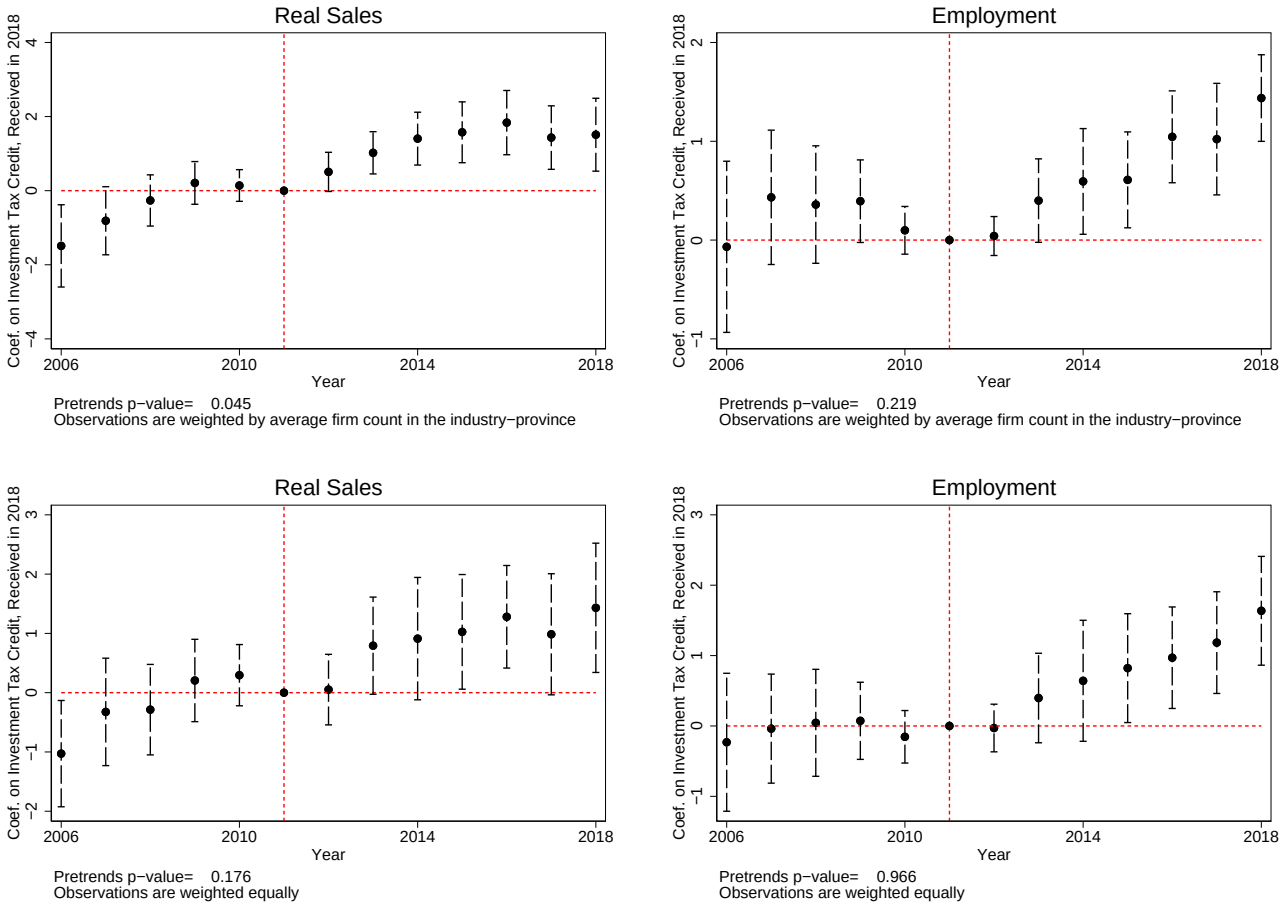

Figure 4: Examination of pre-trends

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; 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 revenues as the measure of economic activity and weighting by firm counts. The most heavily subsidized province-industry pairs had exceptionally fast revenue growth between 2006 and 2007, but neither exceptionally fast nor slow growth between 2007 and 2011.[18] In sum, while one of our specifications suggests pre-trends may be a concern, the differences in growth rates across heavily subsidized and unsubsidized areas occurred well in advance of the design and implementation of the 2012 reforms.

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.[19] 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 reforms 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 credits 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.[20]

[18] For the specification corresponding to the top left panel of Figure 4, the F-statistic for the test of the null hypothesis that $\beta_{1,2007} = \beta_{1,2008} = \beta_{1,2009} = \beta_{1,2010} = 0$ equals 1.12. The corresponding p-value equals 0.35.

[19] 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.

[20] 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 generosity — had relatively low growth rates. Alternatively, the subsidization levels could be mismeasured.[21]

So far, we have demonstrated that the 2012 reforms led to increased economic activity in the most heavily subsidized industry-province pairs. These industry-level relationships reflect the direct firm-level

[21] In Appendix B, 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 13). 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×industry fixed effects) imply a negative relationship between employment and subsidization.

impact of the subsidy reforms 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, investment, and productivity.

We consider regressions of the form:

$$y_{ft} = \beta_f + \beta_t + \beta_{pn} + \sum_i \beta_i X^i_{f,2012} + \beta_1 S_{ft} + \varepsilon_{ft} \tag{3}$$

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}), year fixed effects (β_t), industry-province fixed effects (β_{pn}), balance-sheet controls $X^i_{f,2012}$, and (in certain specifications) firm fixed effects (β_f).[22] Since we employ firm fixed effects, and since firms' eligibility experiences a one-time shift in 2012, our 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, comparing the first five and final five columns, IV specifications lead to a stronger estimated relationship between subsidies and revenues.[23] 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 10.5 percent increase in revenues.

Table 7 presents corresponding results for investment. Here, too, subsidies lead to increased economic activity, both in the OLS and IV estimations. In contrast to Table 6 (and Table 8, below) our estimates of the relationship between subsidization and economic activity do not depend on whether the

[22] In our specifications with firm-level fixed effects, both the industry-province and balance-sheet controls are redundant.

[23] 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 B, 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					IV				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Investment Tax Credit	-0.012	0.920***				2.561***	2.104***			
Rate	(0.075)	(0.063)				(0.501)	(0.485)			
Inv. Tax Credit Rate +			0.507***	1.127***				3.579***	2.904***	
Closed Certificate			(0.095)	(0.078)				(0.780)	(0.734)	
Closed Certificate					0.372***					0.859***
					(0.028)					(0.270)
N	855,404	855,404	841,118	841,118	841,118	853,158	816,819	838,850	802,431	802,431
Firm FEs	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.370	0.850	0.366	0.852	0.852					
						First Stage				
Statutory investment						0.153***	0.138***	0.109***	0.097***	
tax credit rate						(0.011)	(0.011)	(0.010)	(0.010)	
Eligible for Subsidy?										0.060***
										(0.007)

Notes: The dependent variable is log revenues at the firm-year level. All regressions include province-industry and year fixed effects. Firm controls are natural logarithm of real total assets, an exporter dummy, bank loans / total assets, long term debt ratio, and total debt ratio. Firm controls are set to their 2012 values for each firm. Standard errors are clustered at the province level.

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 begin an investment project when their certificate is "open", and only then receive the full suite of subsidies.

Finally, Table 8 records the effect of the investment subsidies on firms' total factor productivity. According to our IV specifications, a 5 percentage point increase in investment tax credit ratios leads to a 3.5 percent increase in TFP (column 7 of Table 8). There are potentially a number of mechanisms through which the subsidy reforms 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 reforms led to a reduction in firms' marginal cost of production. Since our measure of TFP is a residual of firms' revenues and their unit input costs – TFPR ("revenue productivity") as opposed to technical efficiency in the parlance of Foster et al. (2008)– the subsidy reforms may have led to an increase in measured productivity even without altering their true efficiency in measuring inputs into outputs.[24] 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 reforms 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 reforms 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 reforms along input-output relationships and within the firm's local labor market. 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:

$$y_{ft} = \beta_f + \beta_t + \sum_i \beta_i X^i_{f,2012} + \beta_1 S_{ft} + \beta_2 \cdot w_{npt} \tag{4}$$

[24] 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 reforms, a task we turn to in Section 5, TFPR provides the relevant measure of productivity.

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

	OLS					IV				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Investment Tax Credit	0.366***	0.424***				0.527***	1.468***			
Rate	(0.027)	(0.053)				(0.196)	(0.388)			
Inv. Tax Credit Rate +			0.342***	0.406***				0.508*	1.765***	
Closed Certificate			(0.020)	(0.059)				(0.256)	(0.560)	
Closed Certificate					0.145***					0.951***
					(0.018)					(0.165)
N	755,431	755,431	741,280	741,280	741,280	753,279	723,064	753,279	723,064	708,757
Firm FEs	No	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.037	0.272	0.037	0.277	0.277					
						First Stage				
Statutory investment						0.154***	0.137***	0.110***	0.097***	
tax credit rate						(0.011)	(0.011)	(0.010)	(0.010)	
Eligible for Subsidy?										0.060***
										(0.007)

Notes: The dependent variable is Δlog(PPE) at the firm-year level. All regressions include province-industry and year fixed effects. Firm controls include 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. Firm controls are set to their 2012 values for each firm. Standard errors are clustered at the province level.

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

	OLS					IV				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Investment Tax Credit Rate	-0.051	-0.077**				1.618***	0.697***			
	(0.036)	(0.031)				(0.272)	(0.242)			
Inv. Tax Credit Rate + Closed Certificate			-0.017	0.028				2.453***	1.162***	
			(0.051)	(0.048)				(0.440)	(0.351)	
Closed Certificate					0.007					0.385***
					(0.017)					(0.133)
N	755282	755282	740882	740882	740,882	753,013	723,311	738,610	705,834	705,834
Firm FEs	No	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.454	0.718	0.454	0.722	0.722					
						First Stage				
Statutory investment tax credit rate						0.151***	0.135***	0.105***	0.093***	
						(0.011)	(0.011)	(0.010)	(0.010)	
Eligible for Subsidy?										0.056***
										(0.008)

Notes: The dependent variable is log(TFP) at the firm-year level, estimated using Ackerberg et al. (2015). All regressions include province-industry and year fixed effects. Firm controls include 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. Firm controls are set to their 2012 values for each firm. Standard errors are clustered at the province level.

$$+\beta_{\text{up}} s^{\text{upstream}}_{\vartheta \to ft} + \beta_{\text{down}} s^{\text{downstream}}_{f \to \vartheta, t} + \varepsilon_{ft}$$

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 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 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%.

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

Dependent Variable	Revenues		Employment	
	(1)	(2)	(3)	(4)
Investment Tax Credit	-0.038	0.723***	0.209	0.911***
Rate	(0.063)	(0.046)	(0.186	(0.095)
Weight of subsidized	0.127***	0.073***	0.156***	0.095***
firms in total sales	(0.022)	(0.014)	(0.025)	(0.012)
Weight of subsidized	0.392***	0.092***	0.017	0.032**
firms in total purchases	(0.015)	(0.014)	(0.037)	(0.016)
Log daily wage	0.093***	0.053***	0.009	-0.004
	(0.012)	(0.011)	(0.006)	(0.007)
N	838,612	838,612	839,566	839,566
Firm FEs	No	Yes	No	Yes
Firm controls	Yes	Yes	Yes	Yes
Province× Industry FEs	Yes	Yes	Yes	Yes
R^2	0.554	0.847	0.387	0.877
Dependent Variable	Investment		TFP	
	(5)	(6)	(7)	(8)
Investment Tax Credit	0.378***	0.394***	-0.111***	-0.135***
Rate	(0.027)	(0.063)	(0.035)	(0.048)
Weight of subsidized firms in total sales	0.029***	0.028***	0.161***	0.037***
	(0.004)	(0.009)	(0.020)	(0.011)
Weight of subsidized firms in total purchases	-0.058***	-0.014	-0.070*	0.049***
	(0.007)	(0.012)	(0.038)	(0.015)
Log daily wage	-0.001	0.009	0.045***	0.021**
	(0.007)	(0.012)	(0.012)	(0.009)
N	741,843	741,843	715,492	715,492
Firm FEs	No	Yes	No	Yes
Firm controls	Yes	Yes	Yes	Yes
Province× Industry FEs	Yes	Yes	Yes	Yes
R^2	0.037	0.331	0.390	0.703

Notes: All regressions include province-industry and year fixed effects. Firm controls include 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. Firm controls are set to their 2012 values for each firm. 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	2.254***	2.235***	0.926**	0.995*	0.465**	1.571***	1.337***	0.612*
Rate	(0.480)	(0.370)	(0.432)	(0.502)	(0.190)	(0.422)	(0.345)	(0.355)
Weight of subsidized	0.119***	0.067***	0.154***	0.095***	0.029***	0.022**	0.157***	0.035***
firms in total sales	(0.021)	(0.014)	(0.025)	(0.012)	(0.005)	(0.009)	(0.019)	(0.010)
Weight of subsidized	0.357***	0.065***	0.006	0.031**	-0.060***	-0.034***	-0.093**	0.035**
firms in total purchases	(0.015)	(0.013)	(0.040)	(0.015)	(0.008)	(0.011)	(0.038)	(0.017)
Log daily wage	0.088***	0.049***	0.007	-0.005	-0.001	0.006	0.043***	0.019**
	(0.011)	(0.009)	(0.006)	(0.006)	(0.007)	(0.011)	(0.011)	(0.009)
N	836,192	785,583	837,144	786,549	739,579	699,951	713,096	667,460
Firm FEs	No	Yes	No	Yes	No	Yes	No	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province$\times$ Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First Stage Estimates								
Statutory investment tax	0.161***	0.131***	0.162***	0.131***	0.165***	0.132***	0.150***	0.123***
credit rate	(0.014	(0.011)	(0.014	(0.011)	(0.014	(0.011)	(0.013)	(0.011)
Weight of subsidized	0.002*	0.003**	0.002*	0.003**	0.003***	0.004**	0.002	0.003**
firms in total sales	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Weight of subsidized	0.014***	0.016***	0.014***	0.016***	0.014***	0.016***	0.014***	0.017***
firms in total purchases	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
Log daily wage	0.001	0.002	0.001	0.002	0.001	0.002	0.000	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Notes: All regressions include province-industry and year fixed effects. Firm controls include 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. Firm controls are set to their 2012 values for each firm. Standard errors are clustered at the province level.

5 Aggregate Implications

In this section, we examine the aggregate implications of the 2012 investment subsidy reforms. 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). As we have discussed earlier, a primary goal of the 2012 reforms was to reduce the gap between the relatively low-wage southeast and the rest of the country.[25] We evaluate the reform's success in achieving this goal.

To do so, we 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 reforms spurred investment in targeted regions, domestic trade flows and migration may blunt the reform'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 inelastically supply labor and use their labor earnings to consume; they neither borrow nor save.[26] 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 A delineates the model in much greater detail, spelling out household preferences, firm production functions, market-clearing conditions, and the equilibrium definition.

[25] 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.

[26] In Caliendo et al. (2019), households may optimally choose to abstain from working. In contrast, we exclude this as a possibility, mainly because our data do not allow us to distinguish whether an individual is not working in a given period or is working in the informal economy.

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.

We use this model to understand the impact of the 2012 subsidy reforms. In particular, we solve for the "baseline" model economy — with the observed subsidy reforms 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 industry-region pair at each point in time, (ii) the utility costs of switching industries and regions, (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 Statutory 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	2016 World Input Output Database
(6)	Consumption preference shares by industry and region	Turkish National Input Output Table
(7)	Materials purchases by upstream industry×downstream industry×destination region	Turkish National Input Output Table

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 A.2.

Of particular importance is for our calibration is the direct impact of the subsidy reforms on productivity within each subsidy region and industry at each point in time. We combine information on subsidy take-up rates and the relationship between subsidization and productivity to infer this set of moments. Figure 5 presents the time path of investment subsidies by region.[27] The time series within the plot give

[27] In our calibration, we assign the productivity increases in a region-industry pair on the basis of averages within the cell,

the product of subsidy take-up rates and 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. Region 6 benefited the most from the investment subsidy reforms, with Regions 1, 2, and 3 receiving the least. To infer the direct productivity impact of the subsidy reforms, we multiply these time series by 0.612 (see column 6 of Table 8) — the incremental productivity gain from the investment tax credit.[28,29]

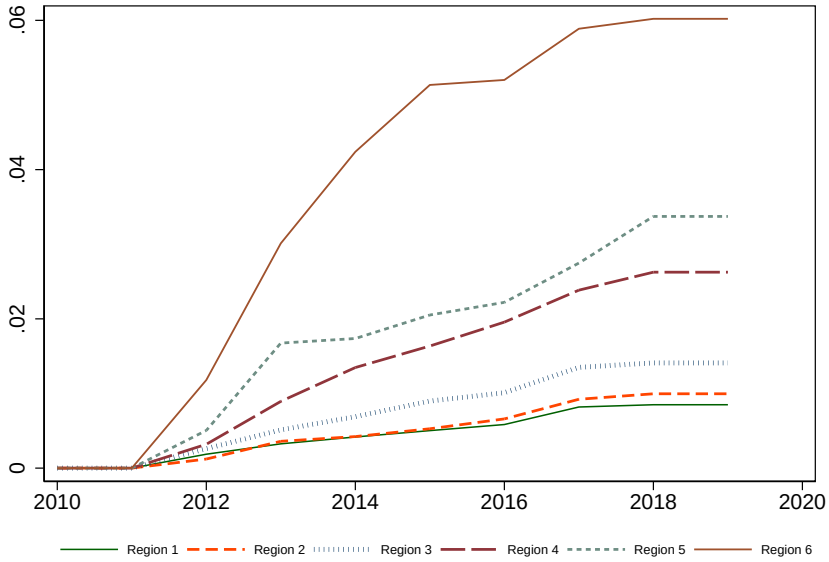

Figure 5: Investment Subsidies

Notes: The plot gives the average investment tax credit tater for each region and year. See Appendix Figure B.3 for investment tax credit subsidy levels by industry and region.

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.

[28]Our counterfactual exercises require, as inputs, expected values for TFP trajectories beyond the end of our sample period. We assume that in years after 2019 the subsidy levels (and, consequently, the direct productivity impacts of the subsidy reforms) are equals to their 2019 values.

[29]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 lowers 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 reforms induced a reallocation of activity from Regions 1 and 2 to Regions 5 and 6, by doing so, we are understating impacts of the reforms on real wage inequality.

5.2 Results

In this section, we report the results from our calibrated model. In addition to our benchmark calibration — which permits trade across regions, migration across geographies, and rents accruing to absentee rentiers — we consider three alternate calibrations. In our second calibration, we restrict migration across provinces. In the third, we additionally restrict inter-regional trade flows. In the fourth and final calibration, 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. Our aim with each of the alternate calibrations is to highlight the importance of trade, migration, and capital rent spillovers in shaping the reform's ability to reduce regional inequality.

Our first set of results assesses the effect of the subsidy reforms on employment by region in the benchmark calibration, the one calibration in which migration across regions may take place. Figure 6 displays the model-implied labor force in each region in our baseline calibration relative to a calibration in which the subsidy reforms had not taken place. According to this figure, the reforms are responsible for a 7.6 percent increase in employment in Region 6, a 5.9 percent increase in employment in Region 5, a 0.8 percent decrease in employment in Region 2, and a 1.1 percent decrease in employment in Region 1. Most of these changes in employment by region occur by 2015, three years after the introduction of the investment subsidy scheme. However, net migration continues well into the late 2020s.

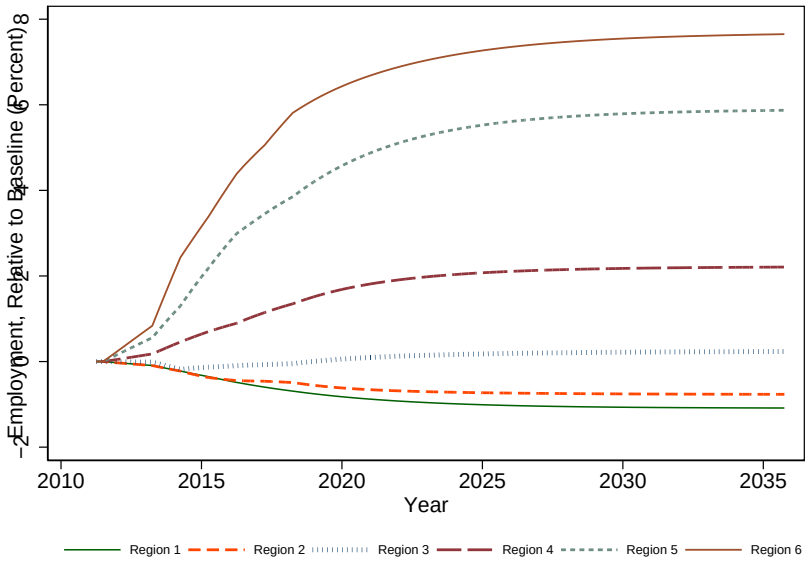

Figure 6: Employment Effects of the Subsidy Reforms

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.

We compute the trajectories of real wages for the four calibrations of our model in Figure 7. In the top left panel, we present the results for the benchmark calibration, with domestic input-output linkages, migration, and structures. The 2012 subsidy scheme increased wages most in Region 6 (the most heavily

subsidized region) and the least in Region. Four years into the subsidy reforms, real wages inequality (between Region 6 and Region 1) decreased by 1.4 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 0.2 percent.

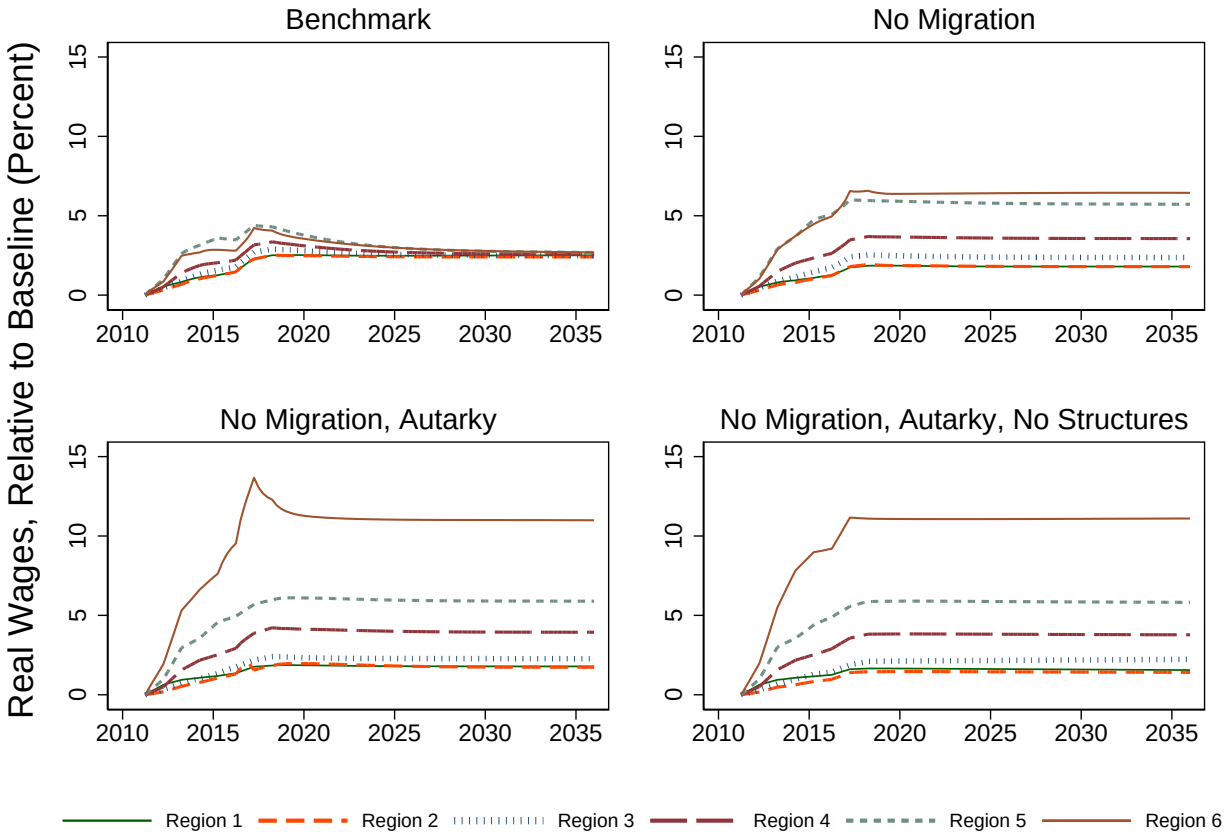

Figure 7: Real Wage Effects of the Subsidy Reforms

Notes: Each of the four panels display real wage trajectories for a separate model calibration. 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 A.3 for the lists of provinces within each of the 6 subsidy regions.

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, we find that the investment subsidies had reduced Region 6 versus Region 1 real wage inequality by 3.6 percent as of 2016, 4.6 percent as of 2026, and 4.6 percent as of 2036.

The bottom panels of this figure next 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, the impact of the subsidy reforms on real wage inequality would have been even greater: 7.9 percent, 9.3, and 9.2 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 reforms 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 these reforms 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.

5.3 Robustness

In Appendix B.3, in Figure 9, we consider 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 reforms 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.

One concern, when applying our Section 4.3 estimates on the impact of subsidization on firm-level TFP to our Section 5 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 reforms, in Appendix C we consider an "indirect inference" approach. Briefly, we regress (i) industry-geography level revenues against subsidy measures in our data; (ii) regress industry-geography 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). Figure 10 presents the real wage effects of the subsidy reforms, the analogue of Figure 7 under this alternate calibration. As with Figure 7, the medium-to-long-run impact of the subsidy reforms on regional inequality is small, less than 1 percent.

6 Conclusion

In this paper we have assessed a large reform of Turkey's industrial policy. These subsidies were aimed at promoting investment activity, particularly in the relatively impoverished southeast of the country. Consistent with the reform's objectives, our firm-level analysis suggests that these policies were a success. For each 5 percentage point increase in investment tax credit subsidy rates, firms' revenues, employment, and TFPR were higher by 10.5%, 6.9%, and 3.5% respectively. However, despite these impressive differences, our general equilibrium analysis reveals that the reforms had only a modest impact on inter-regional inequality. 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 showed, 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 reforms on inter-regional real wage inequality.

There are a number of caveats to these conclusions, the first two of which we cannot feasibly address. 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 subsidy reform period 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.[30,31] Given these unique aspects, a similarly designed set of investment subsidies may 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 reforms, 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 subsidy reforms, are both reasonable and would lead to an alternate assessment on the reform's long-run impact.

In future drafts of this paper, we aim to confront the following two open issues. First, the micro data collected by the Turkish Ministry of Industry and Technology only measure firms and employees in the formal economy. While it is inherently difficult to measure activity in the informal economy, in future drafts we hope to use estimates on the number of workers in each sector and region to better calibrate the Turkish economy's sectoral and geographic composition. Finally, we have thus far only considered the benefits of the subsidies to subsidized firms, their employees, their suppliers, and their customers. We have not weighed these benefits against the costs associated with the reforms, including reduced government expenditures or increased taxes that need to be raised to pay for the subsidies.

[30] 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.

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

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A Description of Caliendo et al. (2019)

A.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 inputs producers and households are indexed by the region ($n \in \{1,...N\}$) in which they reside and the industry ($j \in \{1,...J\}$) in which they produce/work, while rentiers are indexed by the region in which they reside. Time is indexed in period 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, changes to productivity) without having to identify these variables' levels at any given point in time.[32] 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 expenditure of each industry-region pair — as well changes in 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.[33] Let $P_t^{nj,k}$ and $c_t^{nj,k}$ respectively denote the unit price and household purchases of the different goods $k \in \{1,...J\}$ in period t. Moreover, each period households may choose to migrate to another industry-region pairs. 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 an 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:

$$U_t^{nj} = \sum_{k=1}^{J} \alpha^k \log\left(c_t^{nj,k}\right) + \max_{\{i,k\}} \beta \mathbb{E}\left[U_{t+1}^{ik} - \tau^{nj,ik} + \nu\varepsilon_t^{ik}\right] \tag{5}$$

[32] 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.

[33] In contrast to Caliendo et al. (2019), we (for now) exclude the possibility that households do not work.

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.

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

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 $t+1$.

$$\mu_t^{nj,ik} = \frac{\exp\left(\beta V_{t+1}^{ik} - \tau^{nj,ik}\right)^{1/\nu}}{\sum_{m=1}^{N}\sum_{h=0}^{J} \exp\left(\beta V_{t+1}^{mh} - \tau^{nj,mh}\right)^{1/\nu}} \tag{6}$$

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.[34]

Shipments of industry j intermediate inputs from region i to region n incur "iceberg" trade 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:[35]

$$L_t^{nj} = \frac{\gamma^{nj}\left(1-\xi^n\right)}{w_t^{nj}} \cdot \left(\sum_{i=1}^N \pi_t^{ij,nj} X_t^{ij} \right), \text{and} \tag{7}$$

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

[35] 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.

$$H^{nj} = \frac{\gamma^{nj}\xi^{n}}{r_t^{nj}} \cdot \left(\sum_{i=1}^{N} \pi_t^{ij,nj} X_t^{ij} \right). \tag{8}$$

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:

$$X_t^{nj} = \sum_{k=1}^{J}\sum_{i=1}^{N} \gamma^{nk,nj}\pi_t^{ik,nk} X_t^{ik} + \alpha^{j}\left(\sum_{k=1}^{J} w_t^{nk} L_t^{nk} + \iota^{n} \sum_{i=1}^{N}\sum_{k=1}^{J} r_t^{ik} H^{ik} \right) \tag{9}$$

The first sum on Equation 9equals 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:

$$L_{t+1}^{ik} = \sum_{n=1}^{N}\sum_{j=1}^{J} \mu_t^{nj,ik} L_t^{nj}, \tag{10}$$

  where $\mu_t^{nj,ik}$ is given by Equation 6.

- Within each period, the markets for structures and labor clear (Equations 7 and 8);
- For each intermediate good j produced in region n, the goods market clears (Equation 9);
- Households choose consumption to maximize period utility and migration to maximize lifetime utility, with preferences given by Equation 5.
- Intermediate input goods producers and final goods producers maximize profits period by period.

A.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 reforms. Our economy has six regions and 45 industries; we list these industries and regions in Appendix A.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 ν = 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: ι = [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 9) to identify ι^n. In a

future draft of this paper, we will adopt that approach.

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 $\tilde{\pi}_y^{nj,ij}$.[36]

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 a couple 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. The 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.[37] We then iteratively apply Equation 10, using the values of $\mu_t^{nj,ik}$ described in the previous paragraph.

Finally, to compute the direct productivity impact of the subsidy reforms, we draft on 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 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 $\exp\left[0.697 \cdot I_t^{nj}\right]$. In sensitivity analysis, in Appendix B.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.

A.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

[36]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.

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

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.[38] 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, Istanbul, İzmir, Kocaeli, and Muğla;
- 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, Çankıri, 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.

[38] 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).

B Sensitivity Analysis Related to Section4

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

B.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 12 and 13, 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, for employment the sign of the relationship 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 12: 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 13: 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.

B.2 Sensitivity Analysis Related to Section 4.3

Additional outcome variables

In this figure, we consider an additional estimation of Equation 3 in which (the logarithm of) firm employment is the dependent variable. As with revenues and total factor productivity, we find that firm employment increases withe subsidization, withe larger IV than OLS estimates. We find that a 5 percentage point increase in the investment tax credit rate corresponds to a 6.9% increase in firm employment, a somewhat smaller increase than the 10.5% increase that we estimated for firm revenues.

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

Table 14: The Impact of the Subsidy Program on Firm Employment

	OLS					IV				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Investment Tax	0.201	1.149***				1.591***	1.387***			
Credit Rate	(0.195)	(0.090)				(0.400)	(0.449)			
Inv. Tax Credit			1.009***	1.453***				2.281***	1.899***	
Rate + Closed			(0.234)	(0.103)				(0.570)	(0.623)	
Closed					0.504***					0.660***
Certificate					(0.027)					(0.167)
N	859,099	859,099	844,326	844,326	844,326	856,862	820,579	842,064	805,704	805,704
Firm FEs	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.370	0.850	0.366	0.852	0.852					
						First Stage				
Statutory						0.154***	0.140***	0.110***	0.099***	
investment tax						(0.011)	(0.011)	(0.010)	(0.010)	
Eligible for										0.061***
Subsidy?										(0.007)

Notes: The dependent variable is log (Employment) at the firm-year level. All regressions include province-industry and year fixed effects. Firm controls include 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. Firm controls are set to their 2012 values for each firm. Standard errors are clustered at the province level.

defensibly apply. For this reason, we consider a robustness exercise in which we compare firm-level measures of economic activity — TFP, investment, and employment — 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 larger for certain specifications (e.g., most of the specifications with TFP as the outcome variable) and weaker for others (e.g., most of the specifications with investment as the outcome variable.)

B.3 Additional Plots Related to Section 5

In this appendix, we present two additional figures to supplement the analysis in Section 5. First, Figure B.3 displays the average investment tax credit received by firms, by region and 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.

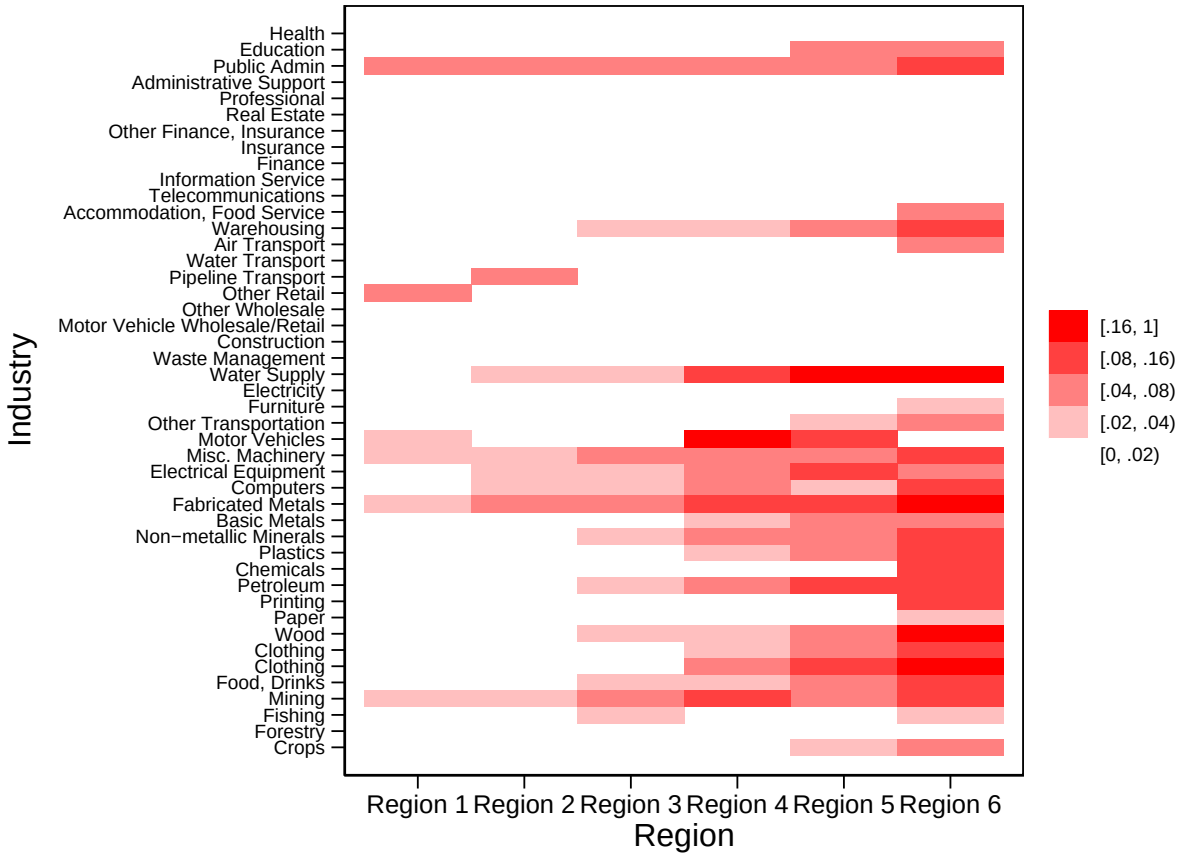

Figure 8: Investment Subsidies
Notes: The plot gives the average investment tax credit for each region and industry.

Second, we assess the sensitivity of our quantification of the subsidy reforms to the subsidy measure.

Table 15: The Impact of the Subsidy Program on TFP

	OLS					IV				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Investment Tax Credit	-0.012	-0.023				2.300***	1.495***			
Rate	(0.055)	0.054				(0.352)	(0.355)			
Inv. Tax Credit Rate +			-0.085	0.016				3.554***	2.491***	
Closed Certificate			(0.085)	(0.087)				(0.642)	(0.671)	
Closed Certificate					0.008					1.031***
					(0.027)					(0.233)
N	350,702	350,702	345,543	345,543	345,543	348,467	322,771	343,306	317,588	317,588
Firm FEs	No	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.463	0.766	0.465	0.769	0.769					
						First Stage				
Statutory investment						0.140***	0.124***	0.092***	0.078***	
tax credit rate						(0.010)	(0.009)	(0.009)	(0.008)	
Eligible for Subsidy?										0.046***
										(0.005)

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.

Table 16: The Impact of the Subsidy Program on Firm Employment

	OLS					IV				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Investment Tax Credit	-0.502***	0.982***				1.784***	1.769***			
Rate	(0.129)	(0.094)				(0.426)	(0.567)			
Inv. Tax Credit Rate +			0.464***	1.456***				2.586***	2.627***	
Closed Certificate			(0.124)	(0.121)				(0.687)	(0.879)	
Closed Certificate					0.535***					1.088***
					(0.039)					(0.255)
N	421,606	421,606	414,537	414,537	414,537	419,336	389,144	412,253	381,970	381,970
Firm FEs	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.361	0.862	0.352	0.864	0.864					
						First Stage				
Statutory investment						0.149***	0.134***	0.100***	0.086***	
tax credit rate						(0.010)	(0.010)	(0.010)	(0.009)	
Eligible for Subsidy?										0.049***
										(0.006)

Notes: See the notes for Table 14. 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 17: The Impact of the Subsidy Program on Firm Investment

	OLS					IV				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Investment Tax Credit	0.307***	0.357***				0.285	1.077***			
Rate	(0.042)	(0.076)				(0.218)	(0.400)			
Inv. Tax Credit Rate +			0.311***	0.429***				0.212	1.311**	
Closed Certificate			(0.034)	(0.076)				(0.304)	(0.636)	
Closed Certificate					0.153***					0.811**
					(0.018)					(0.239)
N	360,706	360,706	354,097	354,097	354,097	358,597	334,307	351,958	327,584	327,584
Firm FEs	No	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.052	0.343	0.052	0.348	0.348					
						First Stage				
Statutory investment						0.150***	0.131***	0.101***	0.084***	
tax credit rate						(0.010)	(0.009)	(0.010)	(0.009)	
Eligible for Subsidy?										0.048***
										(0.006)

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.

In our benchmark analysis, we used the average investment tax credit as our measure subsidy measure. Figure 9 presents the analogue of Figure 7 using the fraction of subsidized firms as our measure. As in Figure, Region 6 has the largest real wage increases as a result of the 2012 subsidy reforms, with migration and trade flows substantially mitigating the impact of the reform on inter-regional real wage inequality.

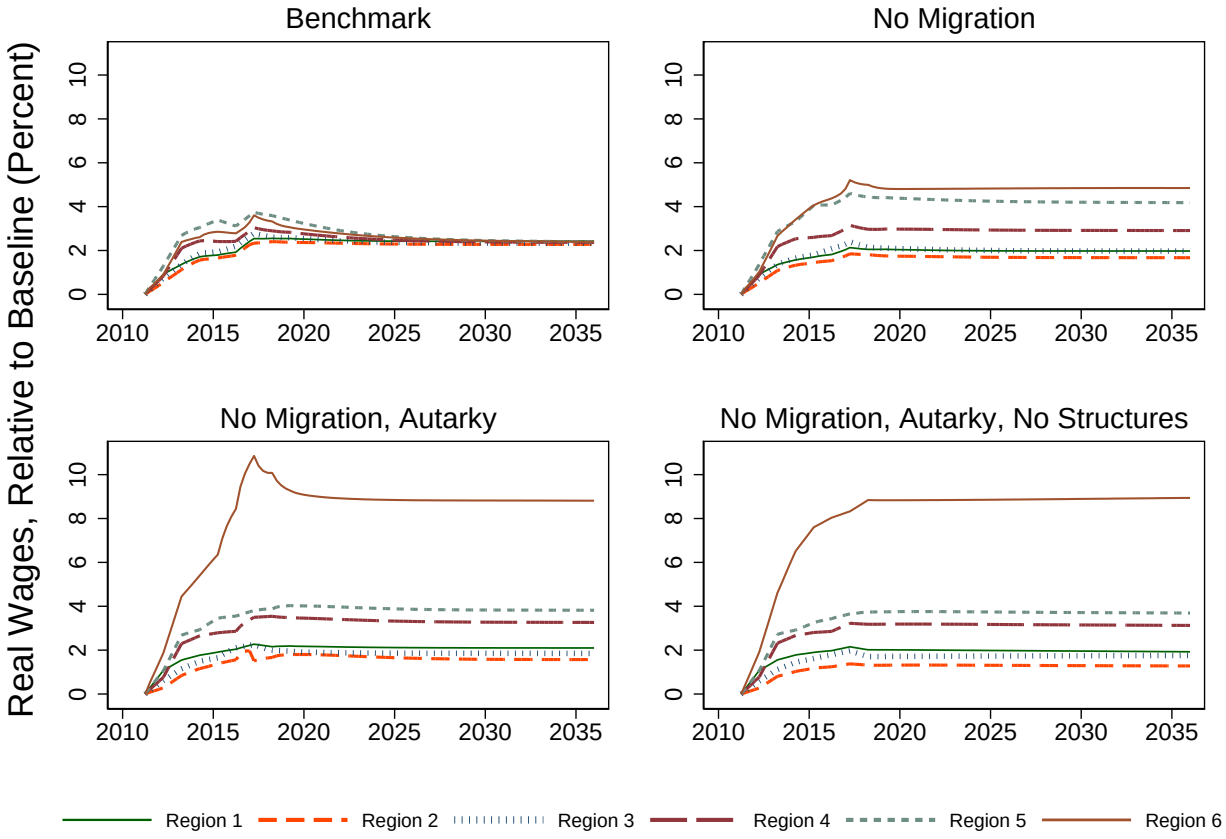

Figure 9: Real Wage Trajectories

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 — is our measure of firm subsidization by province-industry year.

C Indirect Inference

In this appendix, we consider an alternate strategy to calibrate the direct productivity gains from subsidization. We match the relative revenue increases in subsidized vs. unsubsidized industry-geography pairs in the model to be what we observe in the data.

We consider regressions of the form:

$$y_{pnt} = \beta_{pn} + \beta_{pt} + \beta_1 S_{pnt} + \beta' X_{pnt} + \varepsilon_{pnt} \tag{11}$$

Here, p denotes a geography; n denotes either a 2-digit NACE industry or a combination of 2-digit industries, t denotes a year, and y_{pnt} measures log revenues in geography p, industry n, and year t. In different specifications, we use different subsidy measures (either average investment tax credits received; statutory investment tax credit rates; or the fraction of subsidized firms.) Furthermore, we consider two separate specifications when defining geographies, p, and industries, n: In the first, p-n is a province by 2-digit NACE industry combination. In the second, p denotes one of the six subsidy regions and n denotes a combination of 2-digit NACE industries (see Appendix A.3).[39] Throughout, standard errors are clustered at the subsidy region-year level.

In Table 18, we present our estimates of Equation 11. In Panel A, an observation refers to a province by 2-digit NACE industry here. In all specifications, subsidization is associated with higher revenues. According to column 2, which we will consider our preferred specification for now, a 10 percent increase in investment tax credits is associated with a 1.8 percent increase in revenues in the province-industry pair. In Panel B, industries and geographies are now defined more coarsely. Broadly, we still find a positive relationship between subsidization and economic activity. However, the standard errors within each specification are larger; and the coefficient estimates vary more across specifications.

[39] In this exercise, we face the following trade-off: using the industry and geography definitions as in our 5 model reduces the number of observations and, as a result, the precision of our regression estimates. On the other hand, defining geographies and industries more finely — using provinces instead of subsidy regions, and using 2-digit NACE industries as opposed to combinations of 2-digit industries— reduces the comparability of the model-based and data-based regressions.

Table 18: Estimates of Equation 11: Data

Panel A: An observation is a Province×2-Digit Industry	(1)	(2)	(3)	(4)	(5)	(6)
Investment Tax Credit Rate	0.187***			0.147***		
	(0.035)			(0.033)		
Statutory Investment Tax Credit Rate		0.184**			0.265*	
		(0.088)			(0.142)	
Fraction of Subsidized Firms			0.184***			0.164***
			(0.038)			(0.026)
Year FEs	Yes	Yes	Yes	No	No	No
Province × Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry× Year FEs	No	No	No	Yes	Yes	Yes
N	38,637	38,637	38,637	38,632	38,632	38,632
R^2	0.954	0.953	0.954	0.963	0.963	0.963
Panel B: An observation is a Region×1/2-Digit Industry	**(7)**	**(8)**	**(9)**	**10**	**(11)**	**(12)**
Investment Tax Credit Rate	0.044			0.133		
	(0.112)			(0.139)		
Statutory Investment Tax Credit Rate		0.303**			0.589***	
		(0.120)			(0.193)	
Fraction of Subsidized Firms			0.192*			0.037
			(0.103)			(0.116)
Year FEs	Yes	Yes	Yes	No	No	No
Region × Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year FEs	No	No	No	Yes	Yes	Yes
N	2,094	2,094	2,094	2,094	2,094	2,094
R^2	0.978	0.978	0.978	0.989	0.990	0.989

Table 19 presents the model-based counterpart of Table 18. We restrict the coefficient estimates in column (2) of the two tables to be identical to one another. This implies a path of TFP gains in each industry and subsidy region, which we use to calibrate our model. All of the other parameters are calibrated as before, summarized in Table 18 and described more fully in Appendix A.1.

Table 19: Estimates of Equation 11: Model

Panel A: An observation is a Province×2-Digit Industry	(1)	(2)	(3)	(4)	(5)	(6)
Investment Tax Credit Rate	0.149***			0.136***		
	(0.029)			(0.033)		
Statutory Investment Tax Credit Rate		0.184***			0.408***	
		(0.044)			(0.121)	
Fraction of Subsidized Firms			0.109***			0.096***
			(0.028)			(0.033)
Year FEs	Yes	Yes	Yes	No	No	No
Province × Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry× Year FEs	No	No	No	Yes	Yes	Yes
N	33,746	33,746	33,746	33,746	33,746	33,746
R^2	0.859	0.849	0.852	0.883	0.880	0.878
Panel B: An observation is a Region×1/2-Digit Industry	(7)	(8)	(9)	10	(11)	(12)
Investment Tax Credit Rate	0.467***			0.602***		
	(0.075)			(0.081)		
Statutory Investment Tax Credit Rate		0.261***			0.574***	
		(0.086)			(0.162)	
Fraction of Subsidized Firms			0.287***			0.940***
			(0.044)			(0.096)
Year FEs	Yes	Yes	Yes	No	No	No
Region × Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year FEs	No	No	No	Yes	Yes	Yes
N	2,094	2,094	2,094	2,094	2,094	2,094
R^2	0.896	0.833	0.864	0.926	0.862	0.91

Figure 10 presents the counterfactual real wage paths in each of the subsidy regions. To match the industry-geography level revenue gains from subsidization — i.e., to match column (2) in Table 19 to column (2) in Table 18 — we require that a 1 percent increase in the investment tax credit leads to a 1.28 percent increase in firm-level TFP (as opposed to the 0.70 percent increase that we applied in our baseline calibration; see Table 11.) In other words, we impose that the direct effect of subsidization on firm productivity is 1.84 (≈1.28/0.70) times as large as in our benchmark calibration. Correspondingly, the real wage gains from subsidization are magnified by a factor of 1.84. As before, the effect of the subsidy reforms on regional wage inequality are still small in the medium-to-long run, less than 4 percent.

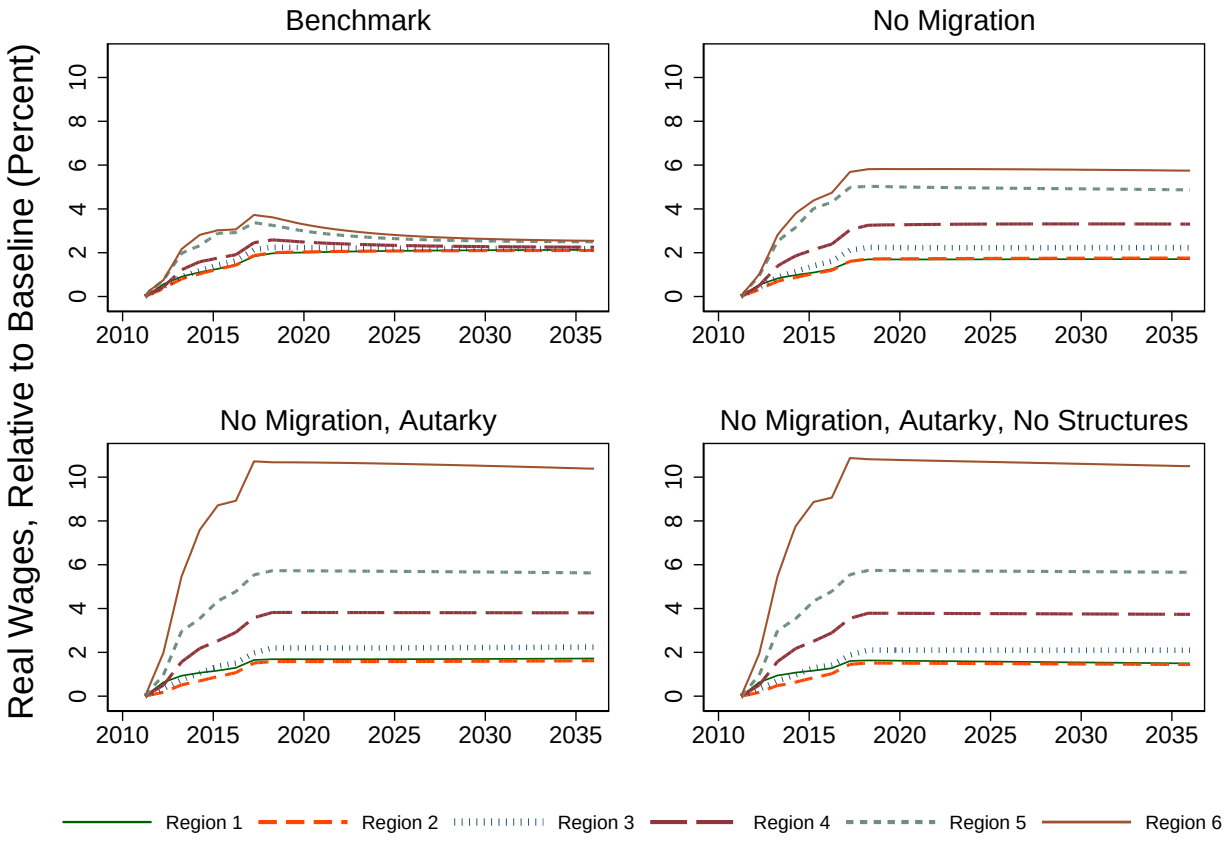

Figure 10: Real Wage Trajectories

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.

D Turkish Investment Subsidies

D.1 Subsidized Industries

According to the subsidy reforms, 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 20, we provide a mapping between the Turkish government's numbering of subsidized sectors and NACE (version 2) industry codes.

Table 20: 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 21, we provide a list of subsidized industries and Turkish provinces.

Table 21: 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 21 (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 21 (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 21 (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 20.

D.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 mainly provides VAT and customs duty exemptions for investments. The Regional Investment subsidy elements vary across regions, and entail eight different support elements. Among these, VAT exemption, customs tax exemption, corporate tax reduction, insurance premium employer share support, 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 22.

Table 22: 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 reduction 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 the region 4 and plans to make an investment of 2,000,000 TL. Also, annual corporate tax base is of the company 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% and 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.

D.3 Subsidy Expenditures

In this appendix, we provide estimates on government outlays of two of the main components of the Turkish subsidy reforms: those related to investment tax credits and those related to employment.[40]

Table 23 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 headquartered in each subsidy region for subsidy documents opened in each year. According to this table, expenditures on investment tax credits were 3.3 billion

[40]In future drafts, we will also compute government expenditures on customs duties rebates and interest rate support. These subsidy items represent a much smaller share of the total expenditures related to the 2012 subsidy reforms.

TL in 2012, increasing to 7.4 billion TL in 2017 and 6.8 billion in 2018. Region 1, despite having the least generous statutory investment tax credit rates, received a plurality — 9.1 billion TL out of 34.6 billion TL — distributed over the 2012 to 2018 period. Region 1's relatively large share of investment tax credits received reflects its large share of national economic activity; see Table 1.

Table 23: Expenditures on Investment Tax Credits

	2012	2013	2014	2015	2016	2017	2018	Total
Region 1	631.8	962.4	1,595.1	632.9	1,001.4	2,372.5	1,920.9	9,116.9
Region 2	273.3	932.6	551.5	937.0	536.3	898.2	1,304.5	5,433.4
Region 3	706.0	841.4	722.8	694.0	645.6	1,117.9	1,215.1	5,942.8
Region 4	302.9	501.0	444.1	563.6	429.4	892.4	751.4	3,884.8
Region 5	722.3	729.3	430.1	588.2	509.2	894.5	714.0	4,587.6
Region 6	678.6	936.5	491.9	543.4	455.3	1,050.4	836.0	4,992.0
Misc. Region	-	10.6	1.6	4.7	348.9	203.2	100.3	669.3
Total	3,314.9	4,913.7	4,237.0	3,963.9	3,926.1	7,429.2	6,842.0	34,626.7

Notes: Values are millions of 2010 TL.

Table 24 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.[41] In contrast to Table 23, 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 — but also 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 50.3 billion TL on investment tax credits and reduced social security payments, with approximately two-thirds of these subsidies taking the form of investment tax credits. Annual expenditures more than doubled over the 2012 to 2018 period, going from 4.7 billion TL to 10.5 billion TL. Over the period, the regional composition of subsidy expenditures was relatively constant: Region 6 received 25.6% of national government outlays in 2012 and 24.2% in 2018, while Region 1 received 16.4% in 2012 and 24.2% in 2018.

[41] 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.

Table 24: Expenditures on Employment Subsidies

	2012	2013	2014	2015	2016	2017	2018	Total
Region 1	137.7	210.1	228.9	126.4	116.5	330.7	338.8	1,489.0
Region 2	103.5	204.0	139.1	124.6	93.7	208.8	229.8	1,103.4
Region 3	229.9	235.4	253.5	146.8	135.6	224.0	257.3	1,482.5
Region 4	138.2	241.1	135.9	125.4	142.0	314.1	501.6	1,598.4
Region 5	250.8	439.0	345.6	243.5	271.2	553.9	588.7	2,692.7
Region 6	528.5	1,212.6	702.8	789.9	872.0	1,481.4	1,691.3	7,278.5
Misc. Region	-	1.2	0.5	0.2	7.2	12.5	3.3	25.0
Total	1,388.6	2,543.3	1,806.3	1,556.8	1,638.3	3,125.5	3,610.7	15,669.4

Notes: Values are millions of 2010 TL.

E Data

E.1 Details on Entrepreneur Information System (EIS)

Entrepreneur Information System (EIS) is administered by the Ministry of Science, Industry and Technology in Turkey as of 2014. Data from eight 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", "Balance Sheet Micro Dataset". While calculating the indirect effects and detailed employment effects, we also use "Declaration-Buying/Selling (BA/BS) Micro Dataset" and "Employee Micro Dataset". EIS includes data for Turkish manufacturing and service companies and the excludes finance sector. Information on the agriculture sector and public personnel is not included in the EIS.

E.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, 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.

E.3 Auditing the Micro Data

In this section, we evaluate the coverage of the micro datasets listed in Appendix E.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 assess 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).

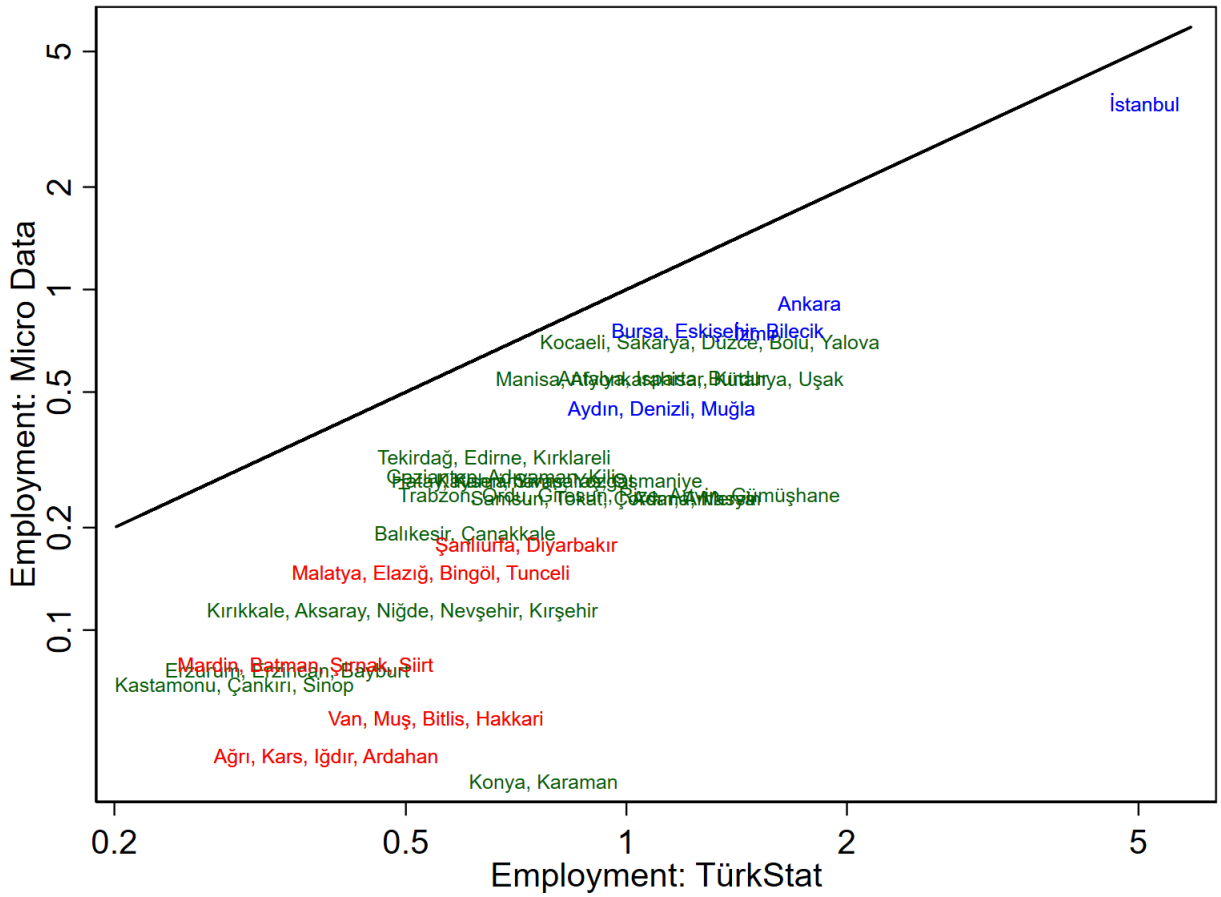

Figure 11: Comparison of Micro to Aggregate Data: Province Employment

Notes: 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 11 presents this comparison for a single year, in 2012. 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 12 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 11. With this caveat in mind, the correlations depicted in the four panels of Figure 12 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 were 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.

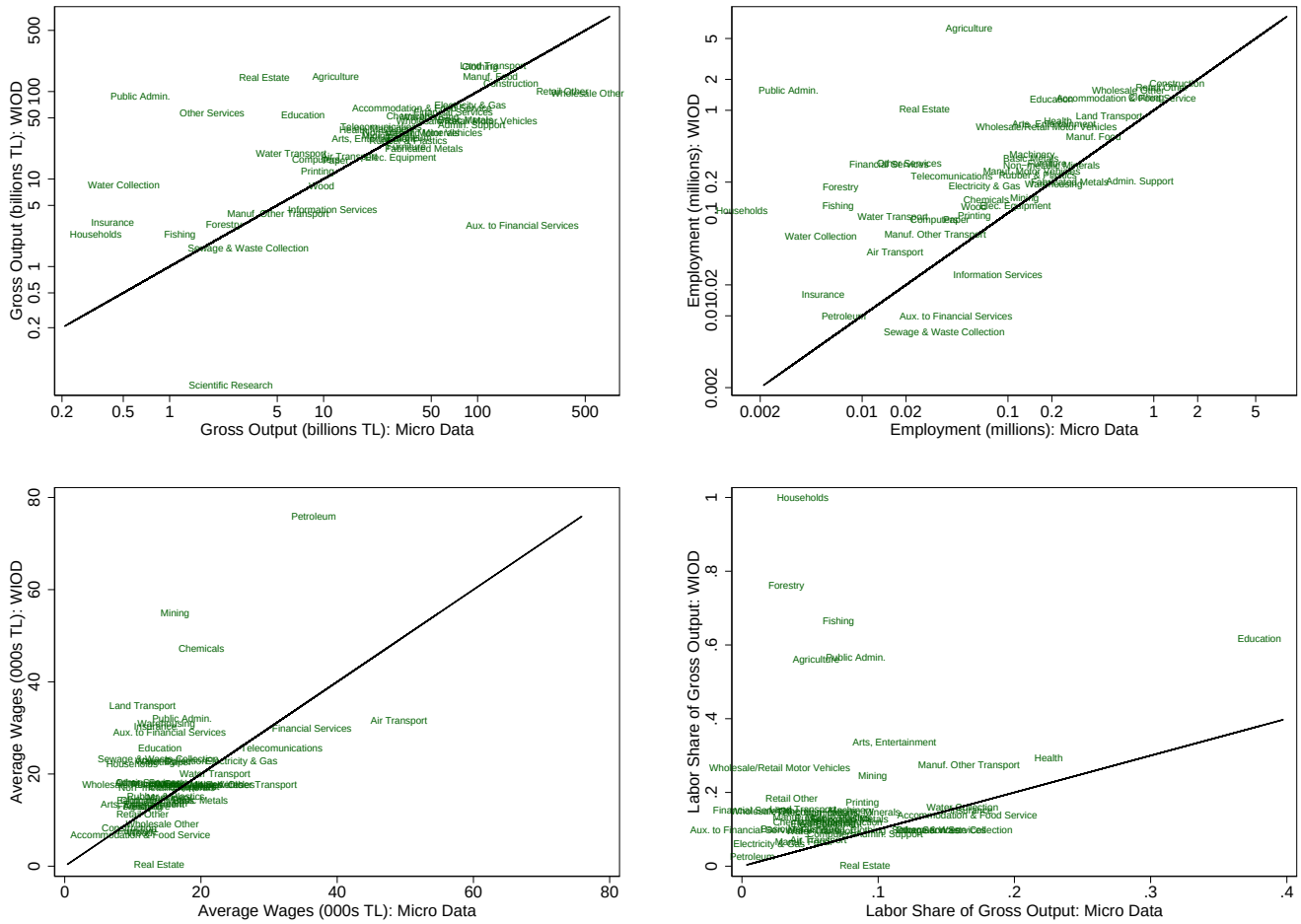

Figure 12: Comparison of Micro to Aggregate Data: Industry Activity
Notes: Values in the top left and bottom left panel are report in 2010 Turkish Liras.