PEDL Research Papers

This research was partly or entirely supported by funding from the research initiative Private Enterprise Development in Low-Income Countries (PEDL), a Foreign, Commonwealth & Development Office (FCDO) funded programme run by the Centre for Economic Policy Research (CEPR).

When Regional Policies Fail: An Evaluation of Indonesia's Integrated Economic Development Zones*

Alexander D. Rothenberg†
Syracuse University

Yao Wang
The Ohio State University

Amalavoyal Chari
University of Sussex

July 2023

Abstract

We study Indonesia's Integrated Economic Development Zone program, which provided tax-breaks for firms locating in poorer districts. Although firms in KAPET districts paid lower taxes, these tax cuts neither stimulated entry nor increased output, and KAPET districts experienced no better development outcomes than non-treated districts. To investigate whether regional policies could be more optimally redesigned, we develop a quantitative spatial model with multiple sectors and a transfer system to finance local public goods. We find that the overall welfare effects of the KAPET program were small, and tax cuts in larger cities would have been more welfare and growth enhancing.

JEL Classifications: R13, R58, O18

Keywords: place-based policies; local taxes; backward districts; informality

*Acknowledgement: We are grateful for financial support from Private Enterprise Development for Low-Income Countries (PEDL), a joint research initiative of the Centre for Economic Policy Research (CEPR) and the Department For International Development (DFID). We also thank seminar participants at MWIEDC, University of Louisville, the Indonesian Institute of Sciences (*Lembaga Ilmu Pengetahuan Indonesia*), the Urban Economic Association, the American Real Estate and Urban Economics Association, the Asian Economic Development Conference, and the Summer Meeting in Urban Economics at Peking University. Kun Gu provided excellent research assistance. All errors remain our own.

†Corresponding author: 426 Eggers Hall, Syracuse, NY 13244-1020. Email: adrothen@syr.edu.

1 Introduction

In developing countries, manufacturing firms are often characterized by small scale and persistently low growth. Such firms are constrained by restricted access to markets, capital, and technologies, as well as by unfavorable investment climates (Tybout, 2000). To spur industrial growth, many countries have established special economic zones, a particular place-based policy that provides tax incentives or reduced regulatory burdens for firms who locate in specific places. Such policies are common in developing world; examples include China's special economic zones (Wang, 2013), export processing zones in Bangladesh, Thailand, and Vietnam, and free trade zones in Honduras (Farole and Akinci, 2011). While some countries choose to establish these special economic zones in favorable areas with good market access, others use them to attract investment to poorer regions.

If threshold effects and multiple equilibria are important features of economic growth, these policies may attract enough manufacturing activity to constitute a "big push" that generates large increases in productivity, improving welfare not only in the affected localities but also throughout the country (e.g., Rosenstein-Rodan, 1943; Murphy et al., 1989; Azariadis and Stachursky, 2005). Although the tax cuts may be costly in the short term, they may also generate productivity spillovers for existing firms and encourage further entry. This could create a self-sustaining, virtuous circle of development, with growth dividends that pay for the initial tax cuts.

However, the relative costs and benefits of place-based policies are difficult to discern. If firms and workers are perfectly mobile, all of the benefits of these policies should accrue to landowners (Rosen, 1979; Roback, 1982). If workers are imperfectly mobile, place-based policies could encourage more productive reallocations of labor across space, but they may also just reshuffle economic activity around from one place to another without increasing aggregate welfare (Bartik, 1991; Glaeser and Gottlieb, 2009; Kline and Moretti, 2014a). Moreover, because many lower to middle-income countries have trouble collecting tax revenues, cuts to local taxes may reduce the provision of public goods.

This paper investigates the effects of a large place-based intervention in Indonesia known as the Integrated Economic Development Zone (*Kawasan Pengembangan Ekonomui Terpadu*, or KAPET) program. This program, which began in the late 1990s, provided substantial tax-breaks for firms that locate in certain districts in the Outer Islands of Indonesia, a country with large regional differences in per-capita income, a sizeable informal sector, and a history of policies to promote inclusive growth. To study this policy, we combine rich spatial variation in the locations of treated districts with high quality data on demographic outcomes, measures of regional growth, employment, informality, and firm-level outcomes. Using a series of reduced form exercises, we estimate the average treatment effect of the KAPET program on treated districts for a rich set of economic outcomes.

When estimating the impact of place-based policies like the KAPET program, a central concern is that omitted variables influence selection into the program and also affect outcomes. We document that KAPET zones were established in poorer districts that were more rugged, further from Jakarta, and less populated than other districts. This endogenous program placement creates a negative targeting bias, meaning that naive treated vs. non-treated comparisons will underestimate program impacts. To improve identification, we first restrict the non-treated comparison group to include only districts in the Outer Islands, which are more comparable to KAPET districts than other districts on Java and Bali.

Next, we use an inverse probability weighting (IPW) approach that explicitly adjusts for potential *ex ante* differences between KAPET and non-KAPET districts. This approach reweighs the contribution of non-treated districts to the counterfactual in accordance with their odds of treatment. These odds are constructed from a propensity score estimation, where treatment selection depends on observable, predetermined characteristics. We verify that after implementing this IPW approach, pre-trend differences between KAPET districts and untreated districts in the Outer Islands disappear.

We find that along many dimensions, KAPET districts experienced no better development outcomes than their non-treated counterparts. Although the program seems to have increased formal employment, the impact is small and not always statistically significant. We also find no significant impacts on migration or population growth. Using data on regional gross domestic product, we also find that the program was not associated with increased economic growth or structural change of economic activity. Similarly, we find that treated districts did not experience any increases in nighttime light intensity, another commonly used measure of regional output (Henderson et al., 2012; Olivia and Gibson, 2013).

We also study the KAPET program using panel data on medium and large manufacturers, from Indonesia's Industrial Survey (*Survei Industri*, or SI). Importantly, we find that firms in KAPET districts paid 50 percent lower sales, license, building, and land taxes than similar firms in non-treated districts. This is reassuring, given that the KAPET program was designed directly to reduce formal taxes in treated districts, and our effect sizes match policy intentions. In spite of these large tax cuts, we find no impacts on firms' use of labor, output, value added, or productivity. These quantitative null results compliment and validate other analyses of the KAPET policy, many of which are qualitative (e.g. Soenandar, 2005; Rahardja et al., 2012; Temenggung, 2013).

There are many possible reasons for the KAPET program's lack of success. The program began around the time of the Asian Financial Crisis and its subsequent political upheaval, so firms may have been dissuaded from making use of the incentives, given the substantial political and macroeconomic instability. However, our findings are also consistent with a strand of literature suggesting that policies encouraging firms to locate in lagging regions may suffer from fundamental challenges. Because firms do not internalize productive externalities, they tend to locate in cities that are too small from the perspective of maximizing social welfare (Henderson, 1974). To the extent that location fundamentals are important determinants of how economic activity is configured across space (e.g. Davis and Weinstein, 2002), it may be impossible even with very large subsidies to attract investment to areas with insufficient market access, communications and transportation infrastructure, or other natural amenities.[1] Moreover, if firms are heterogeneous in productivity, place-based policies to subsidize firms in the poorest regions may attract the least productive firms (Gaubert, 2018). Instead of encouraging firms to locate in remote areas, policymakers may want to reduce barriers to growth in the largest cities (Albouy et al., 2016).

To evaluate the welfare effects of the KAPET program, and to understand whether it could be redesigned to encourage a more productive reallocation of economic activity, we specify a quantitative spatial model of Indonesian economic geography, based on Zárate (2022) and Henkel et al. (2021). In the model, workers sort across multiple asymmetric districts, choosing a location of residence and whether

[1]Much of the success of China's special economic zones may have been due to the fact that the initial SEZs were on established in coastal areas with substantial market access (Wang, 2013).

to work in the formal or the informal sector. Between districts, both trade and migration are costly, and workers value local public goods, which are paid for by local tax revenues and transfers from the central government.

In the model, firms face production wedges (Hsieh and Klenow, 2009), and one component of these wedges are taxes paid by formal sector firms. Formal tax cuts can encourage sector switching and increase firm entry. If tax cuts target productive places or locations with greater potential for agglomeration economies, they could reduce spatial misallocation and lead to overall welfare gains. At the same time, tax cuts to poorer districts with unattractive location fundamentals may not increase welfare. Tax cuts can also reduce the ability of districts to finance local public goods, which reduces workers' welfare. After calibrating the model, we simulate the impact of the KAPET program, and we conduct other policy counterfactuals.

We first demonstrate that the average treatment effects on treated outcomes, estimated from our reduced form analysis, are similar to model-based analogs, using a counterfactual policy where we remove the KAPET tax cuts entirely. Then, we use the model to evaluate the KAPET program and find very small effects: the program only increased national welfare by 0.13 percent and output by 0.01 percent. Although it did lead to a 3.2 percent increase in KAPET districts' formal sector employment, it also displaced informal workers and largely reshuffled economic activity without leading to growth. Because the KAPET program targeted districts that were poor and net recipients of central transfers, the local tax cuts did not have a large impact on equilibrium local public goods. We also find that the KAPET program would have led to lower welfare gains if local public goods were self financed and the transfer system were abolished. We explore the robustness of these findings to different values of key model parameters.

Finally, we also use the model to evaluate the impacts of different regional policies. We conduct several different counterfactual policies, simulating a 20 percent tax cut in each district in Indonesia. We find that tax incentives for firms to locate in larger, denser districts would have been far more welfare and growth enhancing than tax cuts in poorer areas with larger informal sectors. However, if tax cuts in richer districts are sufficiently large, they also reduce welfare because of shortfalls to the transfer system to provide local public goods in poorer districts.

This paper contributes to a large literature evaluating the benefits and costs of different place-based policies (Neumark and Simpson, 2015), much of which focuses on policies implemented in the U.S. and Europe. While some papers find evidence of successful programs, including the Federal Empowerment Zone program in the U.S. (Busso et al., 2013), the West-German Zonenrandgebiet (Ehrlich and Seidel, 2018), or the Tenessee Valley Authority (Kline and Moretti, 2014a), other papers find limited or null effects, such as Neumark and Kolko (2010) on California's Enterprize Zones program or Gobillon et al. (2012) on French Enterprise Zones.[2]

We also contribute to a small but growing literature that studies place-based policies in developing countries (Wang, 2013; Duranton and Venables, 2018; Galle et al., 2023), and in particular, to studies of policies that promote growth in lagging regions. Here, the evidence tends to be a bit more promising. Chaurey (2017) finds that tax exemptions in two poor states in India lead to large increases in employ-

[2]In particular, the evidence on enterprise zones in the U.S., which are similar in some ways to KAPET zones, is quite mixed, with results that often differ depending on the authors' research design (c.f. Elvery, 2009; Ham et al., 2011; Lynch and Zax, 2011; Freedman, 2013).

ment, output, and firm entry. Shenoy (2018) also finds large increases in nighttime light intensity in the Indian state of Uttarakhand in response to a comprehensive place-based policy, including infrastructure investments, investment subsidies, and tax incentives. However, Hasan et al. (2021) study the impact of India's backwards districts program, and they find that large short-term positive impacts mostly come from a displacement of firms from nearby districts, suggesting negligable overall welfare effects. Our study suggests weak responses of firms to changes in tax rates in lagging districts in Indonesia (Rathelot and Sillard, 2008), and that promoting growth in more productive urban areas would have been more welfare enhancing.

The rest of this paper is organized as follows. Section 2 presents background information on the KAPET program and other regional policies in Indonesia. Section 3 describes the different datasets we use to evaluate the KAPET program and presents summary statistics. Section 4 discusses reduced form results. Section 5 describes the quantitative spatial model, and Section 6 explains how we take this model to the data. Section 7 presents counterfactual results, and section 8 concludes.

2 Regional Policies in Indonesia

Spatial differences in the concentration of economic activity, employment, and output have long been a feature of Indonesia's economy. For instance, in the early 17th century, the Dutch East India Company (VOC) practiced an uneven development strategy, promoting extractive enclaves in the form of plantations and mines on Sumatra, Sulawesi, and Kalimantan while encouraging more balanced, diversified growth in Java (Hill, 2000). These regional inequalities, often rooted in differences in natural resources, have strained internal relations throughout Indonesia's history.[3]

After independence, Suharto's New Order regime (1967–1998) enacted several policy initiatives to combate regional inequality (Soenandar, 2005). Beginning in the late 1960s, Suharto's first five-year development plan (*Rencana Pembangunan Lima Tahun I*, or Repelita I) introduced several investment incentives to promote growth in the Outer Islands, including a tax holiday for firms locating outside of Java that began in 1967.[4] However, in 1984, the tax holidays and other fiscal benefits for firms locating off of Java were eliminated, in an effort to simplify taxation and increase revenue (Pangestu and Bora, 1996).[5] Despite these efforts, regional inequalities have remained considerable. For example, in 1990, non-oil GDP per capita in the richest district (Kediri, in East Java) was more than 70 times the non-oil GDP per capita in the poorest district (Lampung Barat, in South Sumatra).

KAPET. Efforts to promote growth in lagging regions were quite limited until the creation of the Integrated Economic Development Zones (*Kawasan Pengembangan Ekonomui Terpadu*, or KAPET), first announced in 1996. The KAPET program was designed to accelerate growth and development in Eastern Indonesia, which consists of the island groups of Kalimantan, Sulawesi, Maluku, Papua, and Nusa Tenggara. By law, formal businesses locating in KAPET zones were eligible for several incentives that reduced corporate income tax. These measures included a partial tax holiday, with a 30 percent reduction

[3] For example, in the 1950s, violent separatist movements in Kalimantan and Sumatra, notably in Aceh, threatened to overwhelm Sukarno's early presidency (1945–1967) and dissolve the Indonesian nation.

[4] For an in-depth discussion of the history of regional policies and investment incentives in Indonesia, see Temenggung (2013).

[5] Some policies that expanded in the late 1970s and early 1980s, such as Indonesia's Transmigration program, were also designed in part to stimulate economic activity in unpopulated, underdeveloped regions (Bazzi et al., 2016).

of taxes on capital, expanded choices for depreciation and amortization of capital and losses, fiscal loss compensation for 10 consecutive years, and a reduced income tax on dividends for foreign taxpayers.[6] Other benefits included: (1) a corporate income tax exemption on imports of capital goods, raw materials, and other equipment directly related to production activities; (2) a 50 percent reduction on building and land taxes for both new construction and expansion; and (3) additional benefits, including being able to deduct 50 percent of employee costs from corporate taxable income (Presidential Decree 9/1998, Article 22).[7]

By using fiscal incentives, policymakers hoped that KAPET areas would attract investment and stimulate manufacturing and export growth. Planners also intended to promote growth and development for micro, small, and medium-sized enterprises (MSMEs) to reduce the size of the informal sector. It was hoped that formal manufacturing growth would create jobs and reduce unemployment and poverty.

Presidential Decree No. 89 of 1996 created the KAPET program, building on a small number of earlier programs aimed at accelerating regional development in Eastern Indonesia. Apart from one KAPET zone created in Papua (which we ignore in our analysis because of data quality concerns), 12 KAPET zones were launched by presidential decree in January 1998, before Suharto resigned, and in September 1998, after Habibie became president. Table 1 lists the names and locations of the 12 KAPETs in our sample, the presidential decree that established them, and the year they started operation. Although one KAPET was established in Banda Aceh, in North Sumatra, the remaining 12 other KAPETs were located in Eastern Indonesia.

On paper, the KAPET program can be thought of as a tax cut for firms, as is often modeled in the study of place-based policies (e.g. Kline and Moretti, 2014b). However, in practice, the program suffered from several implementation issues. First, many KAPETs were created in early 1998, right before the Asian Financial Crisis and its subsequent political upheaval that brought uncertainty to Indonesia's business climate. Despite the tax breaks offered by the program, these political and macroeconomic events may have dissuaded investors from the region, especially during the early years of the program. However, in 2000, Regulation No. 20 offered some streamlining of the KAPET incentives and more flexibility to firms who would use them, so the program continued to operate despite the macroeconomic and political upheaval.

More importantly, KAPETs were managed under a decentralized structure, and local governments had substantial authority over how to use program funds. In the early days of Indonesia's "big bang" decentralization, there was considerable uncertainty over administrative authority and obligations. Local governments had trouble coordinating with the central government and often lacked the capacity to manage and implement many programs transferred to them (Hofman and Kaiser, 2004).

According to a report conducted by the executive director of the Development Council of Acceleration of Eastern Indonesia and the Developing body of KAPET, by 2003, only 6 KAPET zones had actually

[6] Indonesian corporate taxpayers pay both corporate income tax, which apply to profits, and value added taxes, which are levied at a flat rate of 10 percent, with rebates for exports (Basri et al., 2021). The KAPET incentives largely applied to corporate income taxes and not to value added taxes.

[7] The KAPET program also included several non-financial incentives. The zones were coupled with 31 programs aimed at improving human, economic, and national resources, facilities and infrastructure, and investment facilitation services (Temenggung, 2013). There were also several programs targeted at micro, small, and medium-sized enterprises (MSMEs), including counseling and assistance programs, programs to assist MSMEs in applying for loans from the banking sector, and the promotion of a one-stop-shop integrated licensing system (*Pelayanan Terpadu Satu Pintu*, or PTSP) to reduce the costs of business registration.

established transparent fiscal incentives for firms; these included (1) Sabang / Bandar Aceh; (2) Sanggau / Khatulistiwa; (3) Batulicin; (4) Minado-Bintung; (5) Pare-Pare; and (6) Bukari / Bank Sejahtera Sultra (BPKP, 2003 cited in Soenandar, 2005). The remaining KAPETs struggled to do so because of coordination issues between the center and the local governments that adminstered them. Table 1 lists this set of "well implemented" KAPETs, which we take as our main group of treated locations. However, for robustness, we also consider the full set of KAPET zones.

Although 28 different districts were nominally treated by the program, it was only properly implemented in 17 districts.[8] Districts were selected for the KAPET program according to several different criteria: (1) favorable geography; (2) potential for economic growth; (3) containing leading sectors capable of boosting growth in hinterland areas; and (4) potential for large investment returns. Each KAPET zone was established in a different province. Within provinces, it was hoped that KAPET zones would be growth centers, attracting activity from hinterland areas. Figure 1 presents a map of the districts treated by the program.

3 Data

In this section, we first define districts, the spatial unit of analysis used in the empirical work. Then, we describe several key datasets used in the paper: (1) geographic characteristics and satellite data; (2) census data to measure demographic characteristics; and (3) data on economic and industrial activity.[9]

Districts. Throughout the paper, we use Indonesia's districts (*kabupaten*) as the primary spatial unit of analysis. The district is the second administrative division in Indonesia, nested below the province, but above the subdistrict (*kecamatan*) and village (*desa* or *kelurahan*). Because many districts were divided and partitioned into new districts during the process of decentralization after the fall of Suharto, we aggregate the data back to 1990 definitions in order to achieve a consistent geographic unit of analysis.[10] The sample contains 301 districts, with a median land area of 1,886 square kilometers. This is slightly larger than the size of U.S. counties, which have a median area of 1,595 square kilometers.[11]

Geographic Characteristics. We use data from the Harmonized World Soil Database (HWSD) and other sources to measure many agroclimatic characteristics of districts. These include measures of topography, such as elevation, ruggedness, soil characteristics, and distance to rivers and to the coast, all of which capture aspects of districts' natural amenities that may influence productivity. We also construct measures of centroid distance to Jakarta, distances to major roads, and distances to ports to proxy for access to markets. These variables capture many important aspects of the "favorable geography" criterion used to govern the selection of districts into treatment by the KAPET program.

[8] Note that based on legislation documents, 21 districts were fully treated by the program, but 7 districts were only partially treated, with incentives that just covered specific sub-districts. Because much of our data is coded at the district level, we ignore differences between fully treated and partially treated districts in our empirical work.

[9] More information on these variables, including precise details on how various outcome measures were calculated, can be found in Appendix B.

[10] Until the late 1990s, district boundaries were relatively stable (Booth, 2011). However, because of the decentralization process, many subdistricts split off from their original districts, forming new districts. The number of districts increased from 302 in 1999 to 514 in 2014, through a process known as *pemekaran* or blossoming (Bazzi and Gudgeon, 2021).

[11] Indonesia's major cities (*kota*) are also given separate district identifiers, and these designations are also used in the analysis.

Demographic Characteristics. For the last 50 years, Indonesia's Central Statistical Agency (*Badan Pusat Statistik*, or BPS) has collected high quality decennial population censuses. We use IPUMS extracts of the 1990, 2000, and 2010 Indonesian Censuses to measure demographic characteristics at the district level. Measures include the size of the total population, the percent of the population with different levels of educational attainment, and measures of in-migration, including the fraction of the population born in a different province and the share of the population that moved to the current district within the last 5 years.

Output, Employment, and Industrial Activity. We use two different indicators as broad measures of economic activity at the district level: (1) annual data on real non-oil gross domestic product from sub-national product accounts data produced by BPS; and (2) annual data on nighttime light intensity from the National Oceanic and Atmospheric Administration (Henderson et al., 2012). Light intensity has been identified as a strong proxy for local income within Indonesia, over a period of rapid electrification beginning in the late 1980s (Gibson et al., 2020). We analyze the night lights data by measuring average intensity at the district level.

We combine these broad measures of economic activity with employment estimates from the National Labor Force Survey (*Survei Angkatan Kerja Nasional* or *Sakernas*). The *Sakernas* provides annual, district-level estimates of the fraction of workers who are employed. Following Comola and De Mello (2011) and BPS, we measure the share of employed workers who work in the informal sector as the share of workers who are self-employed or family/unpaid workers.[12] We construct these employment measures from the 1990, 2000, and 2010 *Sakernas* surveys.

Finally, we use firm-level data from an annual plant-level survey of medium and large firms, the Survey of Manufacturing Establishments (*Survei Tahunan Perusahaan Industri Pengolahan*, or SI). The SI is intended to be a complete annual enumeration of manufacturing plants with 20 or more employees. The survey records information on plant employment sizes, their industry of operation, cost variables, and measures of value added. We construct district-level aggregates of the SI data, but we also use the individual firm-year panel structure of the data in our analysis below.

3.1 Pre-Treatment Summary Statistics

Table 2 presents summary statistics of several different variables, each measured before the KAPET program was launched in 1998. The first set of columns reports the means, standard deviations, and sample sizes of variables for districts where the KAPET program was well implemented; we drop poorly implemented KAPET districts from this analysis.[13] The second set of columns reports the difference in means between treated and "all non-treated" districts, where this sample includes all districts in Indonesia that did not host the KAPET program. Finally, in the third set of columns, we report the difference in means between treated and non-treated districts in the Outer Islands; this comparison excludes districts on Java and Bali which were not targeted by the policy.

Panel A reports summary statistics for geographic characteristics. Compared to all non-treated districts, KAPET districts are more rugged and farther from Jakarta. While some geographic differences are

[12] Only workers who work for a salary are considered to work in the formal sector.

[13] Comparing all KAPET districts in this analysis, regardless of implementation, yields very similar results. Results are available on request.

statistically significant, differences tend to shrink and significance tends to fall when comparing treated districts to non-treated counterparts in the Outer Islands.

In Panel B, we compare districts on the basis of economic activity. Although measured GDP is larger in treated than non-treated districts, the difference is not statistically significant. However, treated districts exhibited significantly lower average intensity of nightime lights in 1992 as well as significantly smaller pre-treatment growth in night lights from 1992-1997. While treated districts had lower employment rates and a greater share of informal employment than non-treated districts, these differences are only marginally significant. Treated areas also had fewer medium and large manufacturing firms, fewer workers in manufacturing firms, but larger wages for those workers, though this last difference is not statistically significant. Yet again, when we restrict our comparison to non-treated districts in the Outer Islands, these differences tend to attenuate and lose significance.

In Panel C, we show that relative to all non-treated districts, KAPET districts had smaller populations in 1990, but there were no significant educational differences between treated and non-treated districts. However, these differences become insignificant when comparing treated to non-treated districts within the Outer Islands. Panel D also shows that there were no significant differences in the quality of public goods and infrastructure between treated and non-treated districts.

Overall, the results shown in Table 2 suggest that compared to other districts in Indonesia, KAPET districts were more rugged, less developed, and less manufacturing-oriented than non-treated districts, suggesting negative selection. This is not surprising given that the program was designed to promote growth in the Outer Islands, which is traditionally less developed than Java or Bali. However, many of the differences between treated and non-treated districts become smaller and less significant when comparing treated districts to non-treated districts on the Outer Islands. This suggests that districts without KAPET zones in the Outer Islands may provide a stronger comparison group, allowing us to address some first order concerns about endogenous program placement.

4 Evaluating Indonesia's KAPET Program

To study the impact of Indonesia's KAPET program on outcomes, we estimate parameters of the following regression equation:

$$\Delta y_d = \alpha + \beta T_d + \mathbf{x}_d' \beta_x + \varepsilon_d \tag{1}$$

where d indexes districts, Δy_d is the (percent) change in outcome y for district d, T_d is an indicator for whether or not district d was treated by the KAPET program in the late 1990s, $\mathbf{x}_d$ is a vector of predetermined controls (described below), and ε_{dt} is an error term. The key parameter of interest is β, which measures the average treatment effect on the treated (ATT) on the growth in Y for KAPET districts.

Note that when calculating changes in district outcomes over time, we assume that KAPET treatment begins in the year 2000. This choice was made for several reasons, including: (1) data quality in the year 1998, which both coincides with the official start date of the program and also the Asian Financial Crisis; and (2) the timing of the dicennial population census, which was only collected in 1990, 2000, and 2010. However, we show below that our main results are robust to using 1998 as the start year.

A major concern in assigning a causal interpretation to β in equation (1) is that T_d is not randomly assigned. As discussed in Section 2, the KAPET program targeted specific districts in the Outer Islands. Although program documents emphasize that districts were selected for their economic growth potential, the results in Table 2 suggest that KAPET districts were, on average, not very different from other districts in the Outer Islands. However, to the extent that policymakers hoped to use the program to stimulate development in relatively poorer districts, we would expect a naive comparison between treated and non-treated districts to result in a downward bias in estimates of β, even within the Outer Islands.

We address these potential biases using propensity-score re-weighting. The weights come from a first-step estimation of the probability of being selected for the KAPET program as a function of baseline variables, $\mathbf{x}_d$, which include geographic controls and baseline measures of demographic and economic activity. Specifically, we include five geographic controls (the average elevation of the district, the district's average vector ruggedness measure (Sappington et al., 2007), distance to the coast, distance to the nearest river, distance to the nearest major port), two baseline measures of economic activity (average district light intensity in 1992, the average change in light intensity between 1992-1997), and two measures of population (log total population in 1990, and the 1990 rank of the district's population in the province). We also include the change in the provincial vote total for Golkar (Suharto's political party) in legislative elections between 1997 and 1999. These early election results, both after the fall of Suharto, may reflect political sentiment towards the ruling party in 1998 when decisions about the locations of KAPET districts were made.

Appendix Table A.1 reports propensity score estimates. Despite using only a parsimonious set of variables in $\mathbf{x}_d$, our propensity score model explains a sizeable amount of treatment variation, with pseudo-R^2's of between 0.27 and 0.38. The table shows that ruggedness, proximity to ports, larger populations in 1990, and being a district with lower population ranks in the province were all associated with greater treatment likelihood. We also find that districts from provinces with a greater increase in the Golkar vote share were more likely to be treated. Appendix Figure A.1 plots a histogram of the propensity score across treated and all non-treated districts (Panel A) and across treated and non-treated districts in the Outer Islands (Panel B). Overall, this figure showcases that overlap improves with the Outer Islands comparison.

Using weights derived from the propensity score models estimated in Appendix Table A.1, our treatment effect estimates implement both the Robins et al. (1995) two-step, double robust and the Oaxaca-Blinder reweighting approach of Kline (2011). Both approaches assign greater counterfactual weight to non-treated districts with similar underlying natural advantages, similar pre-treatment economic development, and similar political characteristics.

Pre-Treatment Trends in Outcomes. Another key concern with our empirical approach is that the change in outcomes for comparison districts may not be a valid counterfactual for what would have happened to treated districts if they had not been treated. To assess the common trends assumption, Table 3 estimates the effect of the KAPET program on pre-treatment growth of demographic outcomes (Panel A), regional output (Panel B), and employment and activity of large manufacturers (Panel C). Each cell in this table corresponds to estimates from a separate regression, with the dependent variable listed in the far left column. In column 1, we report the unadjusted comparison between treated districts and all non-treated districts. In columns 2-5, we restrict the non-treated sample to districts in the Outer

Islands. Similar to column 1, column 2 is an unadjusted treated and non-treated comparison, while column 3 includes as regressors the predetermined variables in $\mathbf{x}_c$ that may influence selection into treatment (as described above). Column 4 implements the Robins et al. (1995) double robust estimator.[14] Column 5 uses the Oaxaca-Blinder reweighting approach of Kline (2011).

Column 1 shows that compared to all districts, treated districts had significantly slower night lights growth and slower growth in the number of large manufacturers before the program began. However, in column 2, once we include only districts in the Outer-Islands in the control group, these pre-trend differences become much smaller and lose significance. Column 5, our preferred estimator, shows no evidence for any pre-treatment growth differences, apart from more rapid growth in the share of the population with high school completion, though this difference is only marginally significant. We take this as evidence largely in favor of the common trends assumption.

Demographic Impacts. In Table 4, Panel A, we provide estimates of β for growth in demographic outcomes that were plausibly influenced by the KAPET program. The first row of Table 4 provides estimates of the effect on the percent change in the population over the decade. Although treated districts appear to exhibit faster population growth in column 1, once we condition on pre-treatment characteristics and use propensity-score reweighting, these effects become negative, and they are not statistically significant.

Although our sample sizes are relatively small (277 districts in column 1, 17 treated districts and 143 control districts in columns 2-5), the lack of statistical significance is not entirely due to power limitations. For instance, in row 1, the 95 percent confidence interval for the impact of KAPET on population growth from 2000 to 2010 is $[-0.09, 0.03]$. Annualizing this estimate, we can rule out negative effects of a 0.9 percent decline in population per year and positive effects of 0.3 percent increase in population per year over the period, equivalent to roughly 0.3-0.8 standard deviations in annual population growth. We also do not see statistically significant impacts on growth in migration or growth of the population with high school completion (rows 2-4).

Demographic shifts are an important component of evaluating the welfare effects of place-based policies. If a place-based policy encourages greater in-migration, the agglomeration benefits of must be weighed against any congestion impacts. The fact that our results show limited, if any, persistent demographic effects of the KAPET program suggests that the program probably did very little to improve national welfare. Moveover, if the KAPET program had resulted in meaningful spillovers across districts, it likely drew economic activity away from nearby non-treated districts and move it into treated districts, which would exaggerate program effects. This makes the lack of significant demographic impacts based on our specifications even more striking.

Effects on Aggregate Output, Employment, and Manufacturing Growth. In Table 4, Panel B, we provide estimates of β for measures of regional output and economic growth. In general, after restricting the comparison to non-treated districts in the Outer Islands, we do not find any significant effects of the KAPET program on any growth outcomes, either as measured by regional product accounts data or using the night-lights data as proxies.

[14] Note that because the odds of treatment are estimated from a first step propensity score, standard errors need to be adjusted in the second step. We make this adjustment by bootstrapping the entire estimation procedure; results are shown when standard errors are calculated from 1000 bootstrap replications.

In Table 4, Panel C, we examine whether the KAPET program led to changes in employment growth, informality, and whether it affected large manufacturing firms. The first row shows that KAPET districts experienced a 3-4 percent increase in formal employment, but the effects are not robustly significant across specifications. We also see negative, though insignificant, impacts on informality. However, the program does not seem to be associated with changes in the composition of employment, growth in the number of large firms, changes in output for large manufacturers, changes in large firm employment, or changes in wages for workers in these firms.

ATT Estimates: Robustness. When estimating the impact of the KAPET program, our preferred estimates drop the poorly implemented KAPETs from our sample when estimating treatment effects. Appendix Table A.3 shows that our estimates are robust to ignoring these implementation distinctions.[15] Moreover, because of data comparability, our main estimates are based on setting the start date for treatment to be the year 2000. Appendix Table A.4 shows that for measures of economic activity, manufacturing output, and employment information, our post-treatment outcome differences are robust to using 1998 as the year of the start of the program.[16]

Panel Data Estimates for Large Formal Firms. Another way to evaluate the effects of the KAPET program is to study how it affected individual firms, using panel data on manufacturers from the SI. In Table 5, we report these panel data estimates, focusing only on firms in the Outer Islands. The first column reports fixed-effects least squares estimates of the impact of KAPET on firm outcomes, conditioning on separate fixed effects for each year, 5-digit industry, and district. In column 2, we restrict the sample to only include "incumbent" firms that started operation before 1998, when the program was initially implemented. Finally, in column 3, we replace the industry and district fixed effects with firm-fixed effects, and we study how the KAPET program changed outcomes for incumbent firms. In all cases, we restrict our analysis to the years from 1985 to 2012.

The first row shows that the KAPET program was associated with significant decreases in taxes paid on sales, business licenses, building permits, and land for firms affected by the program. Because the dependent variable is in logs, using the value of $\beta = -0.773$ from column 2, the coefficient estimate implies that firms in KAPET districts only paid 46 percent of the taxes that were paid in non-treated districts.[17] This suggests that the KAPET program was associated with a sizeable tax reduction, with a nearly 50 percent reduction in building, land, and employment taxes as stated in policy documents. In a sense, this result can be viewed as a "first stage," corroborating that the program indeed led to significant reductions in the tax burden for formal firms.

However, the remaining rows of the table show no impact of these tax cuts on output, value added, employment, wages, or measures of output and value added per worker. In sum, the KAPET program does not seem to be associated with entry of new, productive firms. If anything, the strongest finding for medium and large manufacturers is that they paid lower taxes, and that the size of the tax cuts is equivalent to what was intended by the policy.

Discussion. Our reduced form results have generally found that as implemented, the KAPET pro-

[15] We can also include the poorly implemented KAPET districts in the control group and when we do, we obtain similar results; these are available upon request.

[16] Recall that we cannot calculate population totals in 1998 because of the timing of the census data.

[17] To obtain this, we simply exponentiate the estimate of $\beta = -0.773$ to obtain $\exp(\beta) = 0.462$.

gram did not increase migration, stimulate economic growth, or improve welfare. This begs an important question: why was this place-based policy unsucessful? One hypothesis is that because KAPET areas tended to have poor location fundamentals, the tax subsidy required to stimulate growth and development in those areas was insufficient. In Appendix Table A.5, we provide some suggestive support for this idea. Using treatment interactions, we find that formal employment growth was significantly lower in more rugged KAPET districts.[18] This suggests that a policy that targeted locations with more favorable geography or with better market access might have been more successful.

On the other hand, perhaps the Indonesian government could stimulate more growth and development by targeting larger cities with tax breaks. Or, maybe the program as implemented would have been more successful if Indonesia's large internal migration costs had been smaller. Unfortunately, the reduced form variation does not allow us to test these different hypotheses. To better understand why the KAPET program was unsuccessful, and to determine whether a differently designed tax incentive program could have reshaped economic geography more optimally, in the next section, we specify a quantitative spatial general equilibrium model.

The model has multiple asymmetric districts, which differ by location fundamentals, and workers sort across locations and between sectors (formal or informal). Taxes are collected locally to provide public goods, but a system of regional transfers is used to finance public goods in regions with low tax revenue. We explain how to estimate and calibrate parameters of the model, and we use it to simulate the effects of different counterfactual place-based policies. The next section describes the model, and the following section explains how we take the model to the data.

5 A Quantitative Spatial Model

Our model is based on Zárate (2022), which incorporates formal and informal sectors into a quantitative spatial model, and on Henkel et al. (2021), which allows for regional public transfers to finance the provision of public goods. The economy consists of N discrete locations (districts). Each district has two sectors, $z \in \{f, \text{inf}\}$, where f denotes the formal sector and inf denotes the informal sector.

Each sector in each district has different levels of amenities and productivity, both of which contain exogenous and endogenous components. Trade and migration are both costly, as in Allen and Arkolakis (2019). Workers are born in a location, and they decide where to live and the sector in which to work to maximize their utility. Tax cuts, like those implemented by the KAPET program, reduce production costs and output prices in the formal sector, but they also make it harder to finance local public goods, which are valued by workers.

5.1 Workers and Migration Flows

The economy has a fixed total population of workers, given by $\overline{L}$. Workers are born in district i (origin), and they choose a district j in which to live (destination) and a sector z in which to work. Each district is endowed with an initial, exogenous stock of labor given by L_i^0, and we assume that $\sum_i L_i^0 = \overline{L}$. The total

[18] Although this relationship is not significant with propensity-score reweighting (columns 5 and 6), the coefficient magnitudes are similar to those from specifications without propensity score reweighting (columns 1-4).

population of workers who choose to work in sector z in residence district j is given by L_{jz}.[19] Workers have preferences over private consumption goods, local public goods, and amenities. They choose the location and sector with the most desirable bundle of wages, prices, amenities, and local public goods, discounted by the migration cost incurred when moving out of their initial (birth) location.

We assume a Cobb-Douglas form for the indirect utility of worker υ who is born in district i, moves to district j, and works in sector z, given by:

$$V_{ijz}(\upsilon) = \frac{u_{jz}}{D_{ij}} \left(\frac{G_j}{{L_j}^{\kappa}} \right)^{\gamma} \left(\frac{w_{jz}}{P_j} \right)^{1-\gamma} \epsilon_{ijz}(\upsilon) \quad , \tag{2}$$

where u_{jz} denotes the level of amenities in district j and sector z, D_{ij} measures the cost of migrating from i to j, w_{jz} denotes the nominal wage in district j and sector z, P_j is the price index of consumer goods in district j, G_j measures local public goods in district j, and $\epsilon_{ijz}(\upsilon)$ is an idiosyncratic preference draw. As in Henkel et al. (2021), the parameter $\kappa \in [0, 1]$ in equation (2) governs the degree of rivalry in public goods, with $\kappa = 0$ capturing the case of pure, non-rival local public goods and $\kappa = 1$ capturing the full rivalry case. Because individuals have Cobb-Douglas preferences over public and private goods, γ measures the elasticity of substitution between these types of goods.

Amenities for sector z in district j have both an exogenous and an endogenous component:

$$u_{jz} = \overline{u}_{jz} L_j^{\beta} \quad , \tag{3}$$

where $\overline{u}_{jz}$ measures pre-determined location fundamentals that influence amenities (e.g., climate, distance to the coast, soil characteristics), and L_j measures the size of the local population, $L_j \equiv L_{j,f} + L_{j,\text{inf}}$, which is determined in equilibrium. The elasticity, $\beta < 0$, measures the strength of congestion forces, operating through various channels, including greater housing prices or longer commute times due to traffic congestion. We allow location fundamentals, $\overline{u}_{jz}$, to differ across sectors in the same location. For instance, workers in the formal sector may have a stronger taste for locations that are closer to more favorable natural amenities. Finally, the idiosyncratic preference draws in equation (2), $\epsilon_{ijz}(\upsilon)$, are assumed to follow a nested Fréchet distribution, whose cumulative distribution function is given by:

$$F(\overrightarrow{\epsilon}) = \exp\left\{ -\sum_{j \in N} \left(\sum_{z \in Z} \epsilon_{ijz}^{-\nu} \right)^{\frac{\eta}{\nu}} \right\} \quad , \tag{4}$$

with shape parameters η and ν that govern the (inverse) dispersion of draws across locations and sectors, respectively. As η decreases, workers' preferences are more dispersed across locations, implying that they have stronger attachment to certain locations and are less responsive to changes in other location characteristics (e.g., wages, prices, public goods, or amenities). As ν decreases, workers' preferences are more dispersed across sectors, which suggests stronger idiosyncratic attachment to one sector over the other.

Each worker chooses the location and sector that offers the highest indirect utility. By properties of the Fréchet distribution, the probability that a worker born in i moves to location j and works in sector

[19] Our model is static and assumes that individuals make a single sector and location choice.

z is given by:

$$\pi_{ijz} = \underbrace{\left\{ \frac{\left[\frac{1}{D_{ij}} \left(\frac{G_j}{L_j{}^{\kappa}} \right)^{\gamma} \left(\frac{1}{P_j} \right)^{1-\gamma} \Phi_j \right]^{\eta}}{\sum_{j'} \left[\frac{1}{D_{ij'}} \left(\frac{G_{j'}}{L_{j'}{}^{\kappa}} \right)^{\gamma} \left(\frac{1}{P_{j'}} \right)^{1-\gamma} \Phi_{j'} \right]^{\eta}} \right\}}_{\pi_{ij}} \underbrace{\left\{ \frac{(u_{jz} w_{jz}{}^{1-\gamma})^{\nu}}{\sum_{z'} (u_{jz'} w_{jz'}{}^{1-\gamma})^{\nu}} \right\}}_{\pi_{ijz|j}} , \tag{5}$$

where $(\Phi_j)^{\nu} = \sum_{z'} (u_{jz'} w_{jz'}{}^{1-\gamma})^{\nu}$ summarizes how attractive location j is to residents. This choice probability is conveniently expressed as the product of two terms: (1) a location choice, π_{ij}; and (2) a sector choice conditional on the choice of location, $\pi_{ijz|j}$.

We can measure the *supply of labor* to location j and sector z by summing across all migration flows from all origin locations i, as follows:

$$L_{jz} = \sum_{i \in N} \pi_{ijz} L_i^0 \ . \tag{6}$$

From the Fréchet distributional assumption, equation (4), we can also show that the ex-ante average welfare of workers born in location i is given by:

$$\mathbb{E} \left[\max_{j,z} \ V_{ijz}(\eta) \right] = \Gamma \left(1 - \frac{1}{\eta} \right) \left\{ \sum_{j'} \left[\frac{1}{D_{ij'}} \left(\frac{G_{j'}}{L_{j'}{}^{\kappa}} \right)^{\gamma} \left(\frac{1}{P_{j'}} \right)^{1-\gamma} \Phi_{j'} \right]^{\eta} \right\}^{\frac{1}{\eta}} , \tag{7}$$

where $\Gamma(\cdot)$ is the Gamma function. The average income of workers in location j is given by $\overline{w}_j = \sum_z \pi_{jz|j} w_{jz}$.

Demand for Goods. Workers have nested constant elasticity of substitution (CES) preferences over varieties of consumption goods produced in each location and sector. In the first nest, consumers allocate their budget to spending across sectors $z \in \{f, \text{inf}\}$, and in the second nest, they choose varieties within sectors. Let ξ denote the elasticity of substitution across formal and informal goods, and let σ_z denote the elasticity of substitution across varieties in sector $z \in \{f, \text{inf}\}$. Following Zárate (2022), we assume that trade flows in the informal sector are more sensitive to trade costs, so that $\sigma_f < \sigma_{\text{inf}}$. The total quantity of consumer expenditures for an individual in location i, q_i, is given by:

$$q_i = \left(\sum_{z \in Z} q_{iz}^{\frac{\xi-1}{\xi}} \right)^{\frac{\xi}{\xi-1}} \qquad \text{where} \qquad q_{iz} = \left(\sum_{j \in N} \int_{\omega} q_{jiz}(\omega)^{\frac{\sigma_z - 1}{\sigma_z}} \, d\omega \right)^{\frac{\sigma_z}{\sigma_z - 1}} , \tag{8}$$

where $q_{jiz}(\omega)$ measures the quantity of variety ω produced in location j and sector z that is consumed in location i. Location i's price index for consumption goods, P_i, is given by:

$$P_i = \left(\sum_{z \in Z} P_{iz}^{1-\xi} \right)^{\frac{1}{1-\xi}} \qquad \text{where} \qquad P_{iz} = \left(\sum_{j \in N} \int_{\omega} p_{jiz}(\omega)^{1-\sigma_z} \, d\omega \right)^{\frac{1}{1-\sigma_z}} , \tag{9}$$

and where $p_{jiz}(\omega)$ measures the unit price of variety ω produced in location j and sector z but consumed in location i. This is the factory-door price, $p_{jz}(\omega)$, inflated by the iceberg trade cost, $p_{jiz}(\omega) = \tau_{ji} p_{jz}(\omega)$.

5.2 Production

This production side of the model is based on Krugman (1980). Each firm produces a differentiated variety, indexed by ω, in location i and sector z. All firms in the same sector and location are equally productive, and they compete monopolistically, using only labor for production. Let F_{iz} denote the fixed entry cost that a firm in location i and sector z must incur in order to produce. When we calibrate F_{iz} below, we will show that $F_{i,f} > F_{i,\text{inf}}$ for all districts $i = 1, ..., N$; that is, fixed entry costs are higher in the formal sector. We also assume that a large number of potential firms exist in each sector and location, so that the profits of all firms must be equal to 0.[20] The production function for a representative firm in location i and sector z is given by:

$$y_{iz} = A_{iz} L_{iz} \quad , \tag{10}$$

where A_{iz} is the overall productivity in location i and sector z,

$$A_{iz} = \overline{A}_{iz} L_i^{\alpha} \quad . \tag{11}$$

Productivity consists of an intrinsic part, $\overline{A}_{iz}$, which measures exogenous location fundamentals, such as natural amenities, and an endogenous part that is determined by the size of the local workforce, L_i. The elasticity $\alpha > 0$ captures agglomeration externalities such as labor market pooling, input sharing, or knowledge spillovers (Rosenthal and Strange, 2004).

As in Hsieh and Klenow (2009), we assume that firms face production wedges, denoted by t_{iz}, when producing goods. These wedges include local taxes on labor, denoted by t_i^*, but they also reflect other sources of misallocation, such as subsidies, the cost of complying with regulations, or differential access to credit, denoted by λ_{iz}. The existence of these misallocation wedges implies that the marginal revenue product of labor is not equalized across firms.

We assume that the total production wedge impacting a firm in location i and sector z is given by:

$$t_{iz} = \begin{cases} t_i^* + \lambda_{i,f} & z = \text{formal} \\ \lambda_{i,\text{inf}} & z = \text{informal} \end{cases} \quad , \tag{12}$$

where t_i^* denotes location i's formal tax rate and λ_{iz} measures the misallocation wedge from other sources for location i and sector z. In our model, informal firms do not pay local taxes. Because informal forms also tend not to comply with formal labor regulations, their overall production wedges are lower ($t_{i,\text{inf}} < t_{i,f}$), and we confirm this when calibrating the model with firm-level data in Section 6.

The total cost of producing q units of variety ω in location i is given by:

$$C_{iz} = \left(F_{iz} + \frac{q}{A_{iz}} \right) w_{iz} \left(1 + t_{iz}\right) \quad . \tag{13}$$

Profit maximization implies that the equilibrium price for firms in location i and sector z is given by:

$$p_{iz} = \left(\frac{\sigma_z}{\sigma_z - 1} \right) \frac{w_{iz} \left(1 + t_{iz}\right)}{A_{iz}} \quad , \tag{14}$$

[20] This is a similar setup to Dix-Carneiro et al. (2021), which assumes that firms enter the formal market endogenously.

so that formal tax cuts translate into lower production costs which are passed on to consumers through lower goods prices. The zero-profit condition implies that the equilibrium output for firms in location i and sector z is given by:

$$q_{iz} = (\sigma_z - 1)\, A_{iz} F_{iz} \quad . \tag{15}$$

Since labor in location i is employed by both types of firms in each location, the total number of firms in location i and sector z is,

$$M_{iz} = \frac{L_{iz}}{\sigma_z F_{iz}} \quad . \tag{16}$$

Given product demand, equation (8), we can show that the share of location j's expenditure on goods produced in location i and sector z is given by:

$$\lambda_{ijz} = \underbrace{\left(\frac{{P_{jz}}^{1-\xi}}{\sum_{z' \in Z} {P_{jz'}}^{1-\xi}} \right)}_{\lambda_{jz}} \underbrace{\left(\frac{M_{iz} p_{ijz}^{1-\sigma_z}}{\sum_{i' \in N} M_{i'z} p_{i'jz}^{1-\sigma_z}} \right)}_{\lambda_{ijz|z}} \quad , \tag{17}$$

where $P_{jz} = \left(\sum_{i' \in N} M_{i'z} p_{i'jz}^{1-\sigma_z} \right)^{\frac{1}{1-\sigma_z}}$ is the equilibrium Dixit-Stiglitz price index.

5.3 Taxes, Public Spending, and Fiscal Transfers

In Indonesia, district governments raise some of their total tax revenues through local taxes, but many districts are heavily reliant on transfers from the central government to finance local public goods (Lewis and Oosterman, 2009; Lewis, 2010).[21] Motivated by these features, we assume that local public goods are financed in three ways: (1) locally retained production wedges, $\lambda_{i,f}$ and $\lambda_{i,\text{inf}}$; (2) local tax revenue from the formal sector, given by $t_i^* w_{i,f} L_{i,f}$; and (3) transfers of formal tax revenue from the national government, $\theta_i w_{i,f} L_{i,f}$, which are applied to formal-sector GDP, and where θ_i is the net transfer rate (relative to total formal income). Note that θ_i is defined to be positive for recipient districts and negative for donor districts.

Given these assumptions, the total formal tax revenue collected by the central government is given by $\sum_i t_i^* w_{if} L_{if}$. The government's total expenditure on public goods from formal tax revenue is given by $\sum_i (t_i^* + \theta_i) w_{if} L_{if}$. Below, we describe how we use official budget statistics to calibrate θ_i across districts.

If $\sum_i \theta_i w_{if} L_{if} = 0$, the government's budget is balanced. However, because θ_i is calibrated based on official statistics which may differ from model-based GDP, there may be a national deficit or surplus for national transfers of formal tax revenue. We assume that because larger districts contribute more to the transfer system, they also have to play a greater role in financing the system's deficit.

To ensure a balanced budget in the model, we assume the government's national transfer deficit or surplus, given by $\sum_i \theta_i w_{if} L_{if}$ is paid to all districts in proportion to their total GDP:

$$D_i = -\chi_i \sum_i \theta_i w_{if} L_{if} \quad , \tag{18}$$

[21] For instance, by the end of 2007, sub-national governments only accounted for about 8 percent of total public revenue (Lewis and Oosterman, 2009; Lewis, 2010). Because local governments have limited fiscal autonomy, the model abstracts away from any optimizing behavior or strategic considerations on the part of governments in setting tax or transfer rates.

where χ_i is the fraction of district i's GDP in total national GDP, given by:

$$\chi_i = \frac{w_{if}L_{if} + w_{i,\text{inf}}L_{i,\text{inf}}}{\sum_i \left(w_{if}L_{if} + w_{i,\text{inf}}L_{i,\text{inf}}\right)} \quad . \tag{19}$$

Given this, we can write the total public goods supplied in district i as the sum of four terms: (1) formal sector tax revenues; (2) net transfers from the central government; (3) locally retained misallocation wedges; and (4) district i's share of the national transfer system deficit (or surplus):

$$G_i = \frac{(\theta_i + t_i^*)w_{if}L_{if} + \sum_z \lambda_{iz}w_{iz}L_{iz} + D_i}{P_i} \quad . \tag{20}$$

Aggregate local expenditure is given by $E_j = \sum_z (1+\lambda_{iz})w_{iz}L_{iz} + (\theta_i + t_i^*)w_{if}L_{if} + D_i$. Given this setup, a cut to local formal taxes will reduce productions costs and goods prices for formal-sector firms, but it will also reduce the ability to provide local public goods, both locally and everywhere else, because each district's local tax revenues may also support local public goods in other districts through the transfer system.

5.4 Equilibrium

Given exogenous parameters, $\{D_{ij}, \tau_{ij}, \bar{A}_{iz}, \bar{L}_{iz}, \iota_i, \kappa, F_z, \xi, \sigma_z, \gamma, \nu, \eta, \alpha, \beta\}$, an equilibrium in this model is described by the endogenous variables, $\{w_{iz}, \bar{w}_i, \phi_{iz}, P_{iz}, L_{iz}\}$, that satisfy the following equilibrium conditions:

1. Total labor payments equal total revenue at each location i and each sector:[22]

$$(1 + t_{iz})\left(w_{iz}L_{iz}\right) = \sum_j \lambda_{ijz}E_j \tag{21}$$

2. Labor market clearing which is captured by location and sector choices in equation (6);

3. The government budget constraint stated in equation (20).

6 Take the Model to the Data

In this section, we explain how we calibrate key parameters for our baseline model. When possible, we estimate these parameters with our data, but in some cases we choose values from prior work. In counterfactual simulations below, we explore the robustness of our results to different parameter values.

Parameters Calibrated from the Literature. Table 6 summarizes parameters that we calibrate from the literature. In particular, for our baseline, we choose the agglomeration elasticity, $\alpha = 0.056$, following Rosenthal and Strange (2004) and Ahlfeldt and Pietrostefani (2019). For the congestion elasticity, we work with a value of $\beta = -0.04$ from Combes and Gobillon (2015). We also assume that public goods are non-rivalrous, setting $\kappa = 0$, and we set the elasticity of substitution between public and private

[22]Because of the transfer system for formal tax revenue, aggregate expenditure is no longer equal to aggregate income in each location.

goods to 0.2, following Henkel et al. (2021). For the Armington elasticity of substitution across varieties, we follow Zárate (2022) and set $\sigma_{\text{inf}} = 7$ and $\sigma_f = 5.4$. Both values are comparable to similar estimates reported by Feenstra et al. (2018) and Simonovska and Waugh (2014). Other parameters are taken from the literature.

Total Production Wedges. Following Hsieh and Klenow (2009), we back out total production wedges, t_{iz}, using the ratio of the wage bill to total revenue as implied by profit maximization:

$$\frac{w_{iz}L_{iz}}{p_{iz}q_{iz}} = s_i \left(\frac{\sigma_z - 1}{\sigma_z}\right)\left(\frac{1}{1+t_{iz}}\right) \quad . \tag{22}$$

The term s_i measures the average share of the wage bill in total revenue in firms located in district i. Though not consistent with our model where labor is the only factor of production, this adjustment is used to account for other factors of production, like capital, which are not modelled but could lead to large differences between a firm's total wage bill and its total revenues. We first use data from the 2006 Economic Census to calculate the left hand side of this expression separately by firm, and we also calculate s_i by industry. Then, we aggregate this expression to the district-sector level, taking the mean of the wage bill across firms in each district-sector.

We estimate separate production wedges for the formal sectors in KAPET and non-KAPET districts, and we assume that production wedges are constant everywhere for the informal sector. Appendix Table A.6 shows that formal production wedges are lower in KAPET districts than they are in other districts, consistent with the reduced form tax evidence presented in Section 4. It also shows that production wedges are substantially smaller for informal firms.

Local Tax Rates. Recall that a major component of the production wedges calibrated above, t_{iz}, are local tax rates, denoted by t_i^*. According to official budget figures, in 2009, Indonesia's total national revenue (from the state budget, *Anggaran Pendapatan dan Belanja Negara*, or APBN) totalled Rp 985,725.3 billion. About 70% of national revenues came from domestic taxes (including income tax, value-added tax, property taxes, and excise taxes), while roughly 26% of national revenues came from non-tax revenue sources, the largest of which consists of natural resource receipts. Our model uses a single parameter, t_i^*, to account for revenue from all of these different sources.

To calculate local tax rates for each district in Indonesia, we first use Ministry of Finance data and data from the Indonesia Database for Policy and Economic Research (INDO-DAPOER) to calculate each district's own-source revenue. We add to it a measure of each district's locally generated, national tax revenue, and we divide that by total GDP:

$$t_i^* = \frac{\text{own-source revenue}_i + \text{locally generated national tax revenue}_i}{GDP_i} \quad .$$

Calculating own-source reveneue is straightforward; we simply use the district's total collected revenue from local taxes (*Pajak Daerah*, or PAD). However, provinces also collect local taxes, so we distribute provincial own-source revenue to districts using weights equal to the share of each district in provincial GDP.

Measuring locally generated tax revenue that contributes to national tax revenue is more difficult. Nationally, we calculate that total tax revenue, after subtracting each district's local taxes, is equal to approximately 7.1 percent of total GDP. After retaining own-source revenues, we assume that each district contributes to national tax revenues in fixed proportion to that district's total GDP, using this national 7.1 percent figure. Districts with higher rates of informality will have lower formal GDP totals, and will contribute less to national tax revenues as a consequence.[23]

Figure 2 presents a histogram of t_i^* across districts. The average formal tax rate is 9.4 percent, and tax rates range from 7.6 to 15 percent. Although poorer districts tend to have higher tax rates than richer districts, richer districts contribute more to overall national tax revenue because they produce higher levels of output.

Regional Public Transfer Rates. To calculate net transfer rates, θ_i, we first calculate total district revenues from various fiscal transfer schemes, using data from the Ministry of Finance and INDO-DAPOER. Such schemes include (1) general allocation grants from the central government (*Dana Alokasi Umum* or DAU); (2) special allocation fund grants (*Dana Alokasi Khusus*, or DAK), and (3) natural resource revenue sharing (*Dana Bagi Hasil Sumber Daya Alam* or DBH SDA); and (4) total other revenues. We then choose θ_i to match the following moment:

$$(t_i^* + \theta_i)\,\text{GDP}_i = \text{own source revenue}_i + \text{fiscal transfers}_i + \text{other income}_i \quad .$$

Districts have an average transfer rate of 11.5 percent, and most districts have postive θ_i's, indicative of being net receipients of transfers. However, 38 districts (16 percent) have negative θ_i's, which means they are donor districts, sending more of their tax revenue than they spend to other districts through the fiscal transfer system.

Figure 3 presents a scatterplot of θ_i against log GDP across districts. This figure shows that wealthier districts have lower θ_i's, while poorer districts have higher θ_i's, as expected.[24] Given that the program targeted lagging regions, it is not surprising that all KAPET districts have positive θ_i's, and that KAPET districts have higher average θ_i's (14.5 percent) than non-KAPET districts (11.3 percent).

Fixed Entry Costs. To estimate fixed entry costs, F_{iz}, note that by taking logs of equation (16), we obtain:

$$\log M_{iz} = \log L_{iz} - \log \sigma_z - \log F_{iz} \tag{23}$$

where M_{iz} is the number of firms in location i and sector z and L_{iz} is the total employment, both of which we calculate from 2006 Economic Census data.

Figure 4 plots kernel density estimates of the distribution of log F_{iz} across districts, separately for the informal and the formal sector. Entry costs are typically much larger in the formal sector than they are in the informal sector, as expected. Appendix Figure A.2 displays the spatial variation in estimates of F_{iz} across districts. Panel A plots entry costs for firms in the formal sector, while Panel B plots those costs for firms in the informal sector. Districts with darker shades of red correspond to districts with higher entry costs.

[23] In practice, districts contribute differently to national tax revenues because different sectors are taxed at different rates. Our assumption of a constant factor here ignores those distinctions, but is nevertheless consistent with our model.

[24] Note that by this formulation, we should have that the sum of total transfers across the economy, namely $\sum_i \theta_i \text{GDP}_i$, should be equal to zero. Although we do not impose this condition in calibrating θ_i, our measure of that sum is very close to zero (-0.0017).

Formal entry costs tend to be higher in bigger cities like Jakarta, Surabaya, Medan, and Bandung, and they are lower in East Java and certain parts of the Outer Islands. Informal entry barriers, which exhibit less dispersion, tend to be higher in West Java and Sumatra, but lower in East Java and many parts of the Outer Islands.

Migration Costs. We parameterize migration costs from location i to location j as follows:

$$D_{ij} = \exp\left\{\beta \ln \text{dist}_{ij} + \mathbf{x}_{ij}'\theta\right\} \quad , \tag{24}$$

where dist_{ij} measures the physical distance between the centroids of districts i and j and $\mathbf{x}_{ij}$ is a vector of pairwise characteristics, including an indicator for whether i and j are on different islands, the absolute difference in latitude, the absolute difference in longitude, agroclimatic similarity between i and j from Bazzi et al. (2016), and an indicator for whether or not the origin and destination districts are the same.

Our model admits a gravity equation for migration flows. In particular, the migration probability from location i to j, π_{ij}, in equation (5), can be expressed as follows:

$$\pi_{ij} = \exp\left\{ \underbrace{\ln(\eta w_j/P_j) + ln(\eta \bar{u}_j)}_{\text{destination FE}} + \underbrace{\ln \sum_{j'} (\bar{u}_{j'} w_{j'}/P_{j'})^{\eta}}_{\text{origin FE}} - \eta\beta \ln \text{dist}_{ij} - \eta\gamma X_{ij} \right\} \quad . \tag{25}$$

To estimate this equation, we use Poisson Pseudo Maximum Likelihood (PPML) with fixed effects, following Correia et al. (2020). In Table 7 shows the results, with two-way clustered standard errors by origin and destination district, reported in parentheses.

Column 1 reports a distance elasticity of -1.4, somewhat larger than other estimates reported in the literature. However, when we add controls for other pairwise characteristics in column 2, the distance elasticity becomes less negative. Interestingly, agroclimatic similarity increases migration flows, even conditional on measures of physical distance. In column 3, when we add an indicator for whether the origin and destination district are the same, the distance elasticity approaches -1, consistent with Allen and Arkolakis (2019). Column 3 is our preferred gravity specification.

Inverting the Model. In Appendix C, we describe how to invert the model and recover the exogenous components of amenities and productivity in each location and sector. Figure 5 plots the spatial distribution of these inverted local fundamentals. Panel A shows that districts comprising major urban centers have higher levels of exogenous formal productivity, $\overline{A}_{i,f}$, while rural districts and districts in the Outer Islands tend to have lower levels of formal sector productivity. Panel B shows that location fundamentals that influence productivity in the informal sector, $\overline{A}_{i,\text{inf}}$, tend to be more evenly dispersed, with greater informal productivity in parts of Sumatra, Sulawesi, and Kalimantan than in Java. In Panels C and D, we find that the location fundamentals influencing both formal and informal sector amenities, $\overline{u}_{i,f}$ and $\overline{u}_{i,\text{inf}}$, tend to be largest in the Inner Islands, consistent with these locations being important population centers.

To confirm the validity of the location fundamentals that we recovered, we correlate them with observed variables that reflect local productivity and amenities from external data. In particular, we use survey data from the 2011 Village Potential Survey (*Podes*), to construct several proxies for amenities and productivity, including distance to retail, education, and health facilities, as well as crime rates and the share of households connected to the national electricity grid (*Perusahaan Listrik Negara*, or PLN).

Table 8 provides coefficients from bivariate regressions of estimated location fundamentals on district-level observables. Each cell in this table is from a separate bivariate, cross-sectional regression, and the row header denotes the right-hand-side variable name. Panel A presents these correlations for exogenous fundamentals, while Panel B presents these regressions for endogenous fundamentals.

In Panel A, columns 1 and 2 show that districts that that are lower elevation and closer to the coast have higher values of formal and informal productivity, though these relationships are not always significant. However, columns 3 and 4 also show such districts are also areas with higher levels of formal and informal amenities. Panel A also shows that districts with higher average soil quality, as measured by higher organic carbon, lower topsoil salinity, and more acidic soils with a lower pH, have higher levels of formal and informal productivity.[25] The effect of soil quality on formal sector productivity is probably higher because Indonesian cities tended to be settled in places with larger areas of agricultural productivity Civelli et al. (2023). The effect of soil quality on amenities tends to be smaller or insignificant.

Panel B shows that greater coverage by the national electricity grid is also correlated positively with endogenous productivity and amenities. Endogenous productivity and amenities also increase with the number of retail facilities per capita, education facilities per capita, and health facilities per capita, while they tend to fall with average distance to each of these types of facilities. In these regressions, we also tend to see larger effects for the formal sector than the informal sector, as expected.

Appendix Table A.7 compares the recovered amenity and productivity levels between KAPET districts and non-KAPET districts. This table shows that the median KAPET district tends to have lower levels of location fundamentals that influence formal sector productivity than non-KAPET districts. This may be one reason why the KAPET investment incentives did not encourage firm relocations and increase output. This table also shows that KAPET districts had slightly higher mean and median levels of amenity fundamentals than non-KAPET districts. This suggests that even if policies to incentivize relocation to KAPET areas may reduce output, they will not necessarily reduce welfare by encouraging people to move to unattractive locations.

7 Counterfactual Results

Comparing the Model's ATT to the Reduced Form ATT. Before we analyze the welfare effects of the KAPET program, we first verify that the model's predictions are similar to the reduced form results. To do so, we use our model to simulate a counterfactual scenario of removing the KAPET tax incentives, assuming that the implemented cut to formal taxes, t_i^*, was 50 percent in treated areas. Our reduced form analysis estimates the average treated effect on the treated for KAPET districts, so we compare the model's predictions of the average impact of the program on KAPET districts to the reduced form

[25] Higher soil organic carbon increases the stability of soils and also improves aeration, water drainage, and nutrient retention (Chan, 2008). On the other hand, soils with greater salinity limit water uptake from soils and impose ion toxicity and nutrient deficiency (Shrivastava and Kumar, 2015). Moreover, many crops prefer acidic soils, particularly rice, and if soil pH is too high, it can create problems for nutrient absorption and growth (Yu, 1991).

estimates on four key dimensions: (1) total population; (2) district GDP; (3) formal employment; and (4) informal employment.

Figure 6 compares the confidence intervals from our preferred reduced form specification (Table 4, Column 5) with the model's average treatment effects. The blue dots and bars display the reduced form point estimates and confidence intervals, while the red diamonds depict the counterfactual model results. In spite of the sometimes wide confidence intervals, our model's predictions line up quite well with those of the reduced form analysis. Although the model predicts slightly larger effects for population growth than the reduced form, the model-based ATT is still well within the 95 percent confidence interval. However, the model-based ATT on district GDP, formal employment, and informal employment are quite similar to the reduced form ATT. This provides a helpful validation check of the model and gives us confidence in using the model to evaluate the welfare effects of the KAPET program and to conduct additional policy counterfactuals.

Welfare Impacts of the KAPET Program. Next, we use the same counterfactual exercise to examine how the KAPET program impacted overall output growth and welfare. Column 1 of Table 9 shows the welfare and output changes of a 50% tax break in the well implemented KAPET districts. We find that the program only increased overall welfare by just over one tenth of one percent (0.13 percent). In total, KAPET districts would have actually experienced a small increase in total population (0.78 percent), with a 3.2% increase of formal sector workers and a 1.4 percent reduction of informal workers. As expected, the effect on overall output is quite small, with an increase of 0.012 percent.

In column 2 of Table 9, we quantify the effects of the KAPET program in a model where we shut down the impact of regional transfers (i.e. setting $\theta_i = 0$ for all districts, so that local public goods are entirely self financed). As we discussed in Section 6, Indonesia's current transfer scheme is designed to redistribute resources from wealthier areas to poorer areas. The districts targeted by the KAPET program are, in general, less-developed and are net transfer recipients. When the transfer scheme is shut down and local taxes are cut, KAPET areas have lower own-resource revenues to finance local public goods, and those districts are not compensated by transfers from the national government. Therefore, relative to the baseline model, those locations experience slower growth in public goods, and this leads to a smaller increase in formal sector employment and a smaller increase in welfare.

We also evaluate the effects of the KAPET program in a more mobile world in column 3, where we reduce migration costs by 10 percent, and column 4, where we reduce trade costs by 10 percent. Lower migration costs allow more people to move into KAPET locations when taxes fall, and this enhances the welfare effects of the KAPET program. Column 4 also shows slightly lower welfare effects if trade costs were 10 percent smaller.

Appendix Figure A.3 plots the spatial variation in different economic outcomes as a result of a 50 percent tax cut in KAPET areas. In these maps, the thick outlines indicate the locations of KAPET districts. Panel A shows that the total population of workers increases in KAPET districts as a result of the tax cut, and this comes from small reductions elsewhere. Panels B and C show the effects on formal and informal employment. These panels indicate that the program induced in-migration of formal sector employment, mostly from nearby areas, and outmigration of informal employment. Panel D shows that output increases in KAPET districts, with small decreases in output elsewhere.

Varying the Magnitude of the Tax Cuts. One possible reason why the KAPET program was not impactful is that the cuts were not large enough to motivate sufficient reallocation. In Figure 7, we explore this hypothesis by plotting welfare and GDP changes across several simulations, where we vary the size of the tax cut that is being applied to KAPET districts. Panel A shows the welfare changes, while Panel B shows the changes in national GDP. We contrast the effects of different tax cuts in KAPET areas (results depicted in blue diamonds) with the impact of different tax cuts in Greater Jakarta, the most populous agglomeration in Indonesia (results depicted in grey circles). This figure shows that the welfare effects of KAPET cuts increase with their size, but they are quite small, never exceeding four tenths of one percent even with a 75 percent tax cut. Moreover, the welfare effects of the KAPET tax cuts are dwarfed by similarly sized tax cuts in Jakarta.[26]

Robustness to Varying Parameters. Our main counterfactual simulations suggest that cutting taxes in Jakarta increases welfare by about 0.4 percent more than cutting taxes in KAPET districts (i.e. the vertical gap between the Jakarta and KAPET simulations in Figure 7, Panel A). In Figure 8, we explore the sensitivity of this conclusion to different parameter values. In each panel, every dot corresponds to the results of a different simulation where we rerun both tax cut counterfactuals after varying a single parameter, holding all others constant at their baseline values. We then calculate the impact of the KAPET program on welfare, and subtract the welfare impact of the Jakarta tax cut. On the y-axis, we plot the difference in welfare between KAPET tax cuts and Jakarta tax cuts; more negative values indicate larger benefits of Jakarta's tax cuts, relative to cutting taxes in KAPET areas. The red dotted lines intersect the y-axis at the baseline difference in welfare between the two simulations, and they intersect the x-axis at the baseline parameter value.

Panel A shows that as the agglomeration parameter, α, increases, the welfare benefits of the KAPET program fall relative to cutting taxes in Jakarta. This negative relationship is intuitive, because moving economic activity to KAPET areas encourages relocation away from bigger cities. With stronger agglomeration forces, this relocation becomes more costly to output and welfare. Similarly, Panel B shows that as congestion effects become weaker (and β increases), the welfare benefits of KAPET relative to cutting taxes in Jakarta also decline. This is also straightforward: one way for KAPET to increase welfare is by moving economic activity out of dense, congested places. If congestion effects are small, the welfare impacts of this kind of reallocation will also be small.

In Panels C and D, we vary the location dispersion parameter, η, and the sector dispersion parameter, ν. These parameters are inversely related to the variance of the Fréchet draws that govern sector and location idiosyncratic heterogeneity. As they decline, there is more heterogeneity, so that workplace and sector choices are more governed by tastes than by changes in location characteristics, like wages, amenities, or productivity. As expected, we find that the welfare differences between the KAPET and Jakarta tax cuts fall with lower values of these parameters; this is because they are less likely to induce relocations if location choices are governed by idiosyncratic heterogeneity. Overall, the results of Figure 8 suggest that our main conclusions about the welfare effects of the KAPET program are robust to different values of key parameters.

Robustness to Alternative Modeling Assumptions. In Appendix Table A.8, we explore the sensitivity

[26] In Appendix Figure A.4, we examine whether the KAPET program would have been more impactful if it had been implemented as policymakers intended. Applying the tax cuts to all 12 KAPET areas from Table 1 (instead of just the "well implemented" districts), we find that welfare impacts of KAPET double, but they are still less than 1 tenth of 1 percent.

of our conclusions about the welfare effects of the KAPET program to different modeling assumptions about the transfer system. In our baseline model, the production wedges (apart from formal taxes), denoted by λ_{iz} in equation (12), are retained locally and increase expenditures, while formal tax revenues are redistributed through the transfer system, with deficit weights, χ_i, that scale by formal GDP. Column 2 examines the welfare effects of the KAPET program where the deficit weights depend on the share of each district in the total population. In columns 3 and 4, the production wedges are now redistributed nationally, just as the formal tax revenue was before, but we maintain the same assumptions on deficit weights as in columns 1 and 2. Overall, despite these different modeling assumptions, the welfare effects of the KAPET program remain small and never exceed two tenths of one percent.

Evaluating Other Place-Based Policies. Given that the welfare effects the KAPET program were probably very small and that the welfare impacts of tax cuts in Jakarta seem larger, a natural question is whether other place-based policies could have encouraged a more productive reallocation of economic activity in Indonesia. We use our baseline model to conduct counterfactual simulations in which a 20% tax cut is applied to every single district the country.

Appendix Table A.9 lists the top 10 districts with the largest welfare benefits and the bottom 10 districts that would be the most costly to subsidize. This table tends to show larger welfare benefits for tax subsidies in the biggest cities, like Jakarta, as well as trading centers like Batam. This is consistent with strong agglomeration forces and a large share of the population located outside of urban areas. However, we also find significant welfare benefits for some smaller to medium sized cities, like Kupang (Lesser Sunda Islands, population 336,239).

In Figure 9, we plot the relationship between welfare changes by district and baseline district characteristics. We see that the welfare effects tend to be largest for tax cuts in denser districts, and for tax cuts in districts with smaller shares of informal employment. Appendix Table A.10, shows regression coefficients of the relationship between the welfare effects of each district's 20 percent tax cut (on the left hand side) against district characteristics (on the right hand side). Apart from relationships already described in Figure 9, we also show greater welfare effects for cutting taxes in districts with greater levels of formal amenities and formal productivity, and for targeting districts with smaller values of θ_i.

8 Conclusion

This paper begins by presenting reduced form estimates of the impact of Indonesia's KAPET program on demographic outcomes, measures of regional output, and on the performance of firms. We find that the program reduced the tax burdens faced by firms, but these tax reductions did not increase the entry of large, productive firms or generate substantial increases in productivity or value added. Consequently, we do not see sustained increases in migration rates or population growth in response to the program, and overall, treated districts did not grow faster after the introduction of the program.

As we discuss above, there are many possible reasons for the lack of success of the KAPET program. The fact that the program was started around the time of the Asian Financial Crisis and its subsequent political upheaval meant that firms may have been dissuaded from making use of the incentives, given the political uncertainty and the volatile exchange-rate environment, at least initially. Moreover, because the program operated at the district level during a period of "big bang" decentralization, it operated differently across treated districts, leading to large variation in project performance.

To understand whether the KAPET program could have been designed differently to increase welfare, we calibrate a quantitative spatial model, based on Zárate (2022) and Henkel et al. (2021). After calibrating the model, we simulate the impact of the KAPET program as it was designed, and we find that the program as implemented only modestly increased output and welfare. We also find that instead of cutting taxes in poorer areas, targeting tax cuts to areas with greater population density and larger levels of formal sector employment would have boosted welfare substantially.

Our work supports the view that it may be difficult for tax incentives to compensate firms adequately for locating in less developed regions, as these areas tend to have unfavorable natural amenities, poor market access, and low quality infrastructure. If anything, place-based policies should be targeted towards stimulating growth in denser places (Gaubert, 2018; Albouy et al., 2016). Like many externalities, firms do not internalize the productivity spillovers they generate for other firms when they choose an industrial location, and consequently, in equilibrium they tend to locate in districts that are smaller than socially optimal.

It is clear that more theoretical and empirical research on the effectiveness of place-based policies in developing countries is needed, especially to determine whether such policies could be justified on different grounds, such as reducing poverty for immobile workers or improving equity. Programs to promote growth in lagging regions are often politically motivated, and although some papers have found promising evidence (Chaurey, 2017; Shenoy, 2018, e.g.), others offer mixed results (Hasan et al., 2021, e.g.). Our case study illustrates that tax incentives in lagging regions alone may just lead to a giveaway for firms who would have behaved similarly in the absence of such subsidies. We need more evidence to help policymakers better understand when such outcomes might happen, when they may not, and how to optimize place-based policies to stimulate growth and welfare.

References

AHLFELDT, G. M. AND E. PIETROSTEFANI (2019): "The economic effects of density: A synthesis," *Journal of Urban Economics*, 111, 93–107.

ALBOUY, D., K. BEHRENS, F. ROBERT-NICOUD, AND N. SEEGERT (2016): "The Optimal Distribution of Population across Cities," NBER Working Paper 22823.

ALLEN, T. AND C. ARKOLAKIS (2019): "Modern Spatial Economics: A Primer," in *World Trade Evolution: Growth, Productivity and Employment*, ed. by L. Y. Ing and M. Yu, Routledge, Routledge-ERIA Studies in Development Economics, 435–472.

AZARIADIS, C. AND J. STACHURSKY (2005): "Poverty Traps," in *Handbook of Economic Growth*, ed. by P. Aghion and E. Durlauf, Elsevier, vol. 1A, 295–384.

BARTIK, T. J. (1991): *Who Benefits From State and Local Economic Development Policies?*, Kalamazoo, Michigan: W. E. Upjohn Institute for Employment Research.

BASRI, M. C., M. FELIX, R. HANNA, AND B. A. OLKEN (2021): "Tax administration versus tax rates: Evidence from corporate taxation in Indonesia," *American Economic Review*, 111, 3827–71.

BAZZI, S., A. GADUH, A. D. ROTHENBERG, AND M. WONG (2016): "Skill Transferability, Migration, and Development: Evidence from Population Resettlement in Indonesia," *American Economic Review*, 106, 2658–98.

BAZZI, S. AND M. GUDGEON (2021): "The political boundaries of ethnic divisions," *American Economic Journal: Applied Economics*, 13, 235–66.

BOOTH, A. (2011): "Splitting, splitting and splitting again: A brief history of the development of regional government in Indonesia since independence," *Bijdragen tot de taal-, land-en volkenkunde/Journal of the Humanities and Social Sciences of Southeast Asia*, 167, 31–59.

BUSSO, M., J. GREGORY, AND P. M. KLINE (2013): "Assessing the Incidence and Efficiency of a Prominent Place Based Policy," *American Economic Review*, 103, 897–947.

CHAN, Y. (2008): "Increasing soil organic carbon of agricultural land," *Primefact*, 735, 1–5.

CHAUREY, R. (2017): "Location-based tax incentives: Evidence from India," *Journal of Public Economics*, 156, 101–120.

CIVELLI, A., A. GADUH, A. D. ROTHENBERG, AND Y. WANG (2023): "Urban Sprawl and Social Capital: Evidence from Indonesian Cities," *The Economic Journal*, uead032.

COMBES, P.-P. AND L. GOBILLON (2015): "The empirics of agglomeration economies," in *Handbook of regional and urban economics*, Elsevier, vol. 5, 247–348.

COMOLA, M. AND L. DE MELLO (2011): "How does decentralized minimum wage setting affect employment and informality? The case of Indonesia," *Review of Income and Wealth*, 57, S79–S99.

CORREIA, S., P. GUIMARÃES, AND T. ZYLKIN (2020): "Fast Poisson estimation with high-dimensional fixed effects," *The Stata Journal*, 20, 95–115.

DAVIS, D. R. AND D. E. WEINSTEIN (2002): "Bones, Bombs, and Break Points: The Geography of Economic Activity," *American Economic Review*, 92, 1269–1289.

DIX-CARNEIRO, R., P. K. GOLDBERG, C. MEGHIR, AND G. ULYSSEA (2021): "Trade and informality in the presence of labor market frictions and regulations," Tech. rep., National Bureau of Economic Research.

DURANTON, G. AND A. J. VENABLES (2018): "Place-based Policies for Development," World Bank Policy Research Paper No. 8410.

EDMOND, C., V. MIDRIGAN, AND D. Y. XU (2015): "Competition, markups, and the gains from international trade," *American Economic Review*, 105, 3183–3221.

EHRLICH, M. V. AND T. SEIDEL (2018): "The Persistent Effects of Place-Based Policy: Evidence from the West-German Zonenrandgebiet," *American Economic Journal: Economic Policy*, 10, 344–74.

ELVERY, J. A. (2009): "The impact of enterprise zones on resident employment: An evaluation of the enterprise zone programs of California and Florida," *Economic Development Quarterly*, 23, 44–59.

FAN, J. (2019): "Internal geography, labor mobility, and the distributional impacts of trade," *American Economic Journal: Macroeconomics*, 11, 252–88.

FAROLE, T. AND G. AKINCI (2011): "Chapter 1: Introduction," in *Special Economic Zones: Progress, Emerging Challenges, and Future Directions*, ed. by T. Farole and G. Akinci, World Bank, 1–21.

FEENSTRA, R. C., P. LUCK, M. OBSTFELD, AND K. N. RUSS (2018): "In Search of the Armington elasticity," *Review of Economics and Statistics*, 100, 135–150.

FINANCIAL AND DEVELOPMENT SUPERVISORY BOARD (BPKP) (2003): "Risk Assessment Koordinasi Pembangunan Kawasan Timur Indonesia di Wilayah KAPET," .

FISCHER, G., F. NACHTERGAELE, S. PRIELER, H. VAN VELTHUIZEN, L. VERELST, AND D. WIBERG (2008): "Global Agro-ecological Zones Assessment for Agriculture (GAEZ 2008)," .

FREEDMAN, M. (2013): "Targeted business incentives and local labor markets," *Journal of Human resources*, 48, 311–344.

GALLE, J., D. OVERBECK, N. RIEDEL, AND T. SEIDEL (2023): "Place-based Policies, Structural Change, and Female Labor: Evidence from India's Special Economic Zones," Working Paper.

GAUBERT, C. (2018): "Firm Sorting and Agglomeration," *American Economic Review*, 108, 3117–53.

GIBSON, J., S. OLIVIA, AND G. BOE-GIBSON (2020): "Night Lights in Economics: Sources and Uses," *Journal of Economic Surveys*, 34, 955–980.

GLAESER, E. L. AND J. D. GOTTLIEB (2009): "The Wealth of Cities: Agglomeration Economies and Spatial Equilibrium in the United States," *Journal of Economic Literature*, 47, 983–1028.

GOBILLON, L., T. MAGNAC, AND H. SELOD (2012): "Do unemployed workers benefit from enterprise zones? The French experience," *Journal of Public Economics*, 96, 881–892.

HAM, J. C., C. SWENSON, A. İMROHOROĞLU, AND H. SONG (2011): "Government programs can improve local labor markets: Evidence from state enterprise zones, federal empowerment zones and federal enterprise community," *Journal of Public Economics*, 95, 779–797.

HASAN, R., Y. JIANG, AND R. M. RAFOLS (2021): "Place-based preferential tax policy and industrial development: Evidence from India's program on industrially backward districts," *Journal of Development Economics*, 150, 102621.

HEAD, K. AND T. MAYER (2014): "Gravity equations: Workhorse, toolkit, and cookbook," in *Handbook of international economics*, Elsevier, vol. 4, 131–195.

HENDERSON, J. V. (1974): "The Sizes and Types of Cities," *The American Economic Review*, 64, 640–656.

HENDERSON, J. V., A. STOREYGARD, AND D. N. WEIL (2012): "Measuring Economic Growth from Outer Space," *American Economic Review*, 102, 994–1028.

HENKEL, M., T. SEIDEL, AND J. SUEDEKUM (2021): "Fiscal transfers in the spatial economy," *American Economic Journal: Economic Policy*, 13, 433–68.

HILL, H. (2000): *The Indonesian Economy*, Cambridge University Press.

HOFMAN, B. AND K. KAISER (2004): "The Making of the 'Big Bang' and its Aftermath: a Political Economy Perspective," in *Reforming Intergovernmental Fiscal Relations and the Rebuilding of Indonesia: The 'Big Bang' Program and Its Economic Consequences*, ed. by J. Alm, J. Martinez-Vazquez, and S. M. Indrawati, Edward Elgar Pub, 15–46.

HSIEH, C.-T. AND P. J. KLENOW (2009): "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics*, 74, 1403–1448.

KHANNA, G., W. LIANG, A. M. MOBARAK, AND R. SONG (2021): "The productivity consequences of pollution-induced migration in China," *NBER Working Paper*.

KLINE, P. (2011): "Oaxaca-Blinder as a Reweighting Estimator," *American Economic Review: Papers and Proceedings*, 101, 532–37.

KLINE, P. AND E. MORETTI (2014a): "Local Economic Development, Agglomeration Economies, and the Big Push: 100 Years of Evidence from the Tennessee Valley Authority," *Quarterly Journal of Economics*, 129, 275–331.

——— (2014b): "People, Places, and Public Policy: Some Simple Welfare Economics of Local Economic Development Programs," *Annual Review of Economics*, 6, 629–662.

KRUGMAN, P. (1980): "Scale economies, product differentiation, and the pattern of trade," *The American Economic Review*, 70, 950–959.

LEWIS, B. D. (2010): "Indonesian decentralization: Accountability deferred," *International Journal of Public Administration*, 33, 648–657.

LEWIS, B. D. AND A. OOSTERMAN (2009): "The Impact of Decentralization on Subnational Government Fiscal Slack in Indonesia," *Public Budgeting & Finance*, 29, 27–47.

LYNCH, D. AND J. S. ZAX (2011): "Incidence and substitution in enterprise zone programs: The case of Colorado," *Public Finance Review*, 39, 226–255.

MURPHY, K., A. SHLEIFER, AND R. VISHNY (1989): "Industrialization and the Big Push," *Journal of Political Economy*, 97, 1003–1026.

NEUMARK, D. AND J. KOLKO (2010): "Do enterprise zones create jobs? Evidence from California's enterprise zone program," *Journal of Urban Economics*, 68, 1–19.

NEUMARK, D. AND H. SIMPSON (2015): "Chapter 18 - Place-Based Policies," in *Handbook of Regional and Urban Economics, Vol. 5*, ed. by G. Duranton, J. V. Henderzon, and W. C. Strange, Elsevier, 1197–1287.

OLIVIA, S. AND J. GIBSON (2013): "Economic Rise and Decline in Indonesia–As Seen from Space," Working Paper.

PANGESTU, M. AND B. BORA (1996): "Evolution of Liberalization Policies Affecting Investment Flows in the Asia Pacific," Policy discussion paper 96/01, Centre for International Economic Studies, University of Adelaide.

RAHARDJA, S., A. KUNCORO, F. FITRIANI, G. VARELA, AND M. A. DIPO (2012): *Agglomeration and Manufacturing Activities in Indonesia*, World Bank.

RATHELOT, R. AND P. SILLARD (2008): "The importance of local corporate taxes in business location decisions: Evidence from French micro data," *The Economic Journal*, 118, 499–514.

ROBACK, J. (1982): "Wages, Rents, and the Quality of Life," *Journal of Political Economy*, 90, 1257–1278.

ROBINS, J. M., A. ROTNITZKY, AND L. P. ZHAO (1995): "Analysis of semiparametric regression models for repeated outcomes in the presence of missing data," *Journal of the American Statistical Association*, 90, 106–121.

ROSEN, S. (1979): "Wage-Based Indexes of Urban Quality of Life," in *Current Issues in Urban Economics*, ed. by P. Mieszkowski and M. Straszheim, Johns Hopkins University Press.

ROSENSTEIN-RODAN, P. N. (1943): "Problems of Industrailisation of Eastern and South-Eastern Europe," *The Economic Journal*, 53, 202–211.

ROSENTHAL, S. S. AND W. C. STRANGE (2004): "Evidence on the nature and sources of agglomeration economies," in *Handbook of regional and urban economics*, Elsevier, vol. 4, 2119–2171.

SAPPINGTON, J. M., K. LONGSHORE, AND D. THOMPSON (2007): "Quantifying Landscape Ruggedness for Animal Habitat Analysis: A Case Study using Bighorn Sheep in the Mojave Desert," *Journal of Wildlife Management*, 71, 1419–1426.

SHENOY, A. (2018): "Regional development through place-based policies: Evidence from a spatial discontinuity," *Journal of Development Economics*, 130, 173–189.

SHRIVASTAVA, P. AND R. KUMAR (2015): "Soil salinity: A serious environmental issue and plant growth promoting bacteria as one of the tools for its alleviation," *Saudi journal of biological sciences*, 22, 123–131.

SIMONOVSKA, I. AND M. E. WAUGH (2014): "The Elasticity of Trade: Estimates and Evidence," *Journal of international Economics*, 92, 34–50.

SOENANDAR, E. S. (2005): "Government Policy in Solving Uneven Regional Development between West and East Indonesia: Case Study on KAPET," *Econ. J. of Hokkaido Univ.*, 24, 171–192.

SURBAKTI, S., R. L. PRAPTOPRIJOKO, AND S. DARMESTO (2000): "Indonesia's 2000 Population Census: A Recent National Statistics Activity," Tech. rep., United Nations Economic and Social Commission on Asia and Pacific.

TEMENGGUNG, D. (2013): "Policies to Promote Development and Integration of Lagging Regions: The Indonesian Experience," in *The Internal Geography of Trade: Lagging Regions and Global Markets*, ed. by T. Farole, Washington, D.C.: The World Bank, 209–227.

TOMBE, T. AND X. ZHU (2019): "Trade, migration, and productivity: A quantitative analysis of china," *American Economic Review*, 109, 1843–72.

TYBOUT, J. R. (2000): "Manufacturing Firms in Developing Countries: How Well Do They Do, and Why?" *Journal of Economic Literature*, 38, 11–44.

WANG, J. (2013): "The Economic Impact of Special Economic Zones: Evidence from Chinese Municipalities," *Journal of Development Economics*, 101, 133–147.

YU, T. (1991): "Characteristics of soil acidity of paddy soils in relation to rice growth," in *Plant-Soil Interactions at Low pH: Proceedings of the Second International Symposium on Plant-Soil Interactions at Low pH, 24–29 June 1990, Beckley West Virginia, USA*, Springer, 107–112.

ZÁRATE, R. D. (2022): "Spatial Misallocation, Informality, and Transit Improvements: Evidence from Mexico City," .

Table 1: KAPET LOCATIONS

Name	Province	# of Kabu	Year	Pres. Decree #	Well Implemented
KAPET Batulicin	Kalimantan Selatan	1	1998	Keppres 11/1998	Yes
KAPET Sasamba	Kalimantan Timur	3	1998	Keppres 12/1998	
KAPET Sanggau / Khatulistiwa	Kalimantan Barat	3	1998	Keppres 13/1998	Yes
KAPET Minado-Bintung	Sulawesi Utara	3	1998	Keppres 14/1998	Yes
KAPET Mbay	Nusa Tenggara Timur	1	1998	Keppres 15/1998	
KAPET Pare-Pare	Sulawesi Selatan	5	1998	Keppres 164/1998	Yes
KAPET Seram	Maluku Tengah	1	1998	Keppres 165/1998	
KAPET Bima	Nusa Tenggara Barat	2	1998	Keppres 166/1998	
KAPET Batui	Sulawesi Tengah	1	1998	Keppres 167/1998	
KAPET Bukari / Bank Sejahtera Sultra	Sulawesi Tenggara	3	1998	Keppres 168/1998	Yes
KAPET DAS Kakab	Kalimantan Tengah	3	1998	Keppres 170/1998	
KAPET Sabang / Bandar Aceh Darussalam	Propinsi D.I. Aceh	2	1998	Keppres 171/1998	Yes

Source: BAPPENAS and various presidential decrees (KEPPRES). This list differs slightly from Soenandar (2005), who does not include KAPET Sabang in his analysis. In our empirical work, because of concerns about data quality, we drop Papua and KAPET Biak entirely from the analysis. The list of "well implemented" KAPETs is from Soenandar (2005) and BPKP (2003).

Table 2: SUMMARY STATISTICS: PRE-TREATMENT CHARACTERISTICS

	Treated		All Non-Treated		Outer Island Non-Treated	
Panel A: Geographic Characteristics	**Mean (sd)**	**N**	**∆ Mean**	**N**	**∆ Mean**	**N**
Average elevation (meters)	272.38 (208.31)	17	-27.39	260	-49.27	143
Vector ruggedness measure	0.28 (0.07)	17	0.06***	260	0.01	143
Distance to Jakarta (km)	1525.34 (450.14)	17	668.42***	260	327.86**	143
Distance to nearest river (km)	7.07 (9.23)	17	2.75	260	1.36	143
Distance to nearest major port (km)	88.87 (86.28)	17	-5.28	260	-20.92	143
Distance to nearest major road (km)	0.08 (0.05)	17	0.01	260	-0.02	143
Kota Status (0 1)	0.24 (0.44)	17	0.02	260	0.03	143
Panel B: Economic Activity						
District GDP in 1990 (constant prices, Rp. mil.)	405.13 (1047.10)	17	46.51	256	200.90	141
Average nighttime light intensity, 1992	1.16 (2.44)	17	-4.41***	260	-1.18	143
Change in average light intensity, 1992-1997	0.00 (0.00)	17	-0.00***	260	-0.00	143
Change in any night lights, 1992-1997	0.14 (0.16)	17	-0.10**	260	0.02	143
Employment rate (1990, Sakernas)	0.61 (0.12)	16	-0.06*	256	-0.06*	141
Informal employment share (1990, Sakernas)	0.79 (0.14)	15	0.05	256	-0.01	141
Number of medium firms (1990, SI)	7.29 (7.57)	17	-37.65***	260	-5.87**	143
Number of large firms (1990, SI)	3.29 (7.32)	17	-13.31***	260	-1.67	143
Number of workers (1990, SI)	2280.84 (5754.16)	17	-6808.17***	260	-432.41	143
Median wage per worker, SI 1990 (Rp ’000)	984.47 (497.85)	16	199.81	238	32.74	121
Panel C: Demographic Characteristics						
Total population, 1990 (thousands)	412.93 (276.29)	17	-286.34***	259	-51.29	142
% of pop. w/ high school completion, 1990	4.13 (2.70)	16	0.21	260	0.26	143
% born in same province, 1990	0.87 (0.12)	16	-0.04	260	-0.02	143
% in same province 5 years ago, 1990	0.96 (0.06)	16	-0.01	260	-0.01	143
Panel D: Public Goods and Infrastructure						
% of HH w/ access to electricity, 1996-1997	65.27 (19.28)	17	-5.70	254	5.55	138
% of HH w/ access to safe water, 1996-1997	36.29 (18.71)	17	-2.71	254	2.53	138
% of HH w/ access to phone lines, 1996	3.30 (3.39)	17	-0.85	255	-0.52	139
% of HH w/ access to safe sanitation, 1996-1997	55.12 (13.33)	17	4.91	254	4.00	138

Notes: Authors’ calculations using data described in Appendix B. The ∆ mean columns report the difference in means between treated and non-treated districts. In the first set of columns, all non-treated districts are used as the comparson group, while in the second set of columns, only non-treated districts off of Java and Bali are used. The significance stars in this table are computed by conducting a two-sided equality of means t-test between comparison groups. */**/*** denotes significant at the 10% / 5% / 1% levels.

Table 3: GROWTH RATES IN KAPET AND NON-KAPET REGIONS, (1990-2000)

Panel A: Demographic Outcomes	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
% Δ Total Population	-0.013	-0.024	-0.042	-0.026	-0.042	0.125
	(0.032)	(0.034)	(0.039)	(0.040)	(0.040)	
% Δ Recent Migrants from Diff. Province	-0.606	-0.666*	-0.547	-0.328	-0.610	0.090
	(0.382)	(0.402)	(0.407)	(0.403)	(0.415)	
% Δ Recent Migrants from Same Province, Diff. District	0.151	-0.004	0.067	-0.091	0.014	-2.905
	(0.192)	(0.197)	(0.211)	(0.239)	(0.210)	
Δ % of Pop w/ High School Completion	0.002	0.004	0.015*	0.010	0.014*	0.100
	(0.014)	(0.015)	(0.008)	(0.010)	(0.008)	
Panel B: Regional Output	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
% Δ GDRP, Total (1993-2000)	-0.064	-0.049	-0.005	-0.005	-0.001	-0.267
	(0.052)	(0.055)	(0.071)	(0.085)	(0.073)	
Δ % Light Intensity (1992-2000)	-0.255***	-0.069	-0.016	-0.026	-0.015	0.316
	(0.052)	(0.054)	(0.051)	(0.050)	(0.056)	
Δ % with Any Night Light (1992-2000)	-0.160***	-0.022	-0.006	-0.005	-0.005	0.128
	(0.030)	(0.028)	(0.026)	(0.026)	(0.029)	
Panel C: Employment and Large Manufacturing	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
Δ Formal Employment Rate (Sakernas)	0.017	0.021	0.035	0.045	0.036	-0.007
	(0.022)	(0.023)	(0.025)	(0.108)	(0.027)	
Δ Informal Employment Rate (Sakernas)	0.017	0.027	0.048	0.055	0.048	-0.038
	(0.023)	(0.025)	(0.030)	(0.062)	(0.034)	
Δ % Working in Agriculture (Sakernas)	0.009	0.014	0.073	0.082	0.056	-0.080
	(0.030)	(0.033)	(0.044)	(0.066)	(0.046)	
Δ % Working in Manufacturing (Sakernas)	-0.015	-0.003	0.005	0.004	0.006	0.005
	(0.015)	(0.016)	(0.016)	(0.022)	(0.017)	
Δ Total Medium and Large Manufacturers (SI)	-18.175***	1.867	0.591	-0.028	0.602	4.074
	(4.703)	(1.918)	(2.067)	(3.114)	(2.189)	
% Δ Total Output (SI)	0.314	-0.088	0.455	0.408	0.551	3.067
	(0.847)	(0.912)	(0.902)	(0.924)	(0.968)	
% Δ Total Workers (SI)	0.253	0.195	0.298	0.279	0.353	0.695
	(0.346)	(0.369)	(0.392)	(0.426)	(0.421)	
% Δ Wages (SI)	0.220	0.142	-0.053	-0.125	0.004	-0.983
	(0.305)	(0.315)	(0.340)	(0.385)	(0.366)	
N	277	160	160	160	160	160
Outer-Islands Only	.	X	X	X	X	
Controls	.	.	X	X	X	
Logistic Reweighting	.	.	.	X	.	
Oaxaca-Blinder	.	.	.	.	X	

Notes: Each cell reports the coefficient from a regression of the given dependent variable (listed in the left-most column) on an indicator for whether or not the district is a KAPET district. Column 1 reports the unadjusted comparison of KAPET districts to all other districts, while Columns 2-5 restrict the non-treated districts to include only districts in the Outer Islands. Columns 3 adds controls (described on page 4), Column 4 is a double-robust specification that both includes controls and reweights non-treated districts by $\hat{\kappa} = \hat{P}/(1 - \hat{P})$, where $\hat{P}$ is the estimated probability that the district is a KAPET district. Column 5 is a control function specification based on a Oaxaca-Blinder decomposition, described in Kline (2011). Robust standard errors are reported in parentheses and are estimated using a bootstrap procedure, with 1000 replications, in column 4 to account for the generated $\hat{\kappa}$ weights. Sample sizes vary across outcomes but include as many as 277 districts in column 1, and 17 treated districts and 143 control districts in columns 2-5. */**/*** denotes significant at the 10% / 5% / 1% levels.

Table 4: Growth Rates in KAPET and Non-KAPET Regions, (2000-2010)

Panel A: Demographic Outcomes	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
% Δ Total Population	0.039*	-0.002	-0.028	-0.029	-0.028	0.179
	(0.022)	(0.023)	(0.030)	(0.033)	(0.032)	
% Δ Recent Migrants from Diff. Province	0.321	0.180	0.033	0.081	0.030	0.341
	(0.289)	(0.294)	(0.294)	(0.316)	(0.300)	
% Δ Recent Migrants from Same Province, Diff. District	0.062	-0.019	-0.046	0.024	-0.055	0.001
	(0.109)	(0.112)	(0.122)	(0.143)	(0.124)	
Δ % of Pop w/ High School Completion	-0.004	-0.006	-0.005	-0.004	-0.005	0.028
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	
Panel B: Regional Output	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
% Δ GDRP, Total (2000-2012)	0.075**	0.043	0.012	-0.005	0.011	0.675
	(0.031)	(0.033)	(0.042)	(0.049)	(0.046)	
% Δ GDRP, Agriculture (2000-2012)	0.097**	0.025	0.015	-0.062	0.009	0.486
	(0.038)	(0.040)	(0.048)	(0.060)	(0.049)	
% Δ GDRP, Manufacturing (2000-2012)	-0.101	-0.085	-0.056	-0.085	-0.056	0.546
	(0.129)	(0.133)	(0.151)	(0.147)	(0.151)	
Δ % Light Intensity (2000-2013)	0.009	0.038	0.055	0.040	0.061	0.289
	(0.082)	(0.084)	(0.058)	(0.088)	(0.070)	
Δ % with Any Night Light (2000-2013)	0.065*	0.021	0.009	0.000	0.012	0.040
	(0.037)	(0.037)	(0.028)	(0.033)	(0.035)	
Panel C: Employment and Large Manufacturing	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
Δ Formal Employment Rate (Sakernas)	0.037**	0.042**	0.039*	0.020	0.041*	-0.015
	(0.017)	(0.018)	(0.020)	(0.029)	(0.021)	
Δ Informal Employment Rate (Sakernas)	-0.069**	-0.018	-0.012	-0.012	-0.008	-0.036
	(0.028)	(0.029)	(0.031)	(0.036)	(0.036)	
Δ % Working in Agriculture (Sakernas)	-0.019	-0.007	-0.029	-0.035	-0.027	-0.076
	(0.037)	(0.039)	(0.040)	(0.070)	(0.042)	
Δ % Working in Manufacturing (Sakernas)	0.008	0.012	0.016	0.020	0.017	-0.010
	(0.013)	(0.014)	(0.014)	(0.030)	(0.016)	
Δ Total Medium and Large Manufacturers (SI, 2000-2012)	-6.326	-2.510	-0.664	-0.909	-0.451	-0.607
	(4.098)	(2.480)	(2.869)	(3.687)	(3.175)	
% Δ Total Output (SI, 2000-2012)	-1.373	-1.351	-1.041	-1.248	-1.253	1.565
	(1.037)	(1.102)	(1.088)	(1.271)	(1.256)	
% Δ Total Workers (SI, 2000-2012)	-0.564	-0.483	-0.129	-0.123	-0.210	-0.023
	(0.380)	(0.400)	(0.388)	(0.415)	(0.425)	
% Δ Wages (SI, 2000-2012)	-0.288	-0.085	-0.065	0.087	-0.089	4.169
	(0.320)	(0.331)	(0.336)	(0.408)	(0.365)	
N	277	160	160	160	160	160
Outer-Islands Only	.	X	X	X	X	
Controls	.	.	X	X	X	
Logistic Reweighting	.	.	.	X	.	
Oaxaca-Blinder	.	.	.	.	X	

Notes: Each cell reports the coefficient from a regression of the given dependent variable (listed in the left-most column) on an indicator for whether or not the district is a KAPET district. Column 1 reports the unadjusted comparison of KAPET districts to all other districts, while Columns 2-5 restrict the non-treated districts to include only districts in the Outer Islands. Columns 3 adds controls (described on page 4), Column 4 is a double-robust specification that both includes controls and reweights non-treated districts by $\hat{\kappa} = \hat{P}/(1-\hat{P})$, where $\hat{P}$ is the estimated probability that the district is a KAPET district. Column 5 is a control function specification based on a Oaxaca-Blinder decomposition, described in Kline (2011). Robust standard errors are reported in parentheses and are estimated using a bootstrap procedure, with 1000 replications, in column 4 to account for the generated $\hat{\kappa}$ weights. Sample sizes vary across outcomes but include as many as 277 districts in column 1, and 17 treated districts and 143 control districts in columns 2-5. */**/*** denotes significant at the 10% / 5% / 1% levels.

Table 5: FIRM-LEVEL REGRESSIONS

	All Firms	Incumbent Firms	
	(1)	(2)	(3)
Log Taxes on Sales, Licenses, Buildings and Land	-0.773***	-0.677**	-0.705*
	(0.285)	(0.313)	(0.373)
Log Output	-0.065	0.009	-0.022
	(0.118)	(0.099)	(0.070)
Log Value Added	-0.127	-0.073	-0.101
	(0.134)	(0.114)	(0.086)
Log Number of Workers	-0.054	-0.021	-0.026
	(0.058)	(0.047)	(0.034)
Log Wages per Worker	-0.048	0.014	-0.009
	(0.139)	(0.140)	(0.123)
Log Output per Worker	-0.013	0.030	0.006
	(0.070)	(0.063)	(0.046)
Log Value Added per Worker	-0.077	-0.055	-0.074
	(0.089)	(0.079)	(0.064)
N	71,586	59,920	59,920
Year FE	X	X	X
District FE	X	X	.
5-Digit Industry FE	X	X	.
Firm FE	.	.	X

Notes: Each row reports the coefficient estimate of being a KAPET district on the outcome listed in the left-most column, using firm-level panel data for analysis. The first column uses all Outer Island firms to estimate effects, while columns 2 and 3 only focus on incumbent firms, which were in existence before 1998, when the program took place. Sample sizes vary across outcomes but include as many as 71,586 firm-year observations districts in column 1, and 59,920 firm-year observations in columns 2 and 3. Robust standard errors, clustered at the district level, are reported in parentheses. */**/*** denotes significant at the 10% / 5% / 1% levels.

Table 6: Calibrated Parameters

Parameter	Baseline Value	Source
Agglomeration Parameters α	0.056	Rosenthal and Strange (2004); Ahlfeldt and Pietrostefani (2019)
Congestion Parameters β	-0.04	Combes and Gobillon (2015)
Armington Elasticity of Substitution σ_z	7 for the informal sector 5.4 for the formal sector	Zárate (2022)
Location Dispersion Parameter η	1.6	Tombe and Zhu (2019); Khanna et al. (2021); Fan (2019)
Sector Dispersion Parameter ν	1.95	Zárate (2022)
Sector Elasticity of Substitution between Goods ξ	2	Edmond et al. (2015)
Trade Cost Elasticity τ_{ij}	-1	Head and Mayer (2014)
Expenditure Share on Public Goods γ	0.2	Henkel et al. (2021)
Degree of Rivary in Public Goods κ	0	Henkel et al. (2021)

Notes: This table shows our baseline values of parameters that we use to calibrate the model, as well as their associated sources.

Table 7: Migration Gravity Estimates

	(1)	(2)	(3)
Log Distance	-1.420***	-1.317***	-1.032***
	(0.017)	(0.032)	(0.061)
Agroclimatic Similarity		0.039***	0.044***
		(0.013)	(0.013)
Absolute Difference in Latitute		0.031	-0.009
		(0.022)	(0.021)
Absolute Difference in Longtitute		-0.052***	-0.088***
		(0.010)	(0.013)
Cross Island (1 0)		-0.213	-0.327**
		(0.164)	(0.160)
Origin = Destination (1 0)			1.273***
			(0.296)
N of Region Pairs	55,932	55,932	55,932
N Origin Clusters	237	237	237
N Destination Clusters	236	236	236
Pseudo R-squared	0.775	0.775	0.775
Origin Kabu FE	Yes	Yes	Yes
Destination Kabu FE	Yes	Yes	Yes

Notes: This table shows the results of estimating the migration gravity equation, equation (25). To estimate this equation, we use Poisson Pseudo Maximum Likelihood (PPML) with fixed effects, following Correia et al. (2020). Robust standard errors, two-way clustered by origin and destination district, are reported in parentheses. */**/*** denotes significant at the 10% / 5% / 1% levels.

Table 8: Inverted and Observed Local Fundementals

	Productivity		Amenities	
	$\overline{A}_f$	$\overline{A}_{\textbf{inf}}$	$\overline{u}_f$	$\overline{u}_{\textbf{inf}}$
Panel A: Exogenous Fundamentals	**(1)**	**(2)**	**(3)**	**(4)**
Elevation	-0.000 (0.000)	0.000 (0.000)	-0.000*** (0.000)	-0.000 (0.000)
Log Distance to Coast	-0.214 (0.154)	-0.093** (0.038)	-0.099*** (0.027)	-0.050*** (0.010)
Avg. Topsoil Organic Carbon (%)	0.131*** (0.042)	0.015** (0.008)	0.003 (0.008)	-0.003 (0.002)
Avg. Topsoil Salinity (Elco) (dS/m)	-11.929*** (3.234)	-1.910** (0.968)	-0.632* (0.373)	0.421 (0.286)
Avg. Topsoil pH (-$\log(H+)$)	-1.006*** (0.151)	-0.161*** (0.046)	-0.030 (0.023)	0.012 (0.011)
	A_f	$A_{\textbf{inf}}$	u_f	$u_{\textbf{inf}}$
Panel B: Endogeneous Fundamentals	**(1)**	**(2)**	**(3)**	**(4)**
Electricity Coverage (PLN)	0.052** (0.027)	0.015** (0.006)	-0.000 (0.003)	-0.003** (0.001)
# of Retail Facilities Per Capita	0.009*** (0.002)	0.001*** (0.001)	0.003*** (0.001)	0.000 (0.000)
Avg. Distance to Retail Facilities	-0.014*** (0.004)	-0.004*** (0.001)	-0.002 (0.002)	0.002*** (0.001)
# of Education Facilities Per Capita	0.083** (0.039)	0.006 (0.008)	0.035*** (0.010)	0.001 (0.004)
Avg. Distance to Education Facilities	-0.127 (0.082)	-0.063*** (0.024)	-0.081*** (0.024)	-0.017* (0.010)
# of Health Facilities Per Capita	0.054*** (0.014)	0.006*** (0.002)	0.016*** (0.004)	0.002 (0.002)
Avg. Distance to Health Facilities	-0.203*** (0.075)	-0.080*** (0.023)	-0.041** (0.020)	-0.001 (0.007)
N	235	235	235	235

Notes: This table provides coefficients from bivariate regressions of estimated location fundamentals on district-level observables. Each cell in this table is from a separate bivariate, cross-sectional regression, and the row header denotes the right-hand-side variable name. The values of local productivity and amenities by sector are obtained from the inversion procedure described in Section 6. Sample sizes vary across outcomes but include as many as 235 districts. Robust standard errors are reported in parentheses. */**/*** denotes significance at the 10% / 5% / 1% levels.

Table 9: Welfare and GDP Changes with Tax Reduction by 50%

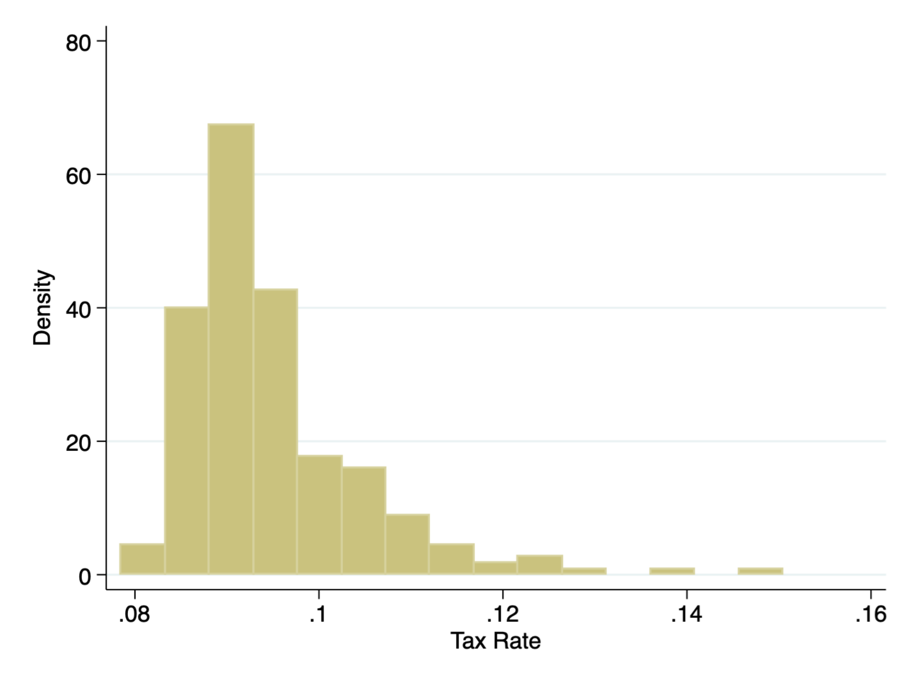
	Baseline	...w/o Transfer	... 10% Reduction in Migration Cost	... 10% Reduction in Trade Cost
Panel A: National Outcomes	**(1)**	**(2)**	**(3)**	**(4)**
... Welfare Change (% Δ)	0.129	0.125	0.169	0.126
... GDP Change (% Δ)	0.012	0.012	0.009	0.011
... Formal GDP (% Δ)	0.055	0.054	0.044	0.053
... Informal GDP (% Δ)	-0.018	-0.018	-0.024	-0.018
... Formal Population Share (% Δ)	0.032	0.031	0.040	0.032
... Welfare Spatial Gini (% Δ)	0.045	0.044	0.048	0.048
... GDP Spatial Gini (% Δ)	-0.018	-0.017	-0.017	-0.017
Panel B: Outcomes in KAPET Districts	**(1)**	**(2)**	**(3)**	**(4)**
... Population in KAPET Districts (% Δ)	0.780	0.743	2.387	0.765
... Formal Employment in KAPET Districts (% Δ)	3.184	3.141	4.835	3.348
... Informal Employment in KAPET Districts (% Δ)	-1.384	-1.409	-0.141	-1.490
... GDP Change in KAPET Districts (% Δ)	1.440	1.376	3.546	1.254
... Formal GDP in KAPET Districts (% Δ)	7.017	6.928	9.179	7.273
... Informal GDP in KAPET Districts (% Δ)	-0.807	-0.847	1.015	-1.042
... Local Public Goods in KAPET Districts (% Δ)	1.259	0.720	3.313	1.446
Panel C: Outcomes in Non-KAPET Districts	**(1)**	**(2)**	**(3)**	**(4)**
... Population in non-KAPET Districts (% Δ)	-0.016	-0.015	-0.065	-0.016
... Formal Employment in non-KAPET Districts (% Δ)	-0.024	-0.023	-0.072	-0.026
... Informal Employment in non-KAPET Districts (% Δ)	-0.006	-0.005	-0.055	-0.003
... GDP Change in non-KAPET Districts (% Δ)	-0.014	-0.013	-0.080	-0.012
... Formal GDP in non-KAPET Districts (% Δ)	-0.035	-0.034	-0.103	-0.038
... Informal GDP in non-KAPET Districts (% Δ)	-0.000	0.001	-0.058	0.006
... Local Public Goods in non-KAPET Districts (% Δ)	-0.042	-0.032	-0.111	-0.044

Notes: Authors' calculations. This table reports percent changes in outcomes, comparing actual values of variables to counterfactual values of variables, where we remove the 50 percent tax cut in KAPET districts. Panel A shows percent changes for national outcomes, while Panels B and C focus on percent changes for outcomes in KAPET and non-KAPET districts, respectively. Column 1 is our baseline model. In column 2, we remove the transfer system, so that local public goods are entirely self financed. In column 3, we revert to the baseline model, but we cut migration costs by 10 percent. In column 4, we again revert to the baseline model, but we instead cut trade costs by 10 percent.

Figure 1: Map of Treated Districts

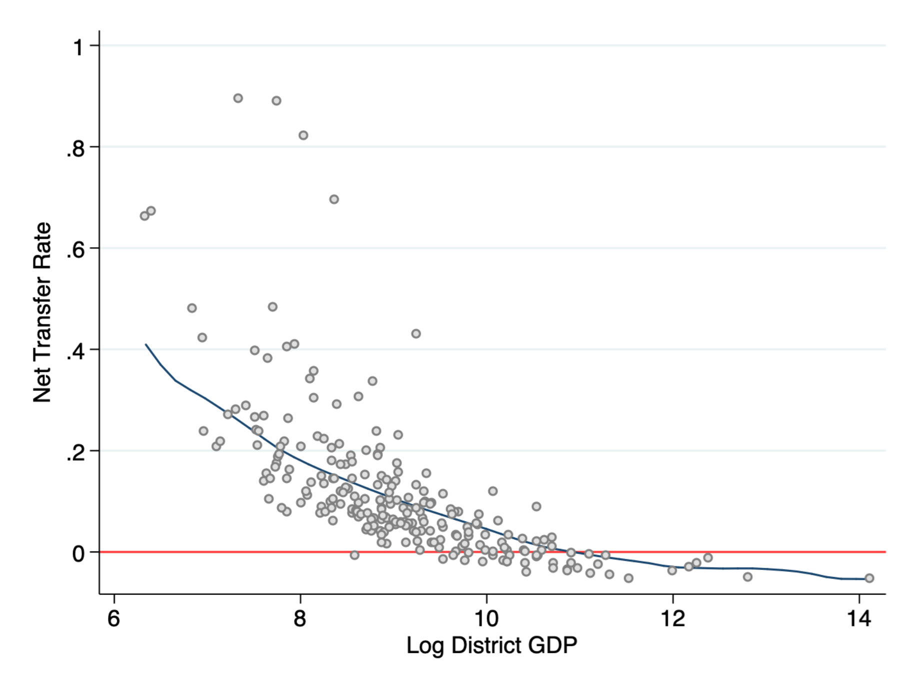
Notes: Authors' calculations using BPS district shapefiles. Information on treated districts was taken from the text of various presidential decrees, listed in Table 1. Here, we assume that districts with poorly implemented KAPET programs were not treated. In our empirical work, because of concerns about data quality, we drop Papua and KAPET Biak entirely from the analysis; these areas are not shown on the map.

Figure 2: The Distribution of Local Tax Rates, t_i^*, across Districts



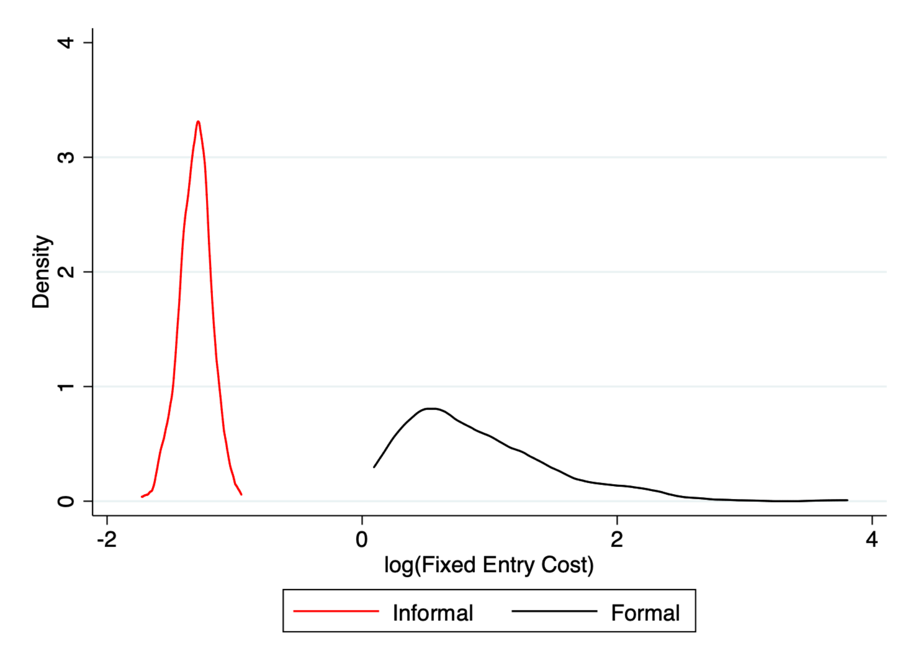
Notes: This figure displays a histogram of the local tax rates, t_i^*, across districts, based on data from Indonesia's Ministry of Finance and data from INDO-DAPOER. The procedure we follow to calculate t_i^* is described in Section 6.

Figure 3: Net Transfer Rates, θ_i, vs. Log District GDP



Notes: This figure presents a scatterplot of θ_i against log GDP across districts. We use data from from Indonesia's Ministry of Finance and data from INDO-DAPOER to calculate θ_i, following a procedure described in Section 6.

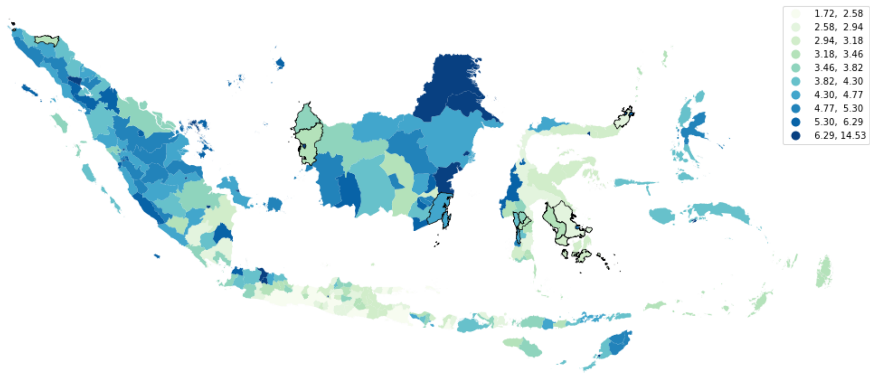
Figure 4: The Distribution of Fixed Entry Costs, F_{iz}, across Districts



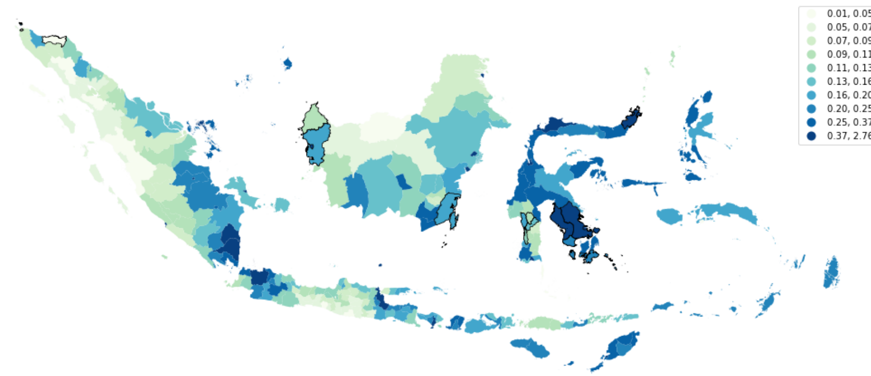
Notes: This figure presents kernel density estimates of the distribution of log F_{iz} across districts, separately for the informal and the formal sector. The density estimation uses an Epanechnikov kernel and rule-of-thumb bandwidth selection. We calculate F_{iz} following the procedure described in Section 6.

Figure 5: Spatial Variation of Inverted Location Fundamentals

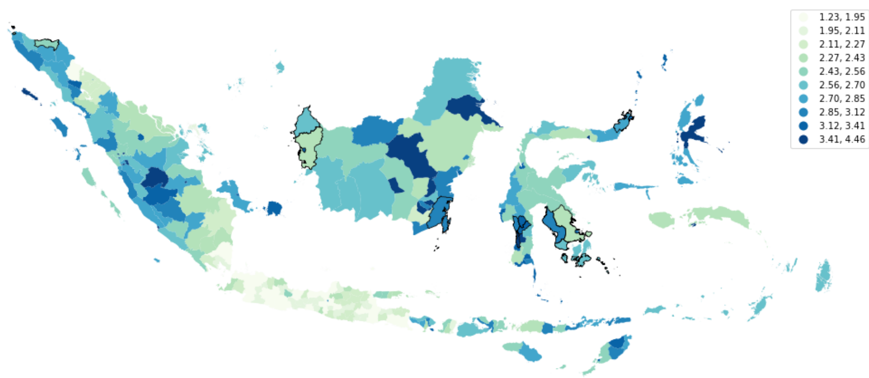
(a) Productivity (Formal)



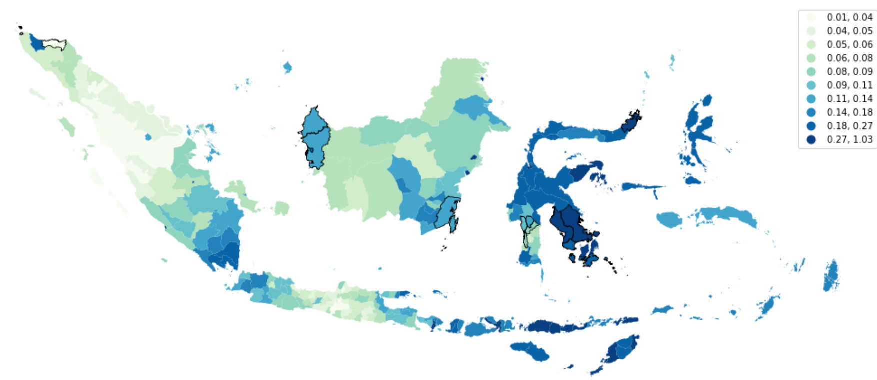
(c) Amenities (Formal)



(b) Productivity (Informal)

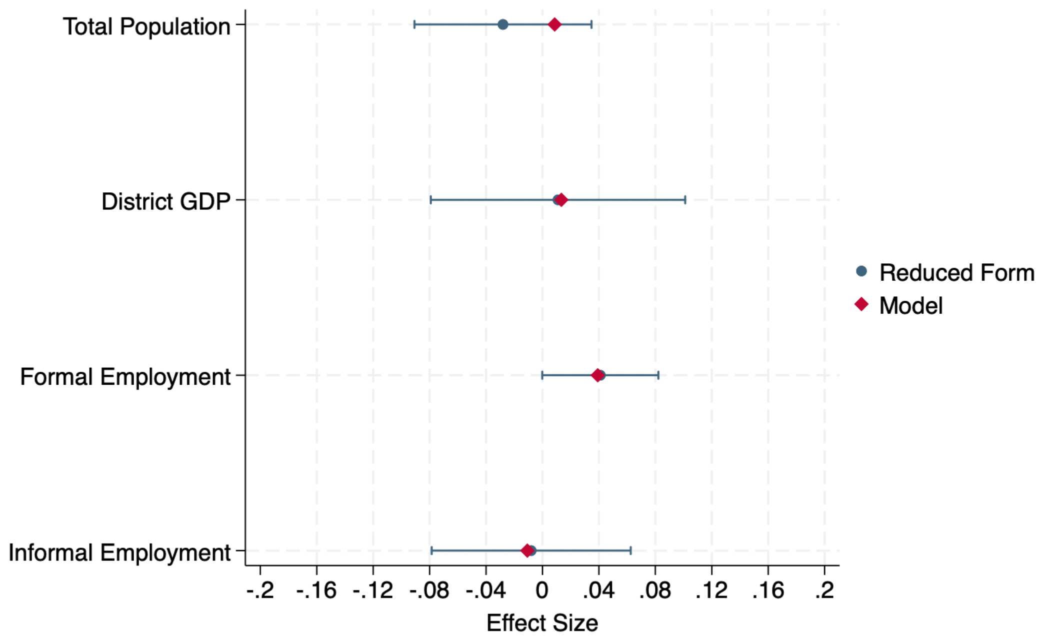


(d) Amenities (Informal)



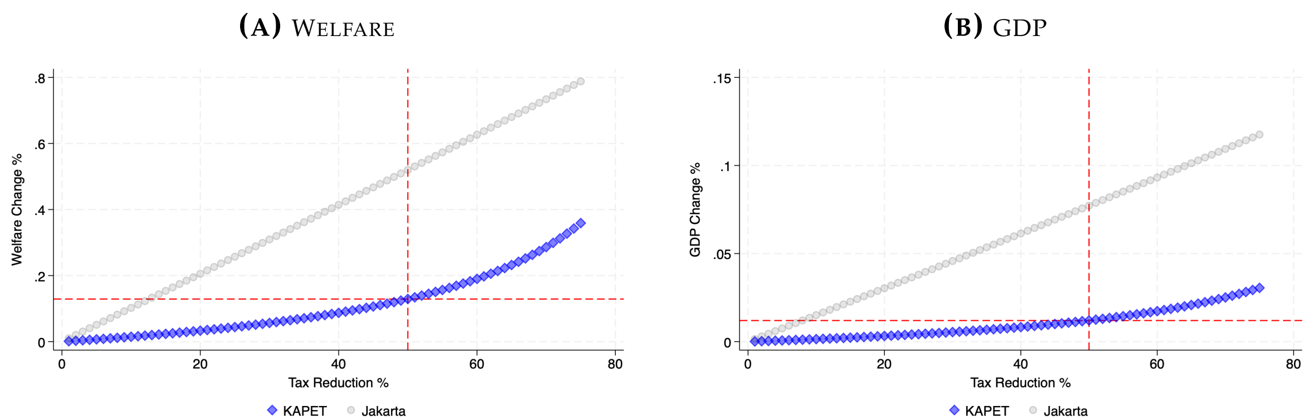
Notes: This figure plots spatial variation in inverted location fundamentals, where the values of local productivity and amenities are obtained from the inversion procedure described in Section 6 and Appendix C. Panel A plots spatial variation in A_{iz} for the formal sector, while Panel B plots spatial variation in A_{iz} for the informal sector. Panel C plots spatial variation in u_{iz} for the formal sector, and Panel D plots spatial variation in u_{iz} for the informal sector. Darker shading corresponds to districts with larger values of these location fundamentals.

Figure 6: Average Treatment Effects of the KAPET Program on Treated Districts: Comparing the Reduced Form to the Model



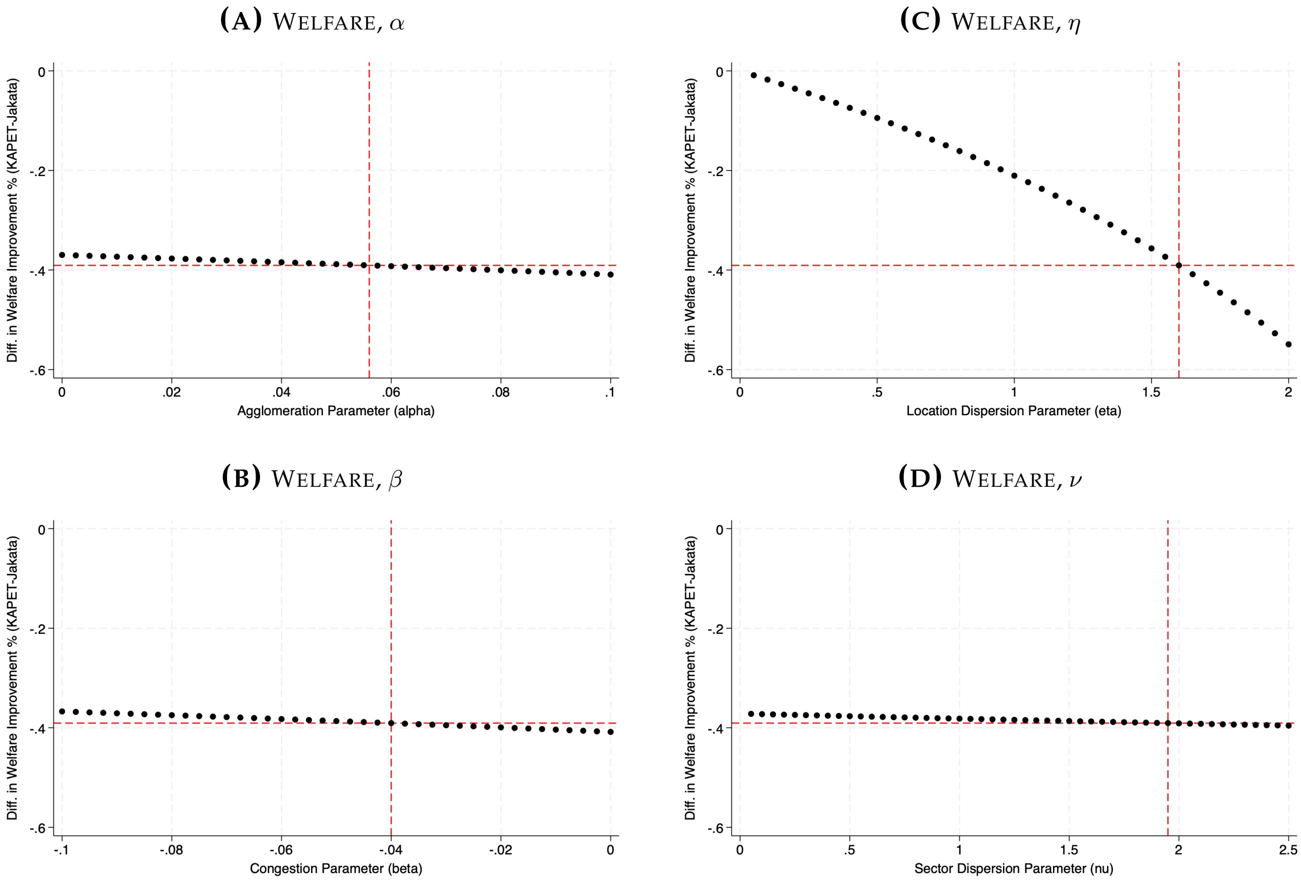
Notes: This figure compares the confidence intervals from our preferred reduced form specification (Table 4, Column 5) with our model's predicted average effects of the KAPET program on treated districts. The blue dots indicate the reduced form point estimates, and the blue bars depict 95 percent confidence intervals. The red diamonds indicate the counterfactual model results.

Figure 7: Welfare and GDP Changes from Tax Reductions, KAPET vs. Jakarta



Notes: In Figure 7, we explore the sensitivity of our main conclusions about the welfare effects of the KAPET program to different parameter values. In each panel, each dot corresponds to the results of a different simulation where we rerun the model by varying a single parameter, holding all others constant at their baseline values, and calculate the impact of the KAPET program on welfare. The red dotted lines along the y-axis indicate the baseline change in welfare, while the red dotted line on the x-axis indicates the baseline parameter value.

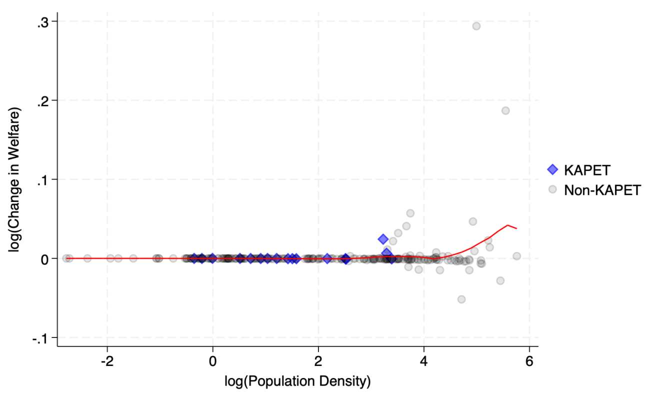
Figure 8: Welfare Impacts of KAPET Comparing to Jarkata: Robustness to Different Parameters



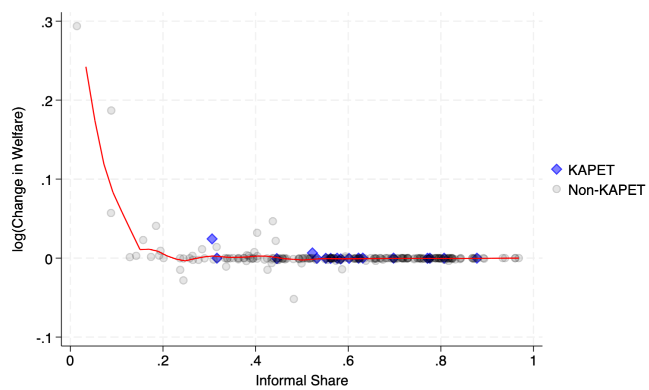
Notes: In Figure 8, we explore the sensitivity of our main conclusions about the welfare effects of the KAPET program, relative to Jakarta tax cuts, to different parameter values. In each panel, each dot corresponds to the results of a different simulation where we rerun the model by varying a single parameter, holding all others constant at their baseline values. We calculate the impact of both tax cut programs on welfare, and form the difference, which is depicted on the y-axis. The red dotted lines along the y-axis indicate the baseline difference in welfare between the KAPET tax cuts and the Jakarta tax cut, while the red dotted line on the x-axis indicates the baseline parameter value.

Figure 9: Welfare Effects of Single District Tax Cuts vs. Local Characteristics

(a) log(Population Density)



(b) Informal Population Share



Notes: This figure plots the welfare effects of single district tax cuts (along the y-axis) against different values of location characteristics (depicted along the x-axis). Each dot on each scatterplot is from a separate counterfactual where we cut that district's taxes by 20 percent. Panel A plots the welfare change of these tax cuts against that district's initial population density, while Panel B plots the welfare change against the share of the population working in the informal sector.

Online Appendix

Rothenberg, A., Wang, Y. and Chari, A. (2023): "When Regional Policies Fail: An Evaluation of Indonesia's Integrated Economic Development Zones"

Table of Contents

List of Tables

List of Figures

A Appendix Tables and Figures

Table A.1: District Propensity Score

	Treated vs. All Non-Treated	Treated vs. Outer-Island Non-Treated
	(1)	**(2)**
Avg elevation of district (meters)	0.004	0.010
	(0.020)	(0.035)
Vector ruggedness measure, (3x3 window)	0.610**	1.048**
	(0.286)	(0.499)
Distance to Jakarta	0.108*	0.174
	(0.059)	(0.112)
Distance to the coast	-0.004	-0.009
	(0.022)	(0.039)
Distance to major ports	-0.042**	-0.071**
	(0.019)	(0.035)
Nighttime Light Intensity, 1992	-0.029	-0.047
	(0.034)	(0.060)
Change in Provincial Golkar Vote Share, 1997-1999	0.384***	0.656***
	(0.127)	(0.220)
Log Total Population, 1990	0.058***	0.099**
	(0.022)	(0.039)
Rank of District Population in Province, 1990	-0.007**	-0.012**
	(0.003)	(0.005)
N	275	158
Pseudo R^2	0.377	0.265
Log Likelihood	-39.7	-39.6
LR χ^2	48.1	28.6

Notes: This table reports marginal effects of our estimated propensity score model. This propensity score is estimated with a logit regression, where the dependent variable is an indicator for whether or not district d was treated by the KAPET program, and the independent variables are a vector of pre-treatment variables, $\mathbf{x}_d$. Column 1 includes results comparing treated districts to all non-treated districts, while Column 2 restricts the comparison to only districts in the Outer Islands. Robust standard errors are reported in parentheses. */**/*** denotes significance at the 10% / 5% / 1% levels.

Table A.2: Growth Rates in KAPET and Non-KAPET Regions (All KAPETs), (1990-2000)

Panel A: Demographic Outcomes	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
% Δ Total Population	0.032	0.018	0.004	0.016	0.001	0.130
	(0.027)	(0.030)	(0.031)	(0.032)	(0.033)	
% Δ Recent Migrants from Diff. Province	-0.372	-0.430	-0.364	-0.167	-0.376	0.113
	(0.258)	(0.294)	(0.305)	(0.290)	(0.308)	
% Δ Recent Migrants from Same Province, Diff. District	0.331**	0.161	0.186	0.078	0.154	-2.894
	(0.153)	(0.164)	(0.158)	(0.158)	(0.159)	
Δ % of pop w/ primary school completion	0.001	-0.006	-0.008	-0.014	-0.008	0.159
	(0.009)	(0.010)	(0.011)	(0.012)	(0.011)	
Δ % of pop w/ high school completion	0.007	0.010	0.018*	0.014	0.017*	0.100
	(0.012)	(0.012)	(0.010)	(0.010)	(0.010)	
Panel B: Regional Output	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
% Δ GDRP, Total (1993-2000)	-0.054	-0.029	0.001	-0.008	0.001	-0.279
	(0.045)	(0.049)	(0.057)	(0.064)	(0.060)	
Δ % Light Intensity (1992-2000)	-0.268***	-0.076	-0.028	-0.025	-0.018	0.310
	(0.045)	(0.047)	(0.042)	(0.043)	(0.047)	
Δ % with Any Night Light (1992-2000)	-0.133***	0.008	0.014	0.022	0.023	0.125
	(0.042)	(0.041)	(0.029)	(0.030)	(0.035)	
Panel C: Employment and Large Manufacturing	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
Δ Formal Employment Rate (Sakernas)	0.007	0.017	0.028	0.032	0.028	-0.010
	(0.016)	(0.018)	(0.019)	(0.026)	(0.021)	
Δ Informal Employment Rate (Sakernas)	0.003	0.017	0.034	0.041	0.035	-0.040
	(0.018)	(0.021)	(0.024)	(0.029)	(0.026)	
Δ % Working in Agriculture (Sakernas)	0.010	0.022	0.071**	0.081*	0.063*	-0.082
	(0.021)	(0.026)	(0.035)	(0.046)	(0.038)	
Δ % Working in Manufacturing (Sakernas)	-0.013	-0.003	0.006	0.006	0.008	0.006
	(0.010)	(0.011)	(0.012)	(0.015)	(0.013)	
Δ Total Medium and Large Manufacturers	-20.294***	0.479	-0.359	-0.593	-0.454	3.595
	(4.581)	(1.588)	(1.718)	(2.335)	(1.881)	
% Δ Total Output (SI)	-0.065	-0.222	0.123	0.025	0.178	2.965
	(0.646)	(0.730)	(0.767)	(0.776)	(0.781)	
% Δ Total Workers (SI)	-0.018	0.073	0.151	0.135	0.184	0.677
	(0.285)	(0.292)	(0.329)	(0.349)	(0.334)	
% Δ Wages (SI)	0.379	0.183	0.045	-0.056	0.062	-0.961
	(0.240)	(0.243)	(0.273)	(0.319)	(0.290)	
N	288	171	171	171	171	171
Outer-Islands Only	.	X	X	X	X	
Controls	.	.	X	X	X	
Logistic Reweighting	.	.	.	X	.	
Oaxaca-Blinder	.	.	.	.	X	

Notes: Each cell reports the coefficient from a regression of the given dependent variable (listed in the left-most column) on an indicator for whether or not the district is a KAPET district. Column 1 reports the unadjusted comparison of KAPET districts to all other districts, while Column 2 restricts the non-treated districts to only include districts in the Outer Islands. Columns 3 includes adds controls (described on page 4), Column 4 is a double-robust specification that both includes controls and reweights non-treated districts by $\hat{\kappa} = \hat{P}/(1 - \hat{P})$, where $\hat{P}$ is the estimated probability that the district is a KAPET district. Column 5 is a control function specification based on a Oaxaca-Blinder decomposition, described in Kline (2011). Robust standard errors are reported in parentheses and are estimated using a bootstrap procedure, with 1000 replications, in column 4 to account for the generated $\hat{\kappa}$ weights. Sample sizes vary across outcomes but include as many 288 districts in column 1, and 28 treated districts and 143 control districts in columns 2-5. */**/*** denotes significant at the 10% / 5% / 1% levels.

Table A.3: Growth Rates in KAPET and Non-KAPET Regions (All KAPETs), (2000-2010)

Panel A: Demographic Outcomes	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
% Δ Total Population	0.049*	0.004	-0.027	-0.027	-0.026	0.180
	(0.025)	(0.027)	(0.032)	(0.030)	(0.031)	
% Δ Recent Migrants from Diff. Province	0.171	0.027	-0.087	-0.078	-0.103	0.337
	(0.190)	(0.202)	(0.203)	(0.202)	(0.208)	
% Δ Recent Migrants from Same Province, Diff. District	0.027	-0.065	-0.089	-0.035	-0.091	0.008
	(0.089)	(0.096)	(0.105)	(0.111)	(0.106)	
Δ % of pop w/ primary school completion	0.002	0.001	0.004	0.009	0.004	-0.032
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	
Δ % of pop w/ high school completion	-0.001	-0.004	-0.003	-0.001	-0.002	0.028
	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	
Panel B: Regional Output	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
% Δ GDRP, Total (2000-2012)	0.074**	0.048	0.007	-0.000	0.011	0.676
	(0.034)	(0.036)	(0.040)	(0.044)	(0.042)	
% Δ GDRP, Agriculture (2000-2012)	0.085**	0.019	0.004	-0.059	0.003	0.485
	(0.034)	(0.036)	(0.042)	(0.049)	(0.045)	
% Δ GDRP, Manufacturing (2000-2012)	-0.149*	-0.141	-0.117	-0.118	-0.112	0.553
	(0.089)	(0.098)	(0.117)	(0.120)	(0.120)	
Δ % Light Intensity (2000-2013)	-0.043	-0.019	-0.008	0.000	0.003	0.294
	(0.058)	(0.061)	(0.052)	(0.055)	(0.057)	
Δ % with Any Night Light (2000-2013)	0.046*	0.001	-0.009	-0.010	-0.006	0.040
	(0.024)	(0.025)	(0.022)	(0.025)	(0.025)	
Panel C: Employment and Large Manufacturing	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
Δ Formal Employment Rate (Sakernas)	0.018	0.022	0.017	0.008	0.023	-0.013
	(0.014)	(0.016)	(0.018)	(0.021)	(0.019)	
Δ Informal Employment Rate (Sakernas)	-0.055***	-0.007	0.006	0.001	0.010	-0.035
	(0.020)	(0.023)	(0.025)	(0.027)	(0.028)	
Δ % Working in Agriculture (Sakernas)	0.001	0.006	-0.011	-0.019	-0.008	-0.074
	(0.025)	(0.028)	(0.031)	(0.039)	(0.032)	
Δ % Working in Manufacturing (Sakernas)	-0.001	0.005	0.010	0.011	0.008	-0.011
	(0.010)	(0.011)	(0.011)	(0.012)	(0.012)	
Δ Total Medium and Large Manufacturers (2000-2012)	-6.101	-2.241	-1.126	-1.661	-0.985	-0.870
	(3.948)	(2.288)	(2.433)	(2.998)	(2.758)	
% Δ Total Output (SI, 2000-2012)	-0.757	-0.878	-0.614	-0.692	-0.826	1.550
	(0.746)	(0.845)	(0.931)	(0.943)	(1.019)	
% Δ Total Workers (SI)	-0.520*	-0.479	-0.230	-0.194	-0.264	-0.055
	(0.287)	(0.315)	(0.345)	(0.342)	(0.354)	
% Δ Wages (SI)	-0.477*	-0.179	-0.140	-0.024	-0.154	4.170
	(0.272)	(0.279)	(0.292)	(0.330)	(0.303)	
N	288	171	171	171	171	171
Outer-Islands Only	.	X	X	X	X	
Controls	.	.	X	X	X	
Logistic Reweighting	.	.	.	X	.	
Oaxaca-Blinder	.	.	.	.	X	

Notes: Each cell reports the coefficient from a regression of the given dependent variable (listed in the left-most column) on an indicator for whether or not the district is a KAPET district. Column 1 reports the unadjusted comparison of KAPET districts to all other districts, while Column 2 restricts the non-treated districts to only include districts in the Outer Islands. Columns 3 includes adds controls (described on page 4), Column 4 is a double-robust specification that both includes controls and reweights non-treated districts by $\hat{\kappa} = \hat{P}/(1-\hat{P})$, where $\hat{P}$ is the estimated probability that the district is a KAPET district. Column 5 is a control function specification based on a Oaxaca-Blinder decomposition, described in Kline (2011). Robust standard errors are reported in parentheses and are estimated using a bootstrap procedure, with 1000 replications, in column 4 to account for the generated $\hat{\kappa}$ weights. Sample sizes vary across outcomes but include as many 288 districts in column 1, and 28 treated districts and 143 control districts in columns 2-5. */**/*** denotes significant at the 10% / 5% / 1% levels.

Table A.4: Growth Rates in KAPET and Non-KAPET Regions (1998-2010)

Panel A: Regional Output	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
% Δ GDRP, Total (1998-2012)	0.132**	0.103	0.076	0.040	0.075	1.760
	(0.065)	(0.068)	(0.085)	(0.100)	(0.090)	
Δ % Light Intensity (1998-2013)	-0.031	0.030	0.045	0.041	0.050	0.322
	(0.080)	(0.083)	(0.057)	(0.067)	(0.069)	
Δ % with Any Night Light (1998-2013)	0.048	0.030	0.010	0.007	0.014	0.055
	(0.036)	(0.036)	(0.029)	(0.045)	(0.036)	
Panel B: Employment and Large Manufacturing	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Mean**
Δ Formal Employment Rate (Sakernas, 1998-2010)	0.021	0.030*	0.023	0.018	0.026	-0.016
	(0.015)	(0.015)	(0.016)	(0.018)	(0.017)	
Δ Informal Employment Rate (Sakernas, 1998-2010)	-0.066***	-0.025	-0.033	-0.040	-0.029	-0.020
	(0.025)	(0.025)	(0.024)	(0.025)	(0.027)	
Δ % Working in Agriculture (Sakernas, 1998-2010)	-0.027	-0.031	-0.052	-0.059	-0.052	-0.047
	(0.038)	(0.039)	(0.040)	(0.048)	(0.043)	
Δ % Working in Manufacturing (Sakernas, 1998-2010)	0.001	0.017	0.019*	0.017	0.022*	-0.016
	(0.010)	(0.010)	(0.011)	(0.013)	(0.012)	
Δ Total Medium and Large Manufacturers (SI, 1998-2012)	-8.164*	-1.425	0.602	0.603	0.789	-1.222
	(4.155)	(2.672)	(2.956)	(3.870)	(3.289)	
% Δ Total Output (SI, 2000-2012)	-0.718	-0.607	0.060	-0.264	-0.037	1.886
	(1.347)	(1.394)	(1.322)	(1.450)	(1.516)	
% Δ Total Workers (SI, 1998-2012)	-0.385	-0.228	0.223	0.183	0.178	-0.026
	(0.447)	(0.463)	(0.443)	(0.487)	(0.488)	
% Δ Wages (SI, 1998-2012)	0.055	0.243	0.269	0.289	0.240	4.640
	(0.276)	(0.285)	(0.317)	(0.398)	(0.329)	
N	288	171	171	171	171	171
Outer-Islands Only	.	X	X	X	X	
Controls	.	.	X	X	X	
Logistic Reweighting	.	.	.	X	.	
Oaxaca-Blinder	.	.	.	.	X	

Notes: Each cell reports the coefficient from a regression of the given dependent variable (listed in the left-most column) on an indicator for whether or not the district is a KAPET district. Column 1 reports the unadjusted comparison of KAPET districts to all other districts, while Column 2 restricts the non-treated districts to only include districts in the Outer Islands. Columns 3 includes adds controls (described on page 4), Column 4 is a double-robust specification that both includes controls and reweights non-treated districts by $\hat{\kappa} = \hat{P}/(1-\hat{P})$, where $\hat{P}$ is the estimated probability that the district is a KAPET district. Column 5 is a control function specification based on a Oaxaca-Blinder decomposition, described in Kline (2011). Robust standard errors are reported in parentheses and are estimated using a bootstrap procedure, with 1000 replications, in column 4 to account for the generated $\hat{\kappa}$ weights. Sample sizes vary across outcomes but include as many 288 districts in column 1, and 28 treated districts and 143 control districts in columns 2-5. */**/*** denotes significant at the 10% / 5% / 1% levels.

Table A.5: Heterogeneous Effects of KAPET on Change in Formal Employment Rate (2000-2010)

	(1)	(2)	(3)	(4)	(5)	(6)
KAPET District (0 1)	0.042**	0.132**	0.039*	0.143***	0.020	0.180
	(0.018)	(0.056)	(0.020)	(0.051)	(0.030)	(0.163)
Ruggedness		-0.048	-0.220	-0.195	0.178	0.261
		(0.104)	(0.143)	(0.144)	(0.646)	(0.693)
KAPET District × Ruggedness		-0.321*		-0.371**		-0.575
		(0.193)		(0.171)		(0.587)
N	136	136	136	136	136	136
Adjusted R^2	0.012	0.006	0.138	0.138	0.149	0.159
F-Stat	5.2	4.0	7.3	8.1		
N	160	160	160	160	160	160
Outer-Islands Only	X	X	X	X	X	X
Controls	.	.	X	X	X	X
Logistic Reweighting	.	.	.	.	X	X

Notes: Each row reports the coefficient estimate of being a KAPET district on the outcome listed in the left-most column, using firm-level panel data for analysis. The first column uses all Outer Island firms to estimate effects, while columns 2 and 3 only focus on incumbent firms, which were in existence before 1998, when the program took place. Robust standard errors, clustered at the district level, are reported in parentheses. */**/*** denotes significant at the 10% / 5% / 1% levels.

Table A.6: Estimated Production Wedges

	Production Wedges
KAPET Formal	1.655
Non-KAPET Formal	1.790
Informal	0.087

Notes: This table shows the estimated production wedges in formal sectors of KAPET districts, formal sectors of non-KAPET districts, and informal sectors. Details on how these wedges are calculated are described in Section 6.

Table A.7: Location Fundamentals in KAPET and Non-KAPET Districts

	Formal Productivity		Informal Productivity		Formal Amenities		Informal Amenities	
	KAPET	Non-KAPET	KAPET	Non-KAPET	KAPET	Non-KAPET	KAPET	Non-KAPET
Mean	4.44	4.28	3.08	2.59	0.42	0.20	0.24	0.12
Median	3.68	3.91	2.97	2.54	0.18	0.12	0.13	0.08
N	17	218	17	218	17	218	17	218

Notes: This table shows the mean and median values of formal productivity, informal productivity, formal amenities, and informal amenities for KAPET and non-KAPET districts. The values of local productivity and amenities by sector are obtained from the inversion procedure described in Section 6.

Table A.8: Welfare Effects of the KAPET Program: Robustness to Different Specifications of Public Transfer System

	Locally Retained Wedges Redistributed Formal GDP by GDP Share (Baseline)	Locally Retained Wedges Redistributed Formal GDP by Pop. Share	Centrally Distributed Wedges (by GDP%) Redistributed Formal GDP by GDP Share	Centrally Distributed Wedges (by GDP%) Redistributed Formal GDP by Pop Share
Panel A: National Outcomes	**(1)**	**(2)**	**(3)**	**(4)**
... Welfare Change (% Δ)	0.129	0.085	0.081	0.099
... GDP Change (% Δ)	0.012	0.007	0.011	0.012
... Formal GDP (% Δ)	0.055	0.036	0.052	0.054
... Informal GDP (% Δ)	-0.018	-0.018	-0.018	-0.019
... Formal Population Share (% Δ)	0.032	0.031	0.031	0.032
... Welfare Spatial Gini (% Δ)	0.045	0.016	0.024	0.031
... GDP Spatial Gini (% Δ)	-0.018	-0.017	-0.012	-0.012
Panel B: Outcomes in KAPET Districts	**(1)**	**(2)**	**(3)**	**(4)**
... Population in KAPET Districts (% Δ)	0.780	0.916	0.413	0.431
... Formal Employment in KAPET Districts (% Δ)	3.184	3.372	2.740	2.746
... Informal Employment in KAPET Districts (% Δ)	-1.384	-1.300	-1.683	-1.674
... GDP Change in KAPET Districts (% Δ)	1.440	1.571	0.894	0.928
... Formal GDP in KAPET Districts (% Δ)	7.017	7.272	6.325	6.316
... Informal GDP in KAPET Districts (% Δ)	-0.807	-0.688	-1.302	-1.272
... Local Public Goods in KAPET Districts (% Δ)	1.259	1.484	-2.141	-2.284
Panel C: Outcomes in non-KAPET Districts	**(1)**	**(2)**	**(3)**	**(4)**
... Population in non-KAPET Districts (% Δ)	-0.016	-0.019	-0.009	-0.009
... Formal Employment in non-KAPET Districts (% Δ)	-0.024	-0.026	-0.017	-0.016
... Informal Employment in non-KAPET Districts (% Δ)	-0.006	-0.009	0.001	0.000
... GDP Change in non-KAPET Districts (% Δ)	-0.014	-0.020	-0.005	-0.005
... Formal GDP in non-KAPET Districts (% Δ)	-0.035	-0.040	-0.025	-0.023
... Informal GDP in non-KAPET Districts (% Δ)	-0.000	-0.003	0.010	0.009
... Local Public Goods in non-KAPET Districts (% Δ)	-0.042	-0.046	0.033	0.034

Notes: Authors' calculations. This table reports percent changes in outcomes, comparing actual values of variables to counterfactual values of variables, where we remove the 50 percent tax cut in KAPET districts. Panel A shows percent changes for national outcomes, while Panels B and C focus on percent changes for outcomes in KAPET and non-KAPET districts, respectively.

Table A.9: Counterfactual Results of Reducing Tax by 20%, Ranked by Welfare Change

Rank	District Code	District Name	Formal Productivity	Informal Productivity	Formal Amenities	Informal Amenities	Transfer Rate	Formal Tax Rate	Change in GDP	Change in Welfare
1	55	Batam	14.532	2.068	1.047	.076	-.037	.086	.037	.341
2	1	Jabodetabekpunjur	4.167	1.232	.824	.158	-.054	.091	.03	.205
3	54	Tarakan	12.659	2.837	1.665	.305	.092	.092	.004	.059
4	5	Sarbagita	3.817	2.292	.598	.314	-.009	.15	.011	.048
5	53	Samarinda	7.972	2.883	1.561	.427	-.001	.089	.003	.042
6	61	Kupang	7.526	3.149	1.943	1.027	-.008	.086	.001	.032
7	71	Bimindo	5.885	3.389	2.76	.847	.059	.09	0	.025
8	45	Gerbangkertosusilo	3.144	1.448	.467	.108	-.052	.089	.01	.023
9	70	Kendari	6.011	3.201	1.716	.877	.073	.093	.001	.022
10	75	Patungraya Agung (Palembang)	6.367	2.305	.332	.139	-.033	.088	.01	.014
				......						
226	23	Kebumen	1.723	1.917	.05	.051	.102	.094	0	-.004
227	32	Surakarta, Boyolali, Sukoharjo, Karanganyar	2.368	1.688	.094	.037	.023	.096	.003	-.004
228	83	Yogyakarta, Bantul, Sleman	2.804	1.907	.073	.035	.019	.104	.005	-.006
229	24	Klaten	2.552	2.02	.061	.032	.039	.09	.003	-.007
230	1371	Kota Padang	6.119	2.734	.025	.011	-.022	.089	.001	-.011
231	1374	Kota Padang Panjang	7.493	4.355	.02	.013	.237	.113	0	-.014
232	1376	Kota Payakumbuh	7.06	3.495	.031	.016	.104	.105	.002	-.015
233	82	Tebing Tinggi	9.716	3.242	.037	.012	.078	.096	.006	-.015
234	31	Kedungsepur(Salatiga)	6.722	2.876	.034	.01	.139	.114	.011	-.028
235	1375	Kota Bukittinggi	5.822	3.834	.012	.006	.085	.101	0	-.051

Notes: Authors' calculations. This table reports the results of single district tax cuts, in which we cut each district's taxes by 20 percent. We report the top and bottom ten districts characteristics and welfare effects, where we sort districts based on the impact of tax cuts on welfare.

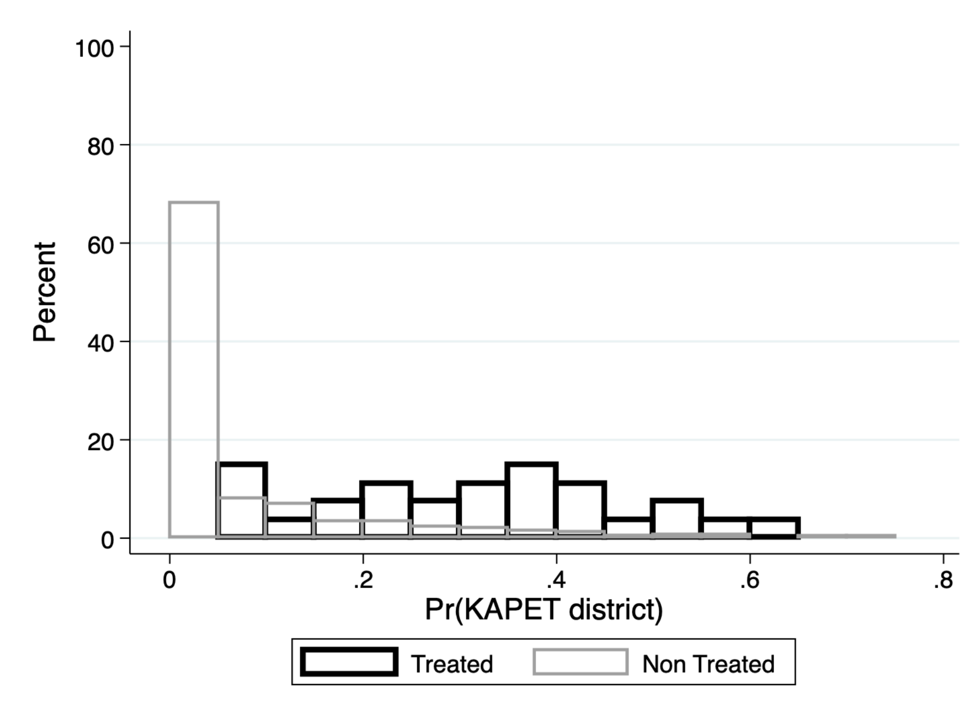
Table A.10: Counterfactual Results: Tax Reduction and Local Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Formal Amenity	0.035***							
	(0.005)							
Informal Amenity		0.027**						
		(0.013)						
Formal Productivity			0.006***					
			(0.001)					
Informal Productivity				-0.007**				
				(0.003)				
log(Population Density)					0.002**			
					(0.001)			
Informal Share						-0.040***		
						(0.008)		
Transfer Rate							-0.021*	
							(0.012)	
Formal Tax Rate								-0.171
								(0.183)
N	235	235	235	235	235	235	235	235
R-squared	0.162	0.018	0.141	0.021	0.023	0.086	0.013	0.004

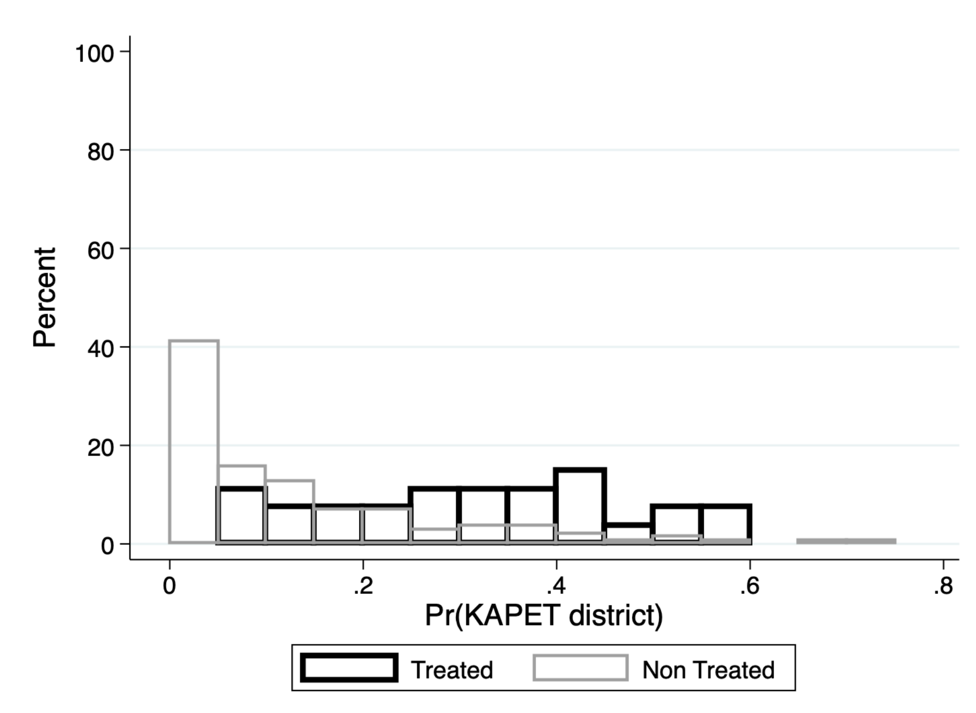
Notes: This table shows regression coefficients of the relationship between the welfare effects of each district's 20 percent tax cut (on the left hand side) against district characteristics (on the right hand side). Robust standard errors are reported in parentheses. */**/*** denotes significant at the 10% / 5% / 1% levels.

Figure A.1: Distribution of District Propensity Scores

(A) Treated vs. All Non-Treated



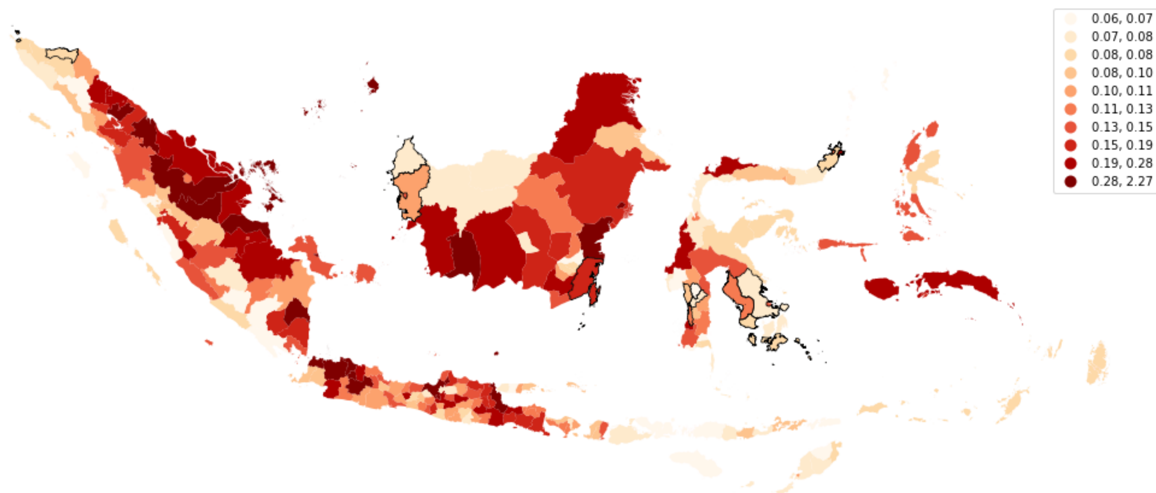
(B) Treated vs. Outer-Island Non-Treated



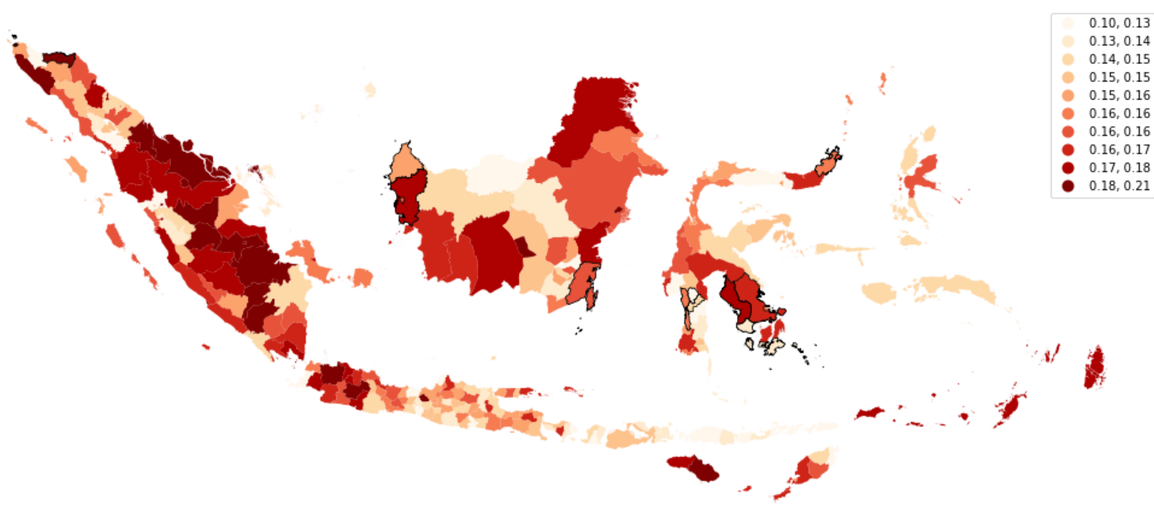
Notes: This figure plots the distribution across communities of the estimated probabilities of being treated by the KAPET program, based on the propensity score regressions reported in Appendix Table A.1. Panel A compares propensity scores for treated districts to all other non-treated districts, while Panel B restricts the comparison to only non-treated districts in the Outer Islands.

Figure A.2: Spatial Variation in Fixed Entry Costs, F_{iz}, across Districts

(a) Formal

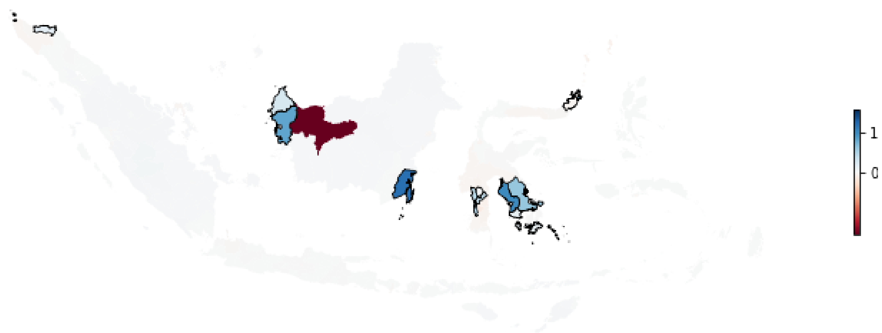


(b) Informal

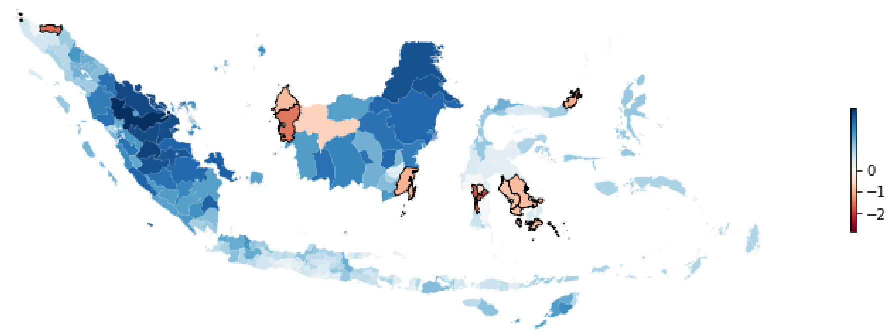


Notes: This figure plots spatial variation in F_{iz} across districts for firms in the formal sector (Panel A) and firms in the informal sector (Panel B). We calculate F_{iz} following the procedure described in Section 6.

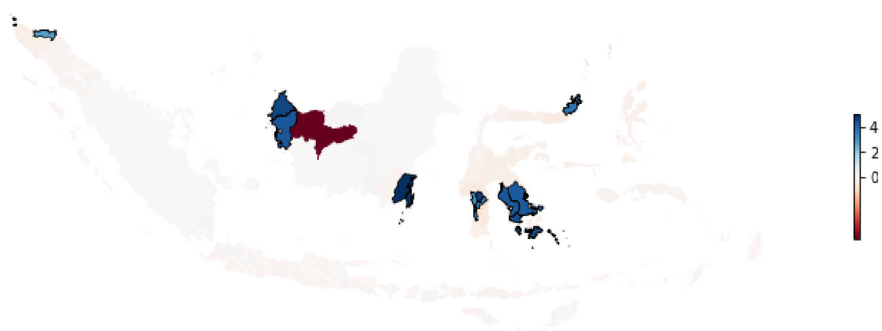
Figure A.3: Changes in Population and Output as a Result of the Tax Cut in KAPET Areas, by District



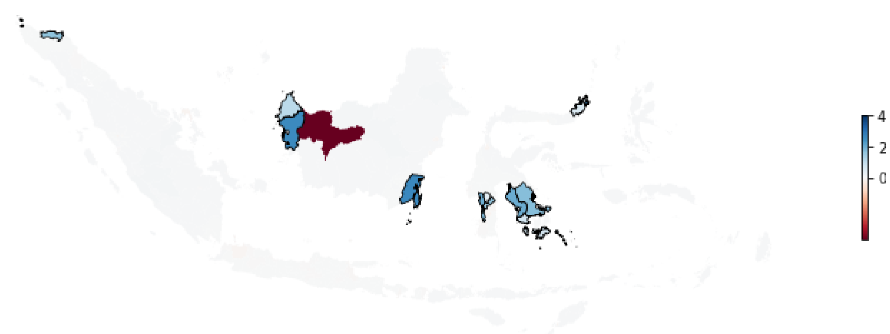
(A) Total Population (% Change)



(C) Informal Population (% Change)



(B) Formal Population (% Change)

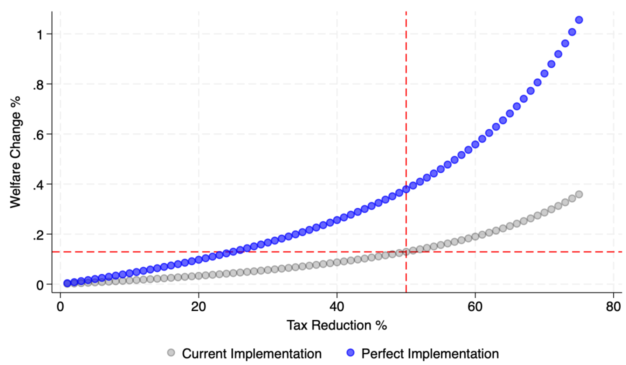


(D) Output (% Change)

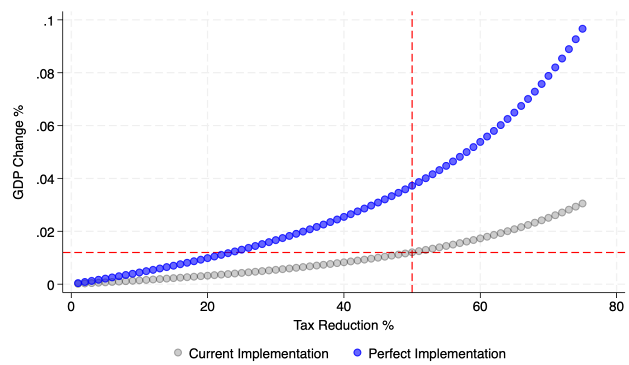
Notes: This figure plots the spatial variation in changes in worker population and output as a result of implementing the 50% tax cut in KAPET areas. In these maps, the thick outlines indicate the locations of KAPET districts. Panel A shows percent changes in total population of workers by district. Panel B shows percent changes in the formal labor force. Panel C shows percent changes in the informal labor force. Panel D shows the percent changes in output.

Figure A.4: Welfare and GDP Changes from Tax Reductions, Perfect Implementation

(A) WELFARE



(B) GDP



:

B Data Appendix

B.1 Administrative Boundaries

Administrative boundary shapefiles were constructed by BPS for use during the 2010 Household Census. These shapefiles contain the polygon boundaries of all provinces, kabupatens, kecamatans, and desas for the entire extent of the Indonesian archipelago. However, after the fall of Suharto and a massive decentralization program, many new kabupatens were created, splitting existing kabupatens into new ones. For instance, in 1990 there were 290 kabupatens and kotas, but by 2003, there were 416 kabupatens and kotas. The fact that administrative boundaries are not fixed over time creates difficulties for the analysis.

Because of the need for a geographic unit of analysis that was consistently defined over time, we used kabupaten borders as they were defined in 1998, the year that the KAPET program was launched. BPS provided the administrative boundary shapefile for 2010, as well as a correspondence table between kabupaten codes in 2010 and kabupaten codes from 1990 to the present. This information was processed using ArcView to create the 1998 shapefiles that form the basis of the analysis. Throughout the paper, all survey data were appropriately merged back to the 1998 kabupaten definitions.

B.2 Spatial, Topographical, and Agro-climatic Variables

Agricultural and climatic variables were created from a variety of sources and often were calculated with the assistance of GIS software (ArcView). This section describes those data in detail and how each of the variables were constructed.

NOAA Data on Light Intensity, 1992-2010. To proxy for economic activities at the local level, we make use of an innovative technique, developed by Henderson et al. (2012), which uses satellite data on nighttime lights. Daily between 8:30 PM and 10:00 PM local time, satellites from the United States Air Force Defense Meteorological Satellite Program (DMSP) record the light intensity of every 30-arc-second-square of the Earth's surface (corresponding to roughly 0.86 square kilometers). DMSP cleans this daily data, dropping anomalous observations, and provides the public with annual averages of light intensity from multiple satellites. After averaging the data across multiple satellites, we obtain annual estimates of light intensity for every 30-arc-second square of the Earth's surface from 1992-2010.

Henderson et al. (2012) show that across countries, growth in night-lights (measured as the change in the spatial average digital number of light intensity over time) is linearly related to growth in output. We use the night-lights growth measure in the analysis, but we calculate the changes at the village-level.

Slope, Aspect, and Elevation Data. Topographical variables were created using raster data from the *Harmonized World Soil Database* (HWSD), Version 2.0 (Fischer et al., 2008).[27] The raster files are compiled from high-resolution source data and aggregated to 30 arc-second grids.

Elevation data were computed for each village as the average elevation over the entire village polygon, using raster data from HWSD.[28] Slope and aspect data were also recorded for each village and calculated similarly. Variables equal to the average share of each village corresponding to each slope class (0-2%, 2-4%, etc.) were constructed using ArcView.

[27] Data from the HWSD project are publicly available and can be downloaded here: http://www.iiasa.ac.at/Research/LUC/luc07/External-World-soil-database/HTML/index.html?sb=1. The terrain, slope, and aspect database provided by HWSD researchers was compiled from a high-resolution digital elevation map constructed by the Shuttle Radar Topography Mission (SRTM). SRTM data is also publicly available as 3 arc-second digital elevation maps (DEM) (approximately 90 meters resolution at the equator), available here: ftp://e0srp01u.ecs.nasa.gov/srtm/.

[28] The HWSD elevation raster file records the median elevation (in meters) for each 30 arc-second grid of the Earth's surface. The median is computed across space, from the values of all 3 arc-second cells in the SRTM database.

Ruggedness. A 30 arc-second ruggedness raster was computed for Indonesia according to the methodology described by Sappington et al. (2007), and village-level ruggedness was recorded as the average raster value. The authors propose a Vector Ruggedness Measure (VRM), which captures the distance or dispersion between a vector orthogonal to a topographical plane and the orthogonal vectors in a neighborhood of surrounding elevation planes. To calculate the measure, one first calculates the x, y, and z coordinates of vectors that are orthogonal to each 30-arc second grid of the Earth's surface. These coordinates are computed using a digital elevation model and standard trigonometric techniques.

Given this, a resultant vector is computed by adding a given cell's vector to each of the vectors in the surrounding cells; the neighborhood or window is supplied by the researcher. Finally, the magnitude of this resultant vector is divided by the size of the cell window and subtracted from 1. This results in a dimensionless number that ranges from 0 (least rugged) to 1 (most rugged).[29]

For example: on a (3×3) flat surface, all orthogonal vectors point straight up, and each vector can be represented by $(0, 0, 1)$ in the Cartesian coordinate system. The resultant vector obtained from adding all vectors is equal to $(0, 0, 9)$, and the VRM is equal to $1 - (9/9) = 0$. As the (3×3) surface deviates from a perfect plane, the length of the resultant vector gets smaller, and the VRM increases to 1.

Soil Quality Covariates. We also make use of the HWSD data for soil quality measures. HWSD provides detailed information on different soil types across the world. The HWSD data for Indonesia is taken from information printed in the FAO-UNESCO Soil Map of the World (FAO 1971-1981), a map printed at a 1:5,000,000 scale. For each village, we created the following measures of soil types: percentage of land covered by coarse, medium, and fine soils, percentage of land covered by soils with poor or excessive drainage, average organic carbon percentage, average soil salinity, average soil sodicity, and average topsoil pH.

B.3 Demographic and Economic Variables

Population Census Data, 2000. Indonesia's 2000 Population Census is a dataset issued by Indonesia's statistical agency, *BPS Statistics* (hereafter, BPS), that was designed as a complete enumeration of the individual members of every household in Indonesia with 100% coverage. However, due to riots and communal violence following the political transition, the population numbers for the provinces of Aceh, Maluku, Papua, and Central Sulawesi had to be estimated (instead of enumerated) by the provincial statistical offices (Surbakti et al., 2000).

The census contains information on the respondents' religion, ethnicity, birth information (year, month, and province), as well as the sector of their employment (if they were working) and their province of residence in 1995. It also includes questions on the respondents' sex, marital status, education, and main activities in the past week. We aggregate the individual-level observations to construct village-level demographic variables and population weights for the similarity indices, and use the individual-level observations to examine occupation choice among the transmigrants.

***Susenas* 2004, *SUPAS* 1985, and Population Census Data 1980.** We also included three additional national-level datasets published by BPS. First, we use the 2004 *Susenas*, which is a household survey, to estimate the relationship between the education of the household head and rice productivity at the household level. Second, we use the 1985 Intercensal Survey, or *SUPAS* to calculate the inter-district migration flows in the early 1980s. Finally, we use the 5% population subset of the 1980 Indonesia Population Census that are available from IPUMS to construct the pre-1980 district-level characteristics that are included as control variables.

[29] The authors have generously provided a Python script for computing their Vector Ruggedness Measure (VRM) in ArcView. The script and detailed instructions for installation can be found here: `http://arcscripts.esri.com/details.asp?dbid=15423`.

C Model Appendix

C.1 Model Inversion

We recover the exogenous amenities and productivity levels in each location and sector, u_{iz} and A_{iz}, from the following steps:

1. After combining equation (21) and equation (17), we obtain the following equations:

$$(1+t_{iz})(w_{iz}L_{iz}) = \sum_j \underbrace{\left(\frac{{P_{jz}}^{1-\xi}}{\sum_{z'\in Z} {P_{jz'}}^{1-\xi}}\right)}_{\lambda_{jz}} \underbrace{\left(\frac{M_{iz}p_{ijz}^{1-\sigma_z}}{\sum_{i'\in N} M_{i'z}p_{i'jz}^{1-\sigma_z}}\right)}_{\lambda_{ijz|z}} E_j \tag{26}$$

$$P_{jz} = \left(\sum_{i'\in N} M_{i'z}p_{i'jz}^{1-\sigma_z}\right)^{\frac{1}{1-\sigma_z}} \tag{27}$$

Rearranging equation (26) and equation (27), we have the following:

$$p_{iz}^{\sigma_z-1} = \frac{M_{iz}}{(1+t_{iz})w_{iz}L_{iz}} \sum_j \left(\frac{{P_{jz}}^{\sigma_z-\xi}}{\sum_{z'\in Z} {P_{jz'}}^{1-\xi}}\right) \tau_{ij}^{1-\sigma_z} E_j \tag{28}$$

$$P_{jz}^{1-\sigma_z} = \sum_{i'\in N} M_{i'z}p_{i'z}^{1-\sigma_z}\tau_{i'j}^{1-\sigma_z} \tag{29}$$

Using data on L_{iz} and w_{iz}, and our calculations of M_{iz} from equation (23), we can invert P_{iz} and p_{iz} from equation (28) and equation (29). Then, using our formula for goods prices, equation (14), we can back out A_{iz}.

2. Then, we use equation (5) to back out Φ_j.

$$L_j = \sum_{i\in N} \underbrace{\left\{\frac{\left[\frac{1}{D_{ij}}\left(\frac{G_j}{{L_j}^{\kappa}}\right)^{\gamma}\left(\frac{1}{P_j}\right)^{1-\gamma}\Phi_j\right]^{\eta}}{\sum_{j'}\left[\frac{1}{D_{ij'}}\left(\frac{G_{j'}}{{L_{j'}}^{\kappa}}\right)^{\gamma}\left(\frac{1}{P_{j'}}\right)^{1-\gamma}\Phi_{j'}\right]^{\eta}}\right\}}_{\pi_{ij}} L_i^0 \tag{30}$$

Denote $\omega_j = \left[\left(\frac{G_j}{{L_j}^{\kappa}}\right)^{\gamma}\left(\frac{1}{P_j}\right)^{1-\gamma}\Phi_j\right]^{\eta}$ and $W_i = \sum_{j'}\left[\frac{1}{D_{ij'}}\left(\frac{G_{j'}}{{L_{j'}}^{\kappa}}\right)^{\gamma}\left(\frac{1}{P_{j'}}\right)^{1-\gamma}\Phi_{j'}\right]^{\eta}$ We have the following equations,

$$\omega_j^{-1} = \sum_{i\in N}\frac{1}{D_{ij}^{\eta}}\frac{L_i^0}{L_j}W_i^{-1} \tag{31}$$

$$W_i = \sum_{j'}\frac{1}{D_{ij'}^{\eta}}\omega_{j'} \tag{32}$$

We can invert ω_j and W_i from Eq.(31) and Eq.(32), then use definition of ω_j to back out Φ_i.

3. Lastly, we use the sectoral employment shares in each location, combining with the inverted Φ_j and data on w_{iz} to back out $u_{i,f}$ and $u_{i,inf}$:

$$\pi_{i,f|i} = \frac{u_{i,f}^{\nu}\left(w_{i,f}^{1-\gamma}\right)^{\nu}}{u_{i,f}^{\nu}\left(w_{i,f}^{1-\gamma}\right)^{\nu} + u_{i,inf}^{\nu}\left(w_{i,inf}^{1-\gamma}\right)^{\nu}}$$