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**FORMALITY AND INFORMALITY IN AN
EMERGING ECONOMY: THE CASE OF
COLOMBIA**

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Humberto Franco
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Botero, J., Castrillón, C., Hurtado, Á., Franco, H., & Vargas, C. (2024). Formality and informality in an emerging economy: The case of Colombia. *Cuadernos de Economía*, 43(91), 345-373.

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The objective of this paper is to evaluate the impact of fiscal instruments for Colombia on two of the country's main issues: income inequality and informality, phenomena that have been exacerbated by the pandemic. For this purpose, we built a DSGE model whose main differentiating element is the level of liquidity of households. The model carried out various simulations of transfers to households, and we examined the effects of these on different macroeconomic variables. We conclude that for the economy to return to the same fiscal adjustment it had before a transfer, the government will somehow have to increase the productivity of the formal sector, as this increase will have a positive effect on growth, increase income taxes and employment, and decrease informality.

Keywords: Informal economy; public expenditure; exogenous shock; DSGE.

JEL: D58, E62, F41, O17.

Botero, J., Castrillón, C., Hurtado, Á., Franco, H., & Vargas, C. (2024). Formalidad e informalidad en una economía emergente: el caso de Colombia. *Cuadernos de Economía*, 43(91), 345-373.

El aporte de este artículo es evaluar el impacto de los instrumentos fiscales para Colombia, con base en la desigualdad de ingresos y el grado de informalidad, hechos que se han visto agudizados por la pandemia. Para ello se construye un modelo DSGE, cuyo principal elemento diferenciador son las diferencias entre hogares, medidas por medio de restricciones de liquidez. Se realizan diferentes simulaciones de las transferencias a los hogares y sus efectos sobre distintas variables macroeconómicas. Concluimos que para recuperar la senda de ajuste fiscal que tenía la economía antes de la contingencia, se debe lograr un aumento de la productividad del sector formal, siendo la forma de generar efectos positivos sobre el crecimiento, el aumento de los impuestos a la renta, el empleo y el menor grado de informalidad.

Palabras clave: economía informal; gasto público; choque exógeno; DSGE.

JEL: D58, E62, F41, O17.

INTRODUCTION

The COVID-19 crisis revealed the magnitude of the problems that informality poses to society. These include the precarious conditions faced by a significant percentage of families engaged in low-productivity activities with irregular incomes. While this represents a problem for the families involved, it is also an important source of vulnerability for the economy, especially if, as is the case in Colombia, these make up a large proportion of the country's families. According to Colombia's Office for National Statistics (DANE, 2022), the most recent data on informality prior to COVID-19 shows that 47.9% of employment in the 23 largest cities and their metropolitan areas was informal.¹ The definition of informality is set out in ILO resolution 15a CIET of 1993, guided by the recommendations of the DELHI expert group, convened by the United Nations. In this document, informality is defined as employment in enterprises of up to five workers, excluding freelancers working in their respective trade and government employees.

Correspondingly, self-employment and unpaid employment (which together could serve as the basis for estimating the size of the informal portion of the national total) accounted for 47.2% of employment in Colombia in June 2019, and increased by June 2020 to 48.9%. A breakdown of these statistics is shown in Table 1.

Table 1.

Comparison in employment between 2019-2020

Employment according to type. Thousands of people					
Type	June 2019	Participation	June 2020	Participation	Variation
Private Employee	8790	38.9%	6955	37.9%	-20.9%
Government employee	900	4.0%	796	4.3%	-11.6%
Domestic employee	699	3.1%	388	2.1%	-44.5%
Day labourer	774	3.4%	619	3.4%	-20.0%
Employer	769	3.4%	617	3.4%	-19.8%
Self-employed	9732	43.0%	8259	45.0%	-15.1%
Unpaid worker	949	4.2%	719	3.9%	-24.2%
Total	22613		18353		-18.8%

Source: DANE (2022).

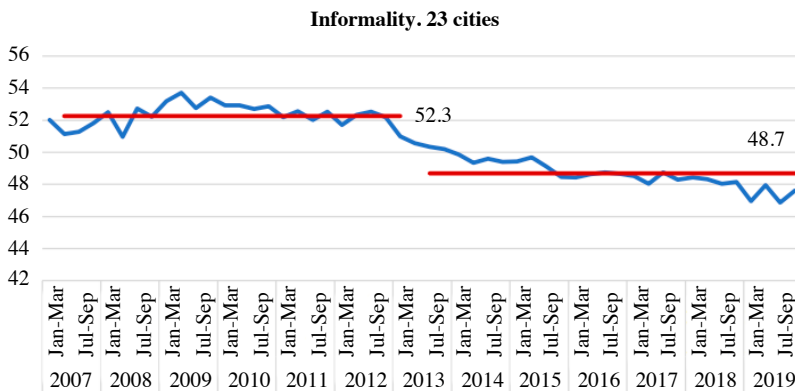
Many economic analysts had correctly identified that incentives for formalization in Colombia were inadequate, discouraged by the burden of para-fiscal contributions. When these were reduced in 2013, there was a corresponding significant decrease in informality, in the order of 3.6 percentage points, as Figure 1 illustrates. However, there is another, larger cause of the problem, which has to do with

¹ The problems of informality in emergent and developing economies have not changed much over the last decade, with the informality rate around 31% in 2012 and even since the beginning in the research of this literature (ILO, 1974).

an inadequate productive structure which creates few job opportunities. It is the scarcity of opportunities, rather than social or business non-compliance, that is the main cause of informality in Colombia.

Alternative measurements of informality based on the data on affiliation to social security systems show a significant degree of elusion and evasion. As Figure 2 illustrates, only 37% of total employees are paying into pensions. However, residual payroll costs can hardly explain the high incidence of informality in employment scenarios. As has been made clear in the pandemic, there is an important layer of society that remains on the margins, invisible even to state institutions that could provide them assistance. Despite having improved social protection coverage, Colombia still has a long way to go. When changes occurring between 2013 and 2020 are analysed, it is noted that although the number of employees affiliated to contributory health coverage and pensions has increased, these changes are minimal, rising from 45% of workers affiliated to health plans in 2013 to 47% in 2020. The case is similar for pensions over the same period, with 31% of workers paying into pensions in 2013 up to 37% in 2020. This data shows the inertia of progress made on reducing informality in the Colombian economy during this period, with few important changes to report.

Figure 1.
Informality in 23 Colombian cities



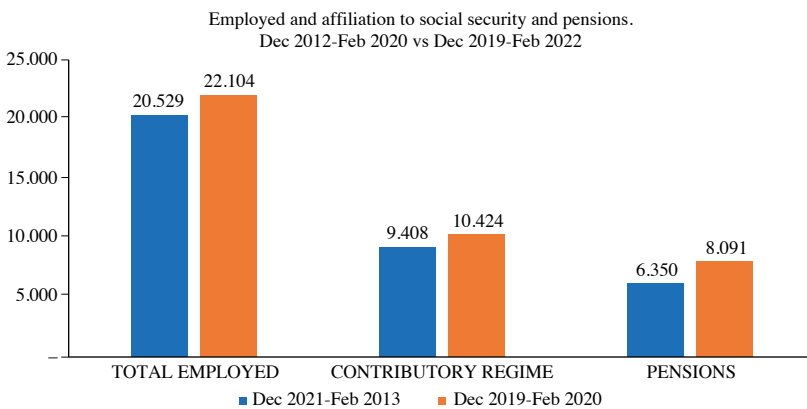
Source: Compiled by the authors using data from DANE (2022).

Given these circumstances, this article addresses the problem of informality as a problem of lack of opportunity, rather than as a conscious decision by employees or employers to comply with or disregard legal or labour obligations. In this sense, there is a consolidated formal labour market, in which a certain number of jobs are available depending on the capital structure of the economy, the productivity of the companies within it and the current phase of the economic cycle. These jobs are filled through complex selection processes, in which workers can partici-

pate with the understanding that they have a limited probability of being chosen for the job. This results in an endogenously determined level of unemployment, which could be attributed to factors such as wage rigidity or incentive mechanisms associated with practices such as efficiency wages. Aware of this situation, workers must choose between joining formal labour markets, which are regulated and in which jobs are remunerated with pay equal to or greater than the legal minimum wage, or to find an occupation in informal markets, in which they will be engaged in low-productivity activities and in which no labour regulations or legal minimums apply (Perry, 2007).

Figure 2.

Social Security Comparison



Source: Compiled by the authors using data from DANE (2022).

Many people with low educational levels are also restricted when accessing capital due to the requirements of the formal credit markets. This is just another factor that makes the decision to resort to informality almost unavoidable. The arguments put forth so far constitute the main contributions of this paper to the literature on informality in Colombia, and set it apart from the predominant literature on the subject. These arguments can be summarized thusly: 1. informality is derived from the lack of opportunities in human capital, physical capital, and social networks and contacts, and 2. since people must satisfy their basic needs and those of their families, they have only one option, which is informality. In other words, people do not make a conscious decision to evade formal requirements or labour regulations, rather, it is the only way they can generate the income necessary for survival.

For the modelling of households, we take into account two household types. The first are those that have no restriction of liquidity, and may therefore engage in inter-temporal optimizing behaviours. The second are those with liquidity restrictions, which only have their current income available for optimization, given their

limited access to credit markets. Liquidity restrictions force many households to engage in low-productivity informal activities (essentially self-employment), and in this way expand the informal sector. The supply of goods and services derives from two sources: formal companies which possess capital and create high-quality jobs, and informal production units, which lack capital and rely on low-productivity informal employment. Both types of household must decide between formally and informally-produced products and services. These two options are imperfect substitutes, and for this reason the decision is based on changes in price.

Based on this social context, this article explores the relationship between informal employment, income distribution, and tax policy using a Dynamic Stochastic Equilibrium Model (DSGE) to represent a simplified version of the Colombian economy, calibrated for 2018. The model (a) explores the effect of various types of taxes and contributions on informality, and (b) analyses the consequences of tax burden and subsidy schemes on income distribution. In the next section, the article briefly reviews relevant literature, and in section three goes on to make a thorough presentation of the DSGE model of the real economy. Section four contains our simulations and section five concludes the article.

The main contribution that this paper makes to the existing literature on informality is to analyse this problem not solely as a matter of the choice that individuals have to pay taxes or to adhere to labour regulations, but rather as a social phenomenon. This analysis considers that a significant segment of the population faces a limited allocation of human and physical capital, reduced access to credit markets and social networks, and scarcity of opportunities. The correct understanding of the problem of informality is necessary for the design of effective policies to formalize the economy. For this purpose, we built a model that can simulate this problem, allowing us to observe which fiscal policy instruments are most effective in reducing levels of informality in middle-income countries. The findings can be employed to design adequate, efficient policies and tools to solve the problem, with lower welfare costs.

DSGE MODELS AND INFORMALITY LITERATURE REVIEW

In their research on the informal economy and economic development, La Porta and Shleifer (2008) show how informal economic activity carried out by companies that are not registered with government institutions or that are registered but do not pay the correct taxes make up between a third and half of total economic activity in developing countries. This proportion greatly reduces as the economy develops. However, we know little about the role played by informal activity in economic development generally, and in particular, the effect that the “formalization” of these hidden sources can have on economic growth. The authors address these issues by presenting new findings on the informal economy and interpreting them using different approaches.

Their article covers three different theories about the role that these companies have in the development of the economy. The first model is the “romantic” vision in which unregistered companies will become the central axis of economic growth if they are not impeded by government regulation. The second model is the “parasitic” vision which indicates that, by evading taxes and state regulations, informal enterprises have an unfair advantage compared to formal enterprises that are more efficient. Informal firms obstruct the market share of formal firms, creating obstacles to development and economic progress. The third model is a twofold vision that argues that informal enterprises tend to be very inefficient, so they do not represent a serious threat to formal enterprises. However, these companies do not favour economic growth, which is stimulated by efficient, formal companies.

To test these different ideas, La Porta and Shleifer (2008) applied a methodology of basic correlations, which includes an analysis that compares the characteristics and productivity of official and unofficial companies in various developing countries, using data from surveys at the World Bank (WB) company level. They found that informal enterprises are small and considerably unproductive, even when contrasted with small formal enterprises, and especially when compared with larger formal enterprises. Another finding shows that formal enterprises are operated by managers who have more qualifications and education than those running informal firms. As a result, the formal companies use more capital, have more diverse customers, market their products, and make use of more external financing. Only a minimal number of formal enterprises had at some point been informal operations. This evidence does not support either the romantic or parasitic visions of informality. It does however support the twofold vision of informal enterprises. The authors assert that in the “Walmart” theory of economic development, growth derives from the creation of formal companies which are more productive.

Additionally, in a later study, La Porta and Shleifer (2014) indicate that in general, informal enterprises represent almost half or more than half of economic activity of developing countries. It is also important to remember that these companies provide sustenance to billions of people. However, the role these companies play in economic development continues to be a contentious issue. To analyse the diverse perspectives found in the literature, the authors have determined five key elements for studying the informal economy: the first factor is the enormous size of the informal economy, predominantly focussed in developing countries. Secondly, the informal economy has markedly low-productivity when compared with the formal economy, because informal enterprises tend to be small, inefficient, and operated by people with little education. The third factor concerns the fact that, although the evasion of taxes and regulations in the informal economy comprise its essential characteristics, the productivity of companies in this sector is notoriously low, preventing them from developing in the formal sector. Additionally, decreasing registration costs to establish a company in the formal sector does not motivate many companies in the informal sector to formalize, nor does it produce economic growth. The fourth element is that the informal economy is

removed from or has no relationship at all with the formal economy. Informal companies almost never become part of the formal sector, and often operate for years or even decades without notable growth or improvement. Finally, the fifth factor is that at a certain point in the development of a country, the informal economy will start to shrink, allowing the formal economy to break through and come to dominate economic life.

The authors argue that their findings from the data are more similar to and consistent with the twofold model of informality. Their study of the models identified the supply and demand factors that preserve the gap between formal and informal economies. They subsequently address the essential question of how to reduce the informal economy. They found that in twofold models, economic growth is the source of expansion of the formal sector, because companies are managed by educated entrepreneurs and thus have very high levels of productivity. This indicates that a significant bottleneck for economic growth is the supply of educated entrepreneurs. The expansion of the formal sector leads to the relative, and, luckily, absolute decline of the informal sector, even though informal employment manages to persist at a high level over a long period, mainly when the growth of the labour force is high. Meanwhile, some informal enterprises become part of the formal sector, although these tend to disappear because they are not able to compete with more productive formal firms. This explanation gives a good overview of how the informal economy is reduced as the economy develops. The recommendation for policy on how to grow the formal economy and reduce the informal economy is to increase the supply of educated entrepreneurs either through immigration, or education and training.

Studies concentrating on Colombia include a paper by Hamann and Mejía (2012) in which they build a dynamic partial balance model for the period 2000-2007 to study entrepreneurs in both the formal and informal sectors. When founding a new business, an entrepreneur decides to run the business informally or formally depending on the cost-benefit analysis, which includes wage costs, taxes, the costs of creating or setting up a business, and financial costs. The authors also examine whether the regulation of the formal sector creates a barrier to the formalization of new companies. The model was calibrated to replicate the added value of the formal versus informal sector in Colombia during the analysis period, and applied a measure of the distribution of the added value of micro-businesses. They also estimated the impact of various formalization policies on the relative size of the formal sector, finding that the current legal institutional regulatory framework acts as an important barrier to the entry of companies into the formal sector. The results show that cost reductions in creating a formal enterprise have an exponential impact.

In another Colombian study, Osorio-Copete (2016) states that, for the period 1996-2013, in the years when unemployment grew, this growth was accompanied by an increase in informality. She attributes this to higher payroll taxes introduced by the labour reforms of the nineties. The purpose of the study was to assess the effective-

ness of the 2012 tax reform on labour formalization. This reform was recommended by the OECD to promote the formalisation of labour and business, through the incentive of a reduction in non-wage costs. The logic behind the reform was the redirection of tax incentives to favour the formalization of employment through the reduction of parafiscal and social security contributions, the reduction of taxes on company profits, an increase in the tax collection base for natural persons and the unification of tariffs.

Osorio-Copete (2016) uses a DSGE model to analyse the impact that the change in fiscal policy had on the Colombian economy. The reform included changes to government and tax policy. The model comprises a closed and decentralized economy and takes into account three agents: households, firms and government. This artificial economy has two productive sectors, one formal and one informal, which produce the same final good using different production technologies. The informal sector is labour intensive, while the formal sector employs capital in its production function.

In a section called quantitative experiments, the author describes the processes undertaken based on the model and its calibration, to measure the impact of tax reform on the artificial economy. She creates two scenarios: in one, the change in tax policy is unanticipated, and in the other, it is anticipated. This is to account for the fact that, generally, in the legislative process, a tax reform is not implemented immediately after approval. So, it is sensible to consider a transition period between the time when the reform is discussed and made public and the effective change in tax rates. The results indicate that the 2012 reform had a positive impact and reduced informality by 2.3%. Between 2000 and 2013, although unemployment decreased by ten percentage points, the informality rate did not respond in equal measure to this trend and maintained above 50% of the working population. Osorio-Copete attributes this to two general aspects: the low education level of the economically active population and institutional barriers such as a high minimum wage, high costs of formal hiring and dismissal and weak institutions that do not devote sufficient efforts to avoiding or penalizing informality.

In their research on the taxonomy of informality in Latin America, Fernández and Villar (2016) indicate that although informality provides a large segment of the population a means to live and feed themselves, it represents a problem for the Latin American region. They cite various facets of this problem: (i) informality has a particularly strong impact on the vulnerable population, (ii) informality leads to a fiscal cost because informal workers saturate public services and do not contribute to them, (iii) the informal sector increases corruption, (iv) this sector is a source of unfair competition for formal firms, and (v) finally, the informal sector decreases the productivity of the country, because informal firms cannot access services such as credit, social protections, copyright protection and justice. These firms also tend to limit their own growth to avoid attracting the attention of the authorities. The authors also affirm that studying informality in Latin America is complex, on the one hand due to the complicated task of verifying concepts and

measurements; and on the other because of the differences in the type of informality that countries face. In countries like Chile and Mexico, informality is understood as the result of a decision made by individuals, whereas in countries such as Colombia and Peru, individuals resort to informality because they have no other choice, either due to their low productivity or the various and complicated barriers to entry to the formal sector. As a result, the authors stress that it is paramount to identify the particular structure of informality in a country when constructing policy recommendations for it.

The objectives of the research are: 1) to reconcile figures and concepts that describe the labour market to create a similar measure for informality using household surveys from several Latin American countries; 2) to evaluate the structure of informality based on the criteria laid out in a previous study (Fernández et al., 2016); and 3) to analyse the coherence of the formalization policies that have been carried out recently in an environment to the type of informality present there. They employ Logit models and their derivations such as Multilogit, alongside other sources of information such as household surveys, to individually analyse seven countries in Latin America: Peru, Colombia, Brazil, Mexico, Argentina, Uruguay and Chile. They also perform a set of several different exercises on all seven countries, which in 2015 together represented 80% of the Gross Domestic Product and 75% of the population of Latin America, according to the World Bank's World Development Indicators (WDI, 2016). Finally, Fernández and Villar explain that, while there are discrepancies in the labour market and informality of each country, these differences do not have a strong influence on the overall results. The differences in the results and particular features of informality between countries can be explained more accurately by the different circumstances of each country, for example, the per capita income and level of development, labour costs, tendency towards informality and the incorrect design of social policy. In other words, these differences in the structure of informality between the countries studied are explained by the forms of informality that predominate in each country. The authors stress that Latin America has a responsibility to investigate efforts in improve education that have been made in countries in other regions.

In the study by Fernandez et al. (2016) cited above, the authors create a taxonomy of informality by analysing the following motivations for informality: 1) low productivity: informal workers do not possess the necessary skills to produce at the level required by the formal labour market; 2) barriers: informal workers' productivity is comparable to workers in the formal labour market but they are prevented from entry due to certain barriers, these can be explicit, such as the cost of payroll taxes, or implicit, such as in cases of gender or race discrimination; 3) choice: informal workers have a level of productivity comparable to workers in the formal labour market but choose to be informal after a cost-benefit analysis. These three types of informal workers are categorized as subsistence, induced and voluntary, respectively. The taxonomy gives the name mixed informality to situation in which there is a combination of subsistence and voluntary informality. The article

makes an excellent review of the literature to create a better definition of informality. The authors then proceed to examine the hypothesis that informality is caused by low productivity in the economy, and conclude that the problem of informality is best described using a productive approach and not as a question of tax evasion or social non-compliance.

In terms of international research, the search and comparison model developed in a study of Brazil by Ulyseia (2018) analyses the determinants and size of informality and how these influence aggregated fluctuations. The model successfully captures the negative relationship between quality and informality, as well as the positive link in the data between informality and consumption and investment volatility, regardless of the underlying cause of changes in informality. However, the model predicts a negative relationship between informality and level of production only if the variation in informality is driven by changes in institutional quality that mainly affect the formal sector. The results of the model suggest that both labour market volatility and the long-term stability of certain macroeconomic aggregates, such as production, consumption and unemployment, may differ widely between economies of the same size. As the size of the informal sector depends on the level of institutional quality it is crucial to identify exactly how this association functions, as well as for correctly characterizing the short- and long-term macroeconomic consequences of informality.

In a different study, Dix-Carneiro *et al.* (2021) indicate that a fundamental fragment of the labour force in many emerging and developing economies is informally employed. Despite this, the informal sector is almost absent in theoretical and empirical studies on trade. While research has indicated that the informal sector plays an essential role in the adjustment of an economy to trade or other economic shocks, the structure of such studies has not been appropriate to expound on the aggregate implications of informality and neither have they been able to analyse how welfare is affected. The authors aim to fill the gap in the literature by developing a structure of general equilibrium that allows them to perform this analysis. Thus, they build a structural balance model containing heterogeneous companies which decide whether to do business in the formal or informal sector. The model has a diverse institutional environment; the economy is composed of a tradable and non-tradable sector. Formal companies must comply with a series of requirements, and in turn, the government imperfectly applies taxes and labour market regulations, creating incentives for companies to operate informally. Dix-Carneiro *et al.* (2021) use various data sources to estimate the model, which include comparative data on employers and employees of formal and informal companies, as well as household surveys, manufacturing and services censuses, and customs data for Brazil. They subsequently carried out a series of hypothetical experiments or counterfactual simulations to better understand the impact of trade shocks in an economy with a large informal sector.

Their research shows, firstly, that trade openness undoubtedly decreases informality in the marketable sector, however, this panorama has confusing effects

on aggregate informality. Secondly, the authors find that the gains in trade productivity are underestimated when excluding the informal sector. Thirdly, trade openness creates broad gains in welfare even when informality is compressed. Meanwhile, the decline in informality increases productivity, but sacrifices employment and welfare. They find that the impact of trade on wage inequality becomes apparent when the informal sector is included in the analysis. Finally, the informal sector performs as “unemployment” but does not function as a “buffer of welfare” when negative economic shocks occur in the economy.

One of the most recent studies in the literature on the analysis of informality using DSGE models is that by Atesagaoglu et al. (2017). These authors study the structural transformation that usually accompanies the economic growth of countries and how this impacts the levels of informality. They indicate that there has traditionally been a focus on the sectorization of the economy in terms of agriculture, industry and services which has ignored the problem of informality and its effects on the use of resources. They follow a methodology based on three-sector structural model which they subsequently augment to create a five-sector model. Their work finds that informality declines in both the industry and service sectors, although it remains higher in services. They examine the implications of their results for the United States and the rest of the world using the same analytical framework.

This allows the authors to use a business cycle model with frictioned labour markets and informal employment to examine the impact the different dimensions of institutional quality have on informality as well as the link between the informal sector and aggregate economic activity. The model focuses on two different dimensions of institutional quality that affect the size of the informality sector in all economies: the economic environment in which formal enterprises operate, as reflected (exogenously) in the productivity of the formal sector, and the degree to which labour regulations are applied in the informal sector.

Nandi (2020) analyses India’s fiscal policy using a Stochastic Dynamic General Balance model in the context of the government’s continual attempts at policy reform. The 2003 Fiscal Responsibility and Budget Management Act (FRBMA), which has been the cornerstone of fiscal rules for India in recent times, interceded to reduce the fiscal deficit to 3% of GDP by 2008-09, and set the goal for the eventual elimination of revenue deficits. However, India’s experience with the legislation has been mixed. The author attempts to offer a critical assessment of the existing theoretical literature on India’s fiscal policy, finding a deficit in the application of advanced macroeconomic policy models to investigate the problems of current fiscal policy in India. The DSGE model he proposes in the paper considers households, firms, fiscal and monetary policy. The work of each household is expressed as the decision-making power each has over the salary they charge. Firms are expressed as the production sector, which is composed of companies of intermediate and final goods. Fiscal policy is understood as total public expenditure, and the fiscal rule is specified as a balanced budgetary framework, where the link between fiscal deficit/GDP is regulated around a long-term objective and res-

ponds to variations in the economic cycle according to the parameter. Monetary policy follows the standard Taylor's rule.

Thusly, Nandi (2020) compares the economic impact of shocks on public consumption, public investment, transfers, consumption tax and income tax. From a political point of view, Nandi (2020) the results underscore the importance of selecting the right form for fiscal intervention. Positive shocks in income spending can increase production and employment, but they fundamentally benefit non-Ricardian consumption, and also result in higher inflation, lower wealth consumption, and the displacement of private investment. Public investment stimulus tends to favour the accumulation of private investment. However, a cut in consumption tax can succeed in encouraging both types of household consumption, while lowering inflation and the nominal interest rate. The transmission of the labour tax cut presents challenges in the case of an emerging economy such as India, where non-Ricardian agents are not integrated within the tax network.

THE MODEL

Our model considers two distinct types of households: (1) households with access to credit and financial markets (optimizing households, denoted by an O at the beginning of the variable) and (2) households with liquidity constraints (restricted households, denoted by U superindex). Endowed with skilled and unskilled labour, each household maximizes its utility in deciding on the optimal supply of labour. The first group makes their decision in an intertemporal context and the latter makes its decision for the current period.

Optimizing households

The following equation describes the decision that a representative optimizing household will make to try to maximize the future expected value of its utility over time:

$$\text{Max } E_t \sum_{t=0}^{\infty} \beta^t \frac{L_t}{L_0} \left(\ln oc_t^F + \psi_t^S \ln(a_t^S - e_t^S) + \psi_t^U \ln(a_t^U - e_t^U) \right), \quad (3.1)$$

subject to

$$(1 - \tau_k) \frac{r_t k_{t-1}}{\theta} + (1 - \tau_l) (w_t^S e_t^S + w_t^U e_t^U) + ner_t fr_t = poc_t oc_t^F + pp_t^F i_t. \quad (3.2)$$

Where E_t is the expected value in period t ; β is the discounted factor; L_t is the labour force, normalized to the initial condition L_0 ; oc_t^F is optimizing household consumption; a_t^S and a_t^U are fractions of skilled and non-skilled agents; e_t^S and e_t^U are employment of skilled and non-skilled agents; r_t is return of capital; k_{t-1} is capital; w_t^S and w_t^U are wage of skilled and non-skilled agents; ner_t is nominal exchange rate; fr_t is external remittances; poc_t is price of optimizing household consumption; pp_t^F is price of formal products; i_t is investment; and τ_k and τ_l are the level of taxes on capital and labour. The parameters θ , ψ_t^S and ψ_t^U are the discount factor,

representing the household's weights in leisure; the population's growth rate; and the utility weight of leisure of skilled and non-skilled agents, respectively. Moreover, with δ as the rate of depreciation, capital evolves over time in the following way:

$$k_t = (1 - \delta) \frac{k_{t-1}}{\theta} + i_t. \quad (3.3)$$

The labour market for the skilled group of consumers is determined by:²

$$\frac{oc_t}{a^s - e_t^s} - \frac{(1 - \tau_t) w_t^s}{\psi_t^s p oc_t} = 0. \quad (3.4)$$

The labour market for the unskilled group is determined by:

$$\frac{oc_t}{a^u - e_t^u} - \frac{(1 - \tau_t) w_t^u}{\psi_t^u p oc_t} = 0. \quad (3.5)$$

The following is the Euler equation:

$$\frac{E_t(oc_{t+1})}{oc_t} - E_t \left[\beta \frac{pp_{t+1}^F}{pp_t^F} \frac{p oc_t}{p oc_{t+1}} \left((1 - \tau_k) \frac{r_{t+1}}{py_{t+1}} + 1 - \delta \right) \right] = 0. \quad (3.6)$$

The budget constraint can be expressed as:

$$(1 - \tau_k) \frac{r_t k_{t-1}}{\theta} + (1 - \tau_t) (w_t^s e_t^s + w_t^u e_t^u) + enr_t fr_t - p oc_t oc_t - pp_t^F \left(k_t - \frac{(1 - \delta) k_{t-1}}{\theta} \right) = 0, \quad (3.7)$$

and the dynamics of capital become:

$$k_t = (1 - \delta) \frac{k_{t-1}}{\theta} + i_t. \quad (3.8)$$

Households facing liquidity constraints

The decision for the second group of households will be to maximize its utility function at time t :

$$\text{Max}_{cc, ec^s, ec^u} U = \text{In} cc_t + \psi_{lc}^s \text{In} (ac^s - ec_t^s) + \psi_{lc}^u \text{In} (ac^u - ec_t^u), \quad (3.9)$$

subject to

$$wc_t^s ec_t^s + wc_t^u ec_t^u + gt_t = p cc_t cc_t. \quad (3.10)$$

Where cc_t is the consumption of liquidity-constrained households, ac_t^s and ac_t^u are fractions of skilled and non-skilled agents, ec_t^s and ec_t^u are employment of skilled and non-skilled agents, wc_t^s and wc_t^u are wage of skilled and non-skilled agents, gt_t is a transfer given by the government and $p cc_t$ is price of consumption of liquidi-

² Lowercase letters refer to relative prices, expressed in terms of P .

ty-constrained households. Parameters ψ_{lc^S} and ψ_{lc^U} are the utility weight of leisure of skilled and non-skilled agents respectively.

The labour market is determined by:

$$\frac{cc_t}{ac^S - ec_t^S} = \frac{wc_t^S}{\psi_{lc^S} pcc_t}, \tag{3.11}$$

$$\frac{cc_t}{ac^U - ec_t^U} = \frac{wc_t^U}{\psi_{lc^U} pcc_t}, \tag{3.12}$$

and the budget constraint by:

$$wc_t^S ec_t^S + wc_t^U ec_t^U + gt_t = pcc_t cc_t. \tag{3.13}$$

The formality vs. informality decision of non-skilled labour

While skilled agents only participate in the formal sector, non-skilled workers have to decide whether to offer their labour in the formal or informal sector. According to the literature on informality, economic agents belonging to the formal sector have no incentive to be part of the informal sector, unless facing extreme circumstances and when the informal sector is seen as a buffer. Assuming that households maximize their income subject to the substitution constraint, we have modelled this decision with a CET utility function. Following the Harris-Todaro model, we assume that a worker’s decision is based on their expected income, which depends, in the formal market, on wage and the probability of being employed. Thus, non-skilled workers choose between joining the formal market (a market with unemployment, and with a limited chance of being hired) and the informal market, where they can be employed according to the equilibrium price in this market.

Optimizing households’ offer of non-skilled labour is determined by:

$$e_t^{FU} = (n_t^{FU} + \mu_t) + n_t^{IU}. \tag{3.14}$$

Where the term in brackets is the participation of the formal market, n_t^{FU} are non-skilled workers in the formal market, μ_t is unemployment and n_t^{IU} are non-skilled workers in the informal market.

The path of expansion and aggregation status condition of optimizing households are expressed thusly:

$$\frac{n_t^{FU} + \mu_t^F}{n_t^{IU}} = \left(pbh_t \frac{we_t^F}{we_t^I} \frac{1 - \omega_F}{\omega_F} \right)^{-\sigma_s}, \tag{3.15}$$

$$w_t^{FU} e_t^{FU} = we_t^F n_t^{FU} + we_t^I n_t^{IU} \tag{3.16}$$

Where pbh_t is the probability of being hired, and we_t^F and we_t^I are wages earned in formal and informal markets. Parameters ω_F and σ_s are, respectively, the utility weight of the formal market and elasticity of substitution.

The formal wage evolves over time in the following way:

$$we_t^F = we_{t-1}^F, \quad (3.17)$$

and the probability of being hired in the formal market is determined by:

$$probh_t = \frac{n_t^{FU}}{n_t^{FU} + \mu_t}. \quad (3.18)$$

The respective functions for households facing liquidity constraints are

$$ec_t^{IU} = (nc_t^{FU} + \mu c_t) + nc_t^{IU}, \quad (3.19)$$

$$\frac{nc_t^{FU} + \mu c_t}{nc_t^{IU}} = \left(probhc_t \frac{wec_t^F}{wec_t^I} \frac{1 - \omega c_F}{\omega c_F} \right)^{-\sigma c_s}, \quad (3.20)$$

$$wec_t^{IU} ec_t^{IU} = wec_t^F nc_t^{FU} + wec_t^I nc_t^{IU}, \quad (3.21)$$

$$wec_t^F = wec_{t-1}^F, \quad (3.22)$$

$$probhc_t = \frac{nc_t^{FU}}{nc_t^{FU} + \mu c_t} \quad (3.23)$$

Where nc_t^{FU} are non-skilled workers in the formal market, nc_t^{FI} are non-skilled workers in the informal market, μc_t is unemployment, $probhc_t$ is the probability of being hired, wec_t^F and wec_t^I are wages earned in formal and informal markets. Parameters ωc_F and σc_s are, respectively, the utility weight of the formal market and elasticity of substitution.

Aggregating household consumption

Aggregated optimizing household consumption is composed of consumption of goods from the formal and the informal sector. The aggregation of all goods is represented by a CES function, given the substitutability between the two types of consumption. As a result, we describe the relationships thusly:

$$c_t^F = B_e \left(\omega c_t^F \frac{\sigma c - 1}{\sigma c} + (1 - \omega c) c_t^I \frac{\sigma c - 1}{\sigma c} \right)^{\frac{\sigma c}{\sigma c - 1}}, \quad (3.24)$$

$$\frac{c_t^F}{c_t^I} = \left(\frac{p_t^F}{p_t^I} \frac{1 - \omega c}{\omega c} \right)^{-\sigma c}, \quad (3.25)$$

and

$$poc_t oc_t = p_t^F c_t^F + p_t^I c_t^I. \quad (3.26)$$

c_t^F and c_t^I are consumption in the formal and the informal sector. p_t^F and p_t^I are their respective prices. B_c is a scale parameter, ω_c is the utility weight of the formal market and σ_c is the elasticity of substitution.

For the constrained households, the respective equations become:

$$cc_t = B_c \left(\omega_{cc} cc_t^F \frac{\sigma_{cc}-1}{\sigma_{cc}} + (1-\omega_{cc}) cc_t^I \frac{\sigma_{cc}-1}{\sigma_{cc}} \right)^{\frac{\sigma_{cc}}{\sigma_{cc}-1}}, \quad (3.27)$$

$$\frac{c^F c_t}{c_t^I} = \left(\frac{p_t^F}{p_t^I} \frac{1-\omega_{cc}}{\omega_{cc}} \right)^{-\sigma_{cc}}, \quad (3.28)$$

and

$$pcc_t cc_t = py_t cc_t^F + p_t^I cc_t^I \quad (3.29)$$

PRODUCTION

Following the work of Levine et al. (2012), we consider two sectors – one formal and one informal – producing different types of goods, which are sold at different prices. While the formal sector employs capital as a factor of production, the informal sector does not.

The formal sector

For the formal sector, we assume a production function with three distinct features. First, labour and capital are aggregated using a Cobb-Douglas function. Second, skilled and unskilled labour combine by means of a CES-type function. Third, skilled and unskilled labour from both household types are aggregated. Essentially, this means that labour from both types of households are not perfect substitutes (which may be explained by differences in education or nutrition, for instance). With respect to our first feature, production states that:

$$Y_t^F = K_{t-1}^\alpha \left(z_t^F L_t N_t^{dF} \right)^{1-\alpha}. \quad (3.30)$$

Where Y_t^F is production in the formal sector, K_{t-1} is capital, N_t^{dF} is the work demanded and z_t^F is the productivity. Parameter α is the weight of capital in the production function.

Minimizing costs with respect to Y leads to:

$$\frac{\partial Y_t^F}{\partial K_{t-1}} = \alpha K_{t-1}^{\alpha-1} \left(z_t^F L_t N_t^{dF} \right)^{1-\alpha} = \frac{r_t}{pY_t} \quad (3.31)$$

and

$$\frac{\partial Y_t^F}{\partial L_t N_t^{dF}} = (1 - \alpha) K_{t-1}^\alpha z_t^{F1-\alpha} (L_t N_t^{dF})^{-\alpha} = \frac{w_t^F}{p y_t}. \tag{3.32}$$

Expressing the above equations in per capita terms, deflated by the IPC, gives:

$$\alpha k_{t-1}^{\alpha-1} \theta^{1-\alpha} (z_t^F N_t^{dF})^{1-\alpha} = \frac{r_t}{p y_t} \tag{3.33}$$

and

$$(1 - \alpha) k_{t-1}^\alpha \theta^{-\alpha} z_t^{F1-\alpha} N_t^{F-\alpha} = \frac{w_t^F}{p y_t}. \tag{3.34}$$

The production function in per capita terms becomes:

$$y_t^F = \left(\frac{k_{t-1}}{\theta} \right)^\alpha (z_t^F N_t^{dF})^{1-\alpha}. \tag{3.35}$$

Aggregated labour in the formal sector consists of skilled and unskilled labour, combining in a CES-type setting. Minimizing costs leads to the following equations:

$$N_t^F = B_{pf} \left(\omega_{pf} N_t^{dF^S} \frac{\sigma_{pf}^{-1}}{\sigma_{pf}} + (1 - \omega_{pf}) N_t^{dF^U} \frac{\sigma_{pf}^{-1}}{\sigma_{pf}} \right)^{\frac{\sigma_{pf}}{\sigma_{pf}-1}}, \tag{3.36}$$

$$\frac{N_t^{dF^S}}{N_t^{dF^U}} = \left(\frac{w_t^{FS}}{w_t^{FU}} \frac{1 - \omega_{pf}}{\omega_{pf}} \right)^{\sigma_{pf}}, \tag{3.37}$$

and

$$w_t^F N_t^{dF} = w_t^{FS} N_t^{dF^S} + w_t^{FU} N_t^{dF^U}. \tag{3.38}$$

B_{pf} is a scale parameter, ω_{pf} is the utility weight of skilled labour and σ_{pf} is the elasticity of substitution.

Skilled and unskilled work in the formal sector are the result of adding together optimizing and liquidity-constrained households. As noted above, the two distinct types of labour are not perfect substitutes. The distinction lies in various aspects, for instance differences in training, education or general living conditions (health, food, place of residence, etc.). Companies minimize the labour costs of both skilled and unskilled labour, given the aggregation constraint of household work. The resulting equations for labour in the formal sector are:

$$N_t^{dF^S} = B_S \left(\omega_S e_t^S \frac{\sigma_S^{-1}}{\sigma_S} + (1 - \omega_S) e c_t^S \frac{\sigma_S^{-1}}{\sigma_S} \right)^{\frac{\sigma_S}{\sigma_S-1}}, \tag{3.39}$$

$$\frac{e_t^S}{ac_t^S} = \left(\frac{w_t^S}{wc_t^S} \frac{1 - \omega_S}{\omega_S} \right)^{-\sigma_S}, \quad (3.40)$$

$$w_t^{FS} N_t^{dFS} (1 - \tau_c) = w_t^S E_t^S + wc_t^S wc_t^S, \quad (3.41)$$

and for unskilled formal sector labour:

$$N_t^{dFU} = B_U \left(\omega_U e_t^{FU} \frac{\sigma_U - 1}{\sigma_U} + (1 - \omega_U) ec_t^{FU} \frac{\sigma_U - 1}{\sigma_U} \right)^{\frac{\sigma_{fn}}{\sigma_{fn} - 1}}, \quad (3.42)$$

$$\frac{e_t^{FU}}{ec_t^{FU}} = \left(\frac{W_t^{FU}}{wc_t^{FU}} \frac{1 - \omega_U}{\omega_U} \right)^{-\sigma_U}, \quad (3.43)$$

and

$$w_t^{FU} N_t^{dFU} (1 - \tau_c) = W_t^{FU} e_t^{FU} + wc_t^{FU} wc_t^{FU}. \quad (3.44)$$

B_S and B_U are scale parameters, ω_S and ω_U are the utility weight of optimizing households respectively, whilst σ_S and σ_U are the elasticity of substitution of each function.

The informal sector

We assume the production function in the informal sector (in per capita terms) to be:

$$y_t^I = z_t^I n_t^I. \quad (3.45)$$

The optimality condition becomes:

$$z_t^I = \frac{w_t^I}{p_t^I}. \quad (3.46)$$

Then, the equilibrium in the informal sector is given by:

$$y_t^I = c_t^I + cc_t^I. \quad (3.47)$$

Now, informal work is also the aggregation (using a CES function) of informal labour from optimizing and constrained households. The optimality conditions for both types of work are summarized in the following equations:

$$n_t^I = B_{pi} \left(\omega_{pi} e_t^{IU} \frac{\sigma_{pi} - 1}{\sigma_{pi}} + (1 - \omega_{pi}) ec_t^{IU} \frac{\sigma_{pi} - 1}{\sigma_{pi}} \right)^{\frac{\sigma_{pi}}{\sigma_{pi} - 1}}, \quad (3.48)$$

$$\frac{e_t^{IU}}{ec_t^{IU}} = \left(\frac{W_t^{IU} (1 - \omega_{pi})}{wc_t^{IU} \omega_{pi}} \right)^{-\sigma_{pi}}, \quad (3.49)$$

and

$$w_t^{IU} N_t^{dlU} = W_t^{IU} e_t^{IU} + wc_t^{IU} wc_t^{IU} \quad (3.50)$$

Parameters B_{pi} , ω_{pi} and σ_{pi} are, respectively, a scale parameter, the utility weight of optimizing household and the elasticity of substitution.

International trade

We assume the existence of a commercial sector, which caters to the demand of domestic and imported goods. The demand for exports depends on foreign traders, who can purchase domestic goods or those from other sources. Export supply is modelled based on the optimal decision-making of entrepreneurs, who can channel their productive resources towards domestic or international markets.

The demand for imports

Retailers minimize their spending, given that imported and domestic goods are not perfect substitutes. Therefore, we model the aggregation of these assets using a CES function, and the cost minimization process of retailers results in the following relationships:

$$c_t^F + cc_t^F + g_t + i_t = B_m \left(\omega_m m_t^{\frac{\sigma_m - 1}{\sigma_m}} + (1 - \omega_m) d_t^{\frac{\sigma_m - 1}{\sigma_m}} \right)^{\frac{\sigma_m}{\sigma_m - 1}}, \quad (3.51)$$

$$\frac{m_t}{d_t} = \left(\frac{pm_t (1 - \omega_m)}{pdd_t \omega_m} \right)^{-\sigma_m}, \quad (3.52)$$

and

$$pf_t (c_t^F + cc_t^F f_t + g_t + i_t) = (1 + iva) (pm_t m_t + pdd_t dd_t). \quad (3.53)$$

The domestic price of imports is given by:

$$pm_t = pm_t^{ROW} ner_t (1 + tf). \quad (3.54)$$

Where g_t is government spending, m_t and pm_t are imports and their price, dd_t and pdd_t are domestic demand and its price, pm_t^{ROW} is the international price of imported goods and ner_t is the nominal exchange rate. B_m is a scale parameter, ω_m is the utility weight of imported goods, σ_{pi} is the elasticity of substitution, iva is a value added tax and tf is an import tariff.

The supply of exports

Input use determines the frontier of production possibility for entrepreneurs, who can export their goods or try to sell them domestically. Given this production limit

(which is modelled by a CET function), entrepreneurs maximize their profit by choosing the optimal mix of export and domestic sales. The resulting equations are:

$$y_t^F = B_e \left(\omega_e x_t^{\frac{\sigma_e-1}{\sigma_e}} + (1-\omega_e) dd_t^{\frac{\sigma_e-1}{\sigma_e}} \right)^{\frac{\sigma_e}{\sigma_e-1}}, \quad (3.55)$$

$$\frac{x_t}{dd_t} = \left(\frac{px_t}{pdd_t} \frac{1-\omega_e}{\omega_e} \right)^{-\sigma_e}, \quad (3.56)$$

and

$$pp_t^F y_t^F = (px_t x_t + pdd_t dd_t). \quad (3.57)$$

The domestic price of exports then becomes:

$$px_t = px_t^{ROW} ner_t. \quad (3.58)$$

Where x_t and px_t are exports and their price and px_t^{ROW} is the international price of export goods. B_e is a scale parameter, ω_e is the utility weight of exported goods, σ_e is the elasticity of substitution.

The demand for exports

The country's exports are not perfect substitutes for goods of other origin. Thus, the international buyer minimizes his expenditure, given the CES aggregation function linking country purchases and purchases from other suppliers. The equations governing this behaviour are:

$$xt_t = B_x \left(\omega_x x_t^{\frac{\sigma_x-1}{\sigma_x}} + (1-\omega_x) xx_t^{\frac{\sigma_x-1}{\sigma_x}} \right)^{\frac{\sigma_x}{\sigma_x-1}}, \quad (3.59)$$

and

$$\frac{x_t}{xx_t} = \left(\frac{px_t^{ROW}}{pw_t} \frac{1-\omega_x}{\omega_x} \right)^{-\sigma_x}. \quad (3.60)$$

Where xx_t and pw_t are purchases from other suppliers and their price. B_x is a scale parameter, ω_x is the utility weight of country purchases, σ_x is the elasticity of substitution.

Closed macroeconomy

Equality of savings and investment is guaranteed in the above approach, as savings are equal to total investment in the economy. The government's budgetary imbalance is financed by external borrowing s_t and external interest rates eir_t :

$$s_t ner_t = \frac{s_{t-1}}{\theta} eir_t ner_t + pp_t^F g_t + gt_t - \tau_k \frac{r_t k_{t-1}}{\theta} + \tau_t (w_t^S e_t^S + w_t^U e_t^U) \\ + \tau_c (w_t^{FS} N_t^{dFS} + w_t^{FU} N_t^{dFU}) - iva \frac{pf_t (c_t^F + cc_t^f + g_t + i_t)}{1 + iva} - tf (pm_t^{ROW} m_t ner_t) \quad (3.61)$$

As soon as the external market closes, the exchange rate adjusts to equalize Current and Capital Account (balance of payments):³

$$walras_t = px_t^{ROW} x_t + fr_t + \left(s_t - \frac{s_{t-1}}{\theta} eir_t \right) - pm_t^{ROW} m_t. \quad (3.62)$$

GDP is defined as:

$$gdp_t = pp_t^F (c_t^F + cc_t^F + g_t + i_t) + p_t^I (c_t^I + cc_t^I) + px_t x_t - \frac{pm_t m_t}{1 + tf}. \quad (3.63)$$

In order to maintain a targeted debt level, the government determines public spending thusly:

$$\frac{s_t ner_t}{gdp_t} = tb. \quad (3.64)$$

The consumer price index (cpi_t) is defined as:

$$\frac{pf_t (c_t^F + cc_t^F) + p_t^I (c_t^I + cc_t^I)}{c_t^F + cc_t^F + c_t^I + cc_t^I} = cpi_t = 1. \quad (3.65)$$

SIMULATION

We postulate that a redirection of government resources to liquidity-constrained households is necessary to generate income redistribution. Nevertheless, it is also crucial to discover which tools are appropriate to enact this redistribution. Specifically, we simulate an increase of 1 percent in transfer of wealth to poor families (those facing liquidity constraints). We also produce the Impulse-Response Function to analyse the impact of this policy on GDP, employment, unemployment, income distribution, informality and household incomes. To maintain fiscal balance, the government must cut spending or increase revenue through taxes. With this in mind, we initially consider four possible scenarios: an offsetting reduction in public spending, increasing taxes on capital, raising taxes on labour, and an increase in value added taxes (VAT).

Traditionally, these types of models include shocks to productivity in their calculations. Because of this, we include an additional option, in which increased trans-

³ Technically, this equation is redundant: the budgetary constraints of the remaining agents in the system and the fact that markets are in equilibrium ensure this equation also remains balanced. However, it includes the “Walras” variable to ensure compliance with this condition (known as Walras’ Law) in the system. Its value must be zero at any point in time.

fer payments are financed by the productivity of formal companies, as a point of comparison to the previous scenarios. Specifically, we increase the total factor productivity by one percent. Concerning the impulse response function (IRF) of GDP and capital, we found that financing transfer payments with higher taxes or lower government spending yields a negative response in the behaviour of both GDP and capital. As expected, the increase in taxes on capital causes a collapse in capital employed in the formal sector of the economy, and also negatively affects the level of employment. On the other hand, financing transfer payments with higher productivity leads to an increase of both aggregate production and capital, where the latter effect is the result of positive changes in investment flows (see Figures 3 and 5). Reducing public expenditure is the best option to compensate for the increase in transfers. This means that optimizing the distribution of public funds among diverse applications is one of the most important policies for a country to consider when facing distributive problems and the need to increase transfers to poor families.

However, the consequences of some types of taxes are very dangerous when it comes to informality in the economy: value added taxes, and taxes on capital increase informal employment. This compensates for the transfer of wealth in negative terms, as in the short term, the transfers increase the income of poor families, yet in the medium and long term, these actions contribute to the root of the problem, that is, informality and, probably, the vulnerability of poor families, as can be seen in Figure 4.

As might be expected, all scenarios result in better income distribution. However, when taxes are increased, there is also a decrease in the overall income of the households. This results in better distribution, but less global income and well-being, as is illustrated by Figure 4. This shows that effective processes of improvement in income distribution are necessary, and these are possible only through improvements in productivity or through better allocation of public spending.

There are, however, some undesirable consequences that must be considered. As is illustrated in Figure 5, employment is reduced in all cases, excluding the productivity scenario. However, in some cases, the unemployment rate also decreases, but then increases again. This is because the transfers occur only once and not continuously; with taxes on labour and reductions of expenditure, the global participation rate reduces, which in turn decreases the unemployment rate. This is probably the result of little incentive to work, where workers leave the labour force. Accordingly, when the government raises value added taxes or taxes on capital to fund the transfer, we see a resulting increase in informality. In Figure 6, we see that it is the productivity shocks that significantly reduce the size of the informal sector, which is consistent with the literature on informality. Shocks in productivity reduce the size of the informal sector, both in terms of businesses and in employment. On the other hand, a very important finding of this exercise is the fact that taxes play a negative role in terms of the impact on the informal sector, since increases in value added taxes and taxes on capital increase the size of the informal sector significantly. However, both

public spending and labour income tax do not affect the informal sector of the economy much. This will be important for in-depth discussions of possible tax reforms in Colombia, where policy makers need to think carefully about what to tax. Also, economic intuition tells us that it must be positive since they move busy from informal to formal. However, it is important to note that the formal work of the economy is not unaffected: keep in mind that we are evaluating the following ratio: $\frac{\text{informal work}}{\text{informal work} + \text{formal work}}$. Figure 6 shows that while, in effect, informal work is reduced, formal work also shrinks and by a greater magnitude. This is consistent with the theory. In terms of absolute numbers, the loss of work comprises 145 thousand formal jobs versus 124 thousand informal.

The fall in informal employment is due to the fact that restricted households that receive transfers leave the labour force. Figures 5 and 6 show that the drop more in the informal economically active population (EAP) of the restricted households than the informal EAP of restricted households. Furthermore, in Figure 6, informally produced products fall to a greater extent than those formally produced, this happens even when the drop in formal employment is greater than that of informal employment. This is due to the fact that the intensity of capital in the formal sector absorbs part of the fall in employment, while the informal sector has no capital at its disposal and all its production depends on manual labour. Therefore, the elasticity of production to employment is greater in the formal sector, while the informal sector is very sensitive to small drops in employment, as can be seen in the graph. In conclusion, the fall in informal production is due to the reduction in informal employment / informal labour offer (as shown in Figure 6).

CONCLUSIONS

The goal of this article was to evaluate the impact of fiscal instruments on two fundamental characteristics of middle-income countries such as Colombia: persistent income inequality and the substantial degree of informality. We found that increased transfer payments to households with lower incomes, which in this case translates to households facing liquidity constraints, have a positive effect on income distribution. However, in order to finance these additional payments, the government must increase taxes or reduce other areas of public spending. Both actions have a negative effect on productivity in the formal sector, on GDP, and on investment. The consequence of this is less total income. In sum, this mechanism achieves a better distribution of less wealth.

Funding transfers with increases in taxes either on value added or on capital results in an increase in informality, whereas raising taxes on labour and reducing public spending have the opposite effect. These results are similar to the phenomenon observed in the unemployment rate, which increases when taxes on value added and capital are raised but drops when government spending is reduced or when taxes on labour are raised.

Finally, it is important to highlight the results from the scenario of an increase in productivity in the formal sector. When the economy manages to raise productivity, investment and formal sector productivity both rise, which in turn generates higher growth, tax revenues, employment, transfer payments, less informality, higher incomes, and a better income distribution within the population.

It is necessary for governments to have an active policy on income redistribution, as the COVID-19 crisis is clearly showing. It is unfeasible for a society as a whole to prosper when a big part of its population is living in vulnerable conditions. In these kinds of situations, we need to decide on three fundamental questions of public policy. The first is how to simultaneously develop different policies that increase the productivity capacity of the economy. The second is how to create a methodology that can define priorities of public expenditure. The last (but not least), is how to evaluate the consequences of the taxes put in place to finance the redistribution effort. As expected, we found that taxes impact income distribution while also impacting efficiency. Additionally, the impulse response functions observed in the simulation exercise show us that some forms of taxation affect employment and the informal sector more than others. Specifically, in the case of Colombia, it showed that taxes on capital and value added significantly impact the creation of more informality. As a consequence, we have demonstrated the need for a general equilibrium methodology, such as the one we propose here, to appreciate the overall effects of policies.

Impulse Response Functions (IRF)

Figure 3.

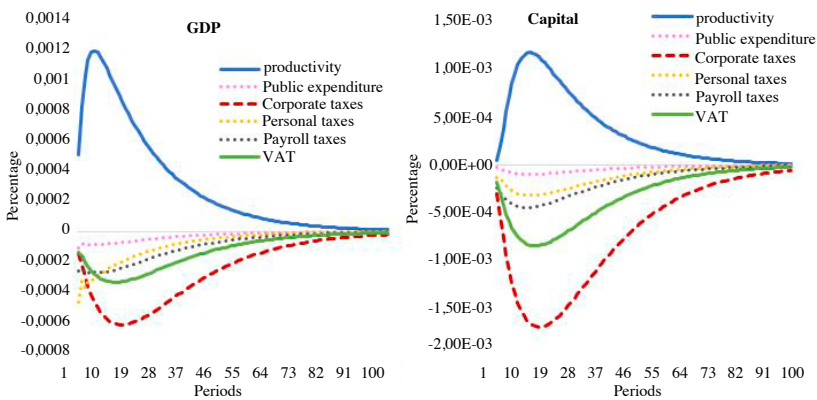
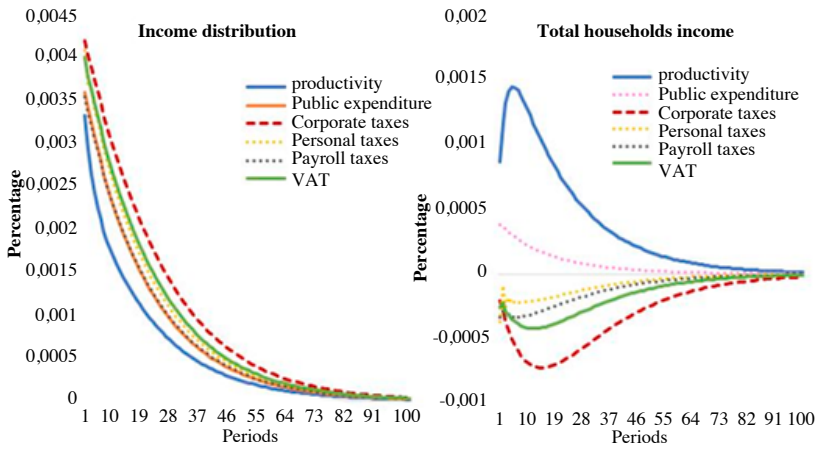


Figure 4.



Source: Calculated by the authors using DSGE models.

Figure 5.

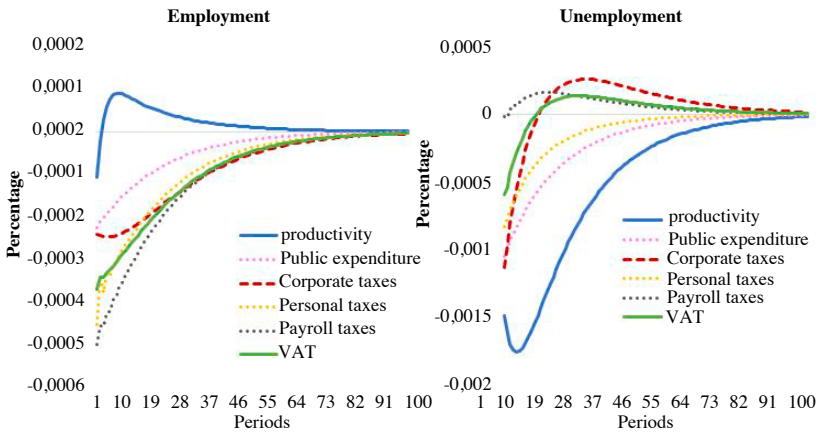
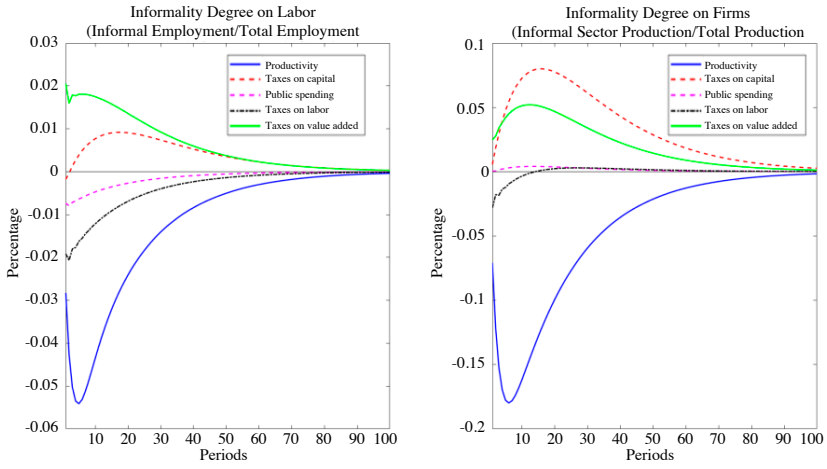


Figure 6.



Source: Calculated by the authors using DSGE models.

Appendix 1					
Variables					
<i>noc</i>	0.0832	<i>nrncf</i>	0.0612	<i>d</i>	6.4879
<i>nonc</i>	0.1798	<i>nrnci</i>	0.0853	<i>pm</i>	1.0000
<i>co</i>	5.0214	<i>wrncf</i>	4.5328	<i>pd</i>	1.0000
<i>i</i>	2.5194	<i>wrnci</i>	3.4430	<i>x</i>	1.6220
<i>k</i>	20.8164	<i>cof</i>	4.2240	<i>px</i>	1.0000
<i>woc</i>	23.5870	<i>coi</i>	0.7975	<i>pwx</i>	1.0000
<i>wonc</i>	8.7921	<i>pf</i>	1.0000	<i>xx</i>	162.2048
<i>po</i>	1.0000	<i>pi</i>	1.0000	<i>s</i>	2.6291
<i>r</i>	0.2037	<i>crf</i>	1.1681	<i>gdp</i>	10.1160
<i>f</i>	0.4879	<i>cri</i>	0.1960	<i>ipc</i>	1.0000
<i>er</i>	1.0000	<i>yf</i>	8.1099	<i>employment</i>	0.4009
<i>nrc</i>	0.0060	<i>nf</i>	0.2478	<i>ginfn</i>	0.3817
<i>nrnc</i>	0.1749	<i>py</i>	1.0000	<i>ingo</i>	7.5409
<i>cr</i>	1.3641	<i>wf</i>	15.8975	<i>ingr</i>	1.3641
<i>wrc</i>	4.2527	<i>zf</i>	12.2831	<i>distr</i>	0.1532
<i>wrnc</i>	3.2659	<i>nfc</i>	0.0892	<i>transr</i>	0.7674
<i>pr</i>	1.0000	<i>nfnc</i>	0.1586	τ_k	0.1245
<i>noncf</i>	0.0974	<i>wfc</i>	27.8997	τ_t	0.0401

(Continued)

Appendix 1					
Variables					
<i>nonci</i>	0.0678	<i>wfnc</i>	9.1446	τ_c	0.2012
<i>uo</i>	0.0147	<i>yi</i>	0.9934	<i>iva</i>	0.1041
<i>ur</i>	0.0284	<i>ni</i>	0.1530	<i>xt</i>	163.8269
<i>proboe</i>	0.8690	<i>wi</i>	6.4922	<i>walras</i>	0.0000
<i>prober</i>	0.6833	<i>zi</i>	6.4922	<i>aran</i>	0.0547
<i>woncf</i>	9.0483	<i>g</i>	1.6394	<i>ing</i>	8.9050
<i>wonci</i>	10.3293	<i>m</i>	2.1626	<i>ginfy</i>	0.1091

Source: National Accounts and GEIH (DANE). Compiled by the authors.

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