Sensitivity Analysis in CGE Models:
An Application to Informal Labour Market Reform in Turkey

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Abstract

The uncertainty surrounding computable general equilibrium models is a fact that modellers cannot deny. However, one can answer these criticisms, as well as increase confidence in the results, by including a sensitivity analysis in each study. The objective of this study is to perform a sensitivity analysis on the results of labour market policy reforms in Turkey using a CGE model developed by Telli, Voyvoda and Yeldan (2006). Labour market reform is one of the important economic reforms that Turkey must undertake before joining the European Union. Several studies have been carried out to assess the implications of these reforms on the Turkish economy using CGE models. Unfortunately, these models did not carry out any systematic analysis of their results. As the behavioural parameters are critical to the outcome of these models, a sensitivity analysis on the results of these models over the most critical parameters is performed.

1. Introduction

Over the years, computable general equilibrium (CGE) models have served as a tool in the analysis of many relevant policy changes and shocks, ranging from pollution taxes to trade liberalization. Many economists, however, criticize CGE models because their results can be greatly affected by choices made by the analyst, with regard to, among others, parameter values and closure rules (Jensen and Tarr, 2007). The most important criticism, which is most often repeated in the literature, concerns the uncertainty surrounding the use of parameters, such as elasticities of substitution that are essential in the calibration of most, if not all, CGE models.

This uncertainty arises from the fact that often the parameter values used by modellers are obtained from econometric studies that either have aggregated their data differently than the study's aggregation, have examined completely different issues than those pertaining to the CGE modeller's study, and/or have been derived from a study researching a different country (Abdelkhalek and Dufour, 1998). If estimates from these sources are not available, then the researcher is forced to use all the available information in order to form a best guess of the estimate. As Harrison and Vinod state: "The elasticities used are invariably obtained from "coffee table conversations" (i.e. guesses) or econometric studies. In each case there are always some uncertainties as to the true elasticity value" (Harrison and Vinod, 1992). This uncertainty can be quite important in the choice of free parameters in CGE models, as the model results can be affected by relatively small changes in the parameters used (Wigle, 1991).

With the crucial role played by chosen parameters in these models, it is necessary for a researcher to conduct a sensitivity analysis in order to check the robustness of their results. Time and computational limitations are often cited as reasons for excluding this kind of analysis; these arguments will be revisited later on in this paper.

Arndt (1996) notes that sensitivity analyses in most large models are typically ad hoc in nature, with the researcher examining how the results are affected by the variation of "a relatively small, arbitrarily determined set of values for key exogenous variables." He argues that while this type of analysis provides some information on the effects of variations in these exogenous variables on model results, it is decidedly not as informative as an analysis that investigates the effects of various combinations of these exogenous variables (Arndt, 1996). The problem with this method is that these parameters can be carefully chosen by the researcher to potentially falsely add more credence to their findings.

Another limited type of sensitivity analysis included in some studies attempts to determine how sensitive the results are to the shocks imposed on the model. An example of this method is presented in Dixon et al (1991) where they include four sets of sensitivity results obtained by varying some of the base assumptions that present some degree of uncertainty. They look at the effect (i) of adding one percentage point to the growth rate of the world price of oil, (ii) of faster labour saving technological progress in the rail industry and (iii) of cost increases in the road industry (Dixon et al, 1991). In a world of uncertain oil growth prices and many other economic uncertainties, these types of sensitivity analyses are very important and relevant. Nonetheless, as necessary as this type of analysis is in determining the robustness of models in relation to their base assumptions, it does not determine if the results are variable, or not, to changes in the free parameters.

Hertel et al (1998) show how substitution elasticities in CES-based Armington functions influence terms of trade effects. As the elasticity of substitution with respect to imports increases, the terms-of-trade effect decreases. Terms of trade effects also depend on the elasticities of the other countries involved; they increase or decrease with size of the elasticity values chosen. Hertel et al are not alone in this critique of Armington elasticities; Taylor and von Arnim (2006) suggest that the Armington elasticities are "the most important and controversial parameters in LINKAGE/GTAP style trade models" and they criticize the World Bank for their use of elasticity values that are "too high". The higher elasticities can lead to underestimating negative terms of trade effects as a higher elasticity improves the responsiveness of trade flows to price changes, which subsequently implies that other macro-economic variables require less adjustment (Taylor and von Armin, 2006). Thus, the results of a policy shock, such as trade liberalization, can be influenced by the choice of these elasticities. This fact should alarm the users of CGE results when a sensitivity analysis or information regarding the uncertain parameters is not included. Alternatively, as DeVuyst and Preckel (1997) point out that "Explicit recognition of the uncertainties regarding these assumptions and evaluation of the robustness of model results can only help to increase the credibility of their conclusions". Thus, sensitivity analysis is necessary in CGE modelling in order to answer some of the main criticisms surrounding CGE models. This leads to higher confidence with the results not only from modellers, but also by those who will ultimately use the results derived from these models, such as politicians, development organizations, and other policy makers.

The uncertainty surrounding the parameters used in CGE analysis, and its obviously consequential influence on model results, has led to the development of different methods of performing sensitivity analyses in order to determine the robustness of the parameters used in modeling. The most often cited sensitivity analyses methods in the literature are those in Wigle (1991), Abdelkhalek and Dufour (1998), Arndt (1996), DeVuyst and Preckel (1997), Domingues et al (2008), and lastly Harrison and Vinod (1992).

The objective of this study is to perform some sensitivity analyses on the results of labour market policy reforms in Turkey using a CGE model developed by Telli, Voyvoda and Yeldan (2006). Labour market reform is one of the important economic reforms that Turkey must undertake before joining the European Union. Several studies have been carried out to assess the implications of these reforms on the Turkish economy using CGE models. Unfortunately, these models did not carry out any systematic analysis of their results. As the behavioural parameters are critical to the outcome of these models, we believe that some sensitivity analysis on the results of these models over the most critical parameters must be performed.

The remainder of this paper is organized as follows. The next section, discusses the main methods of sensitivity analysis in CGE models found in the literature followed by background information regarding the informal labour market in Turkey. The fourth section provides a cursory review of the CGE model developed by Telli, Voyvoda and Yeldan (2006). In the fifth section, we discuss the methodology used in this paper to perform the sensitivity analysis, followed by the discussions of the results. The last section concludes.

2. Introduction to sensitivity analysis methods

With the main goal of this paper being the implementation of a sensitivity analysis, it is appropriate to provide a definition of what exactly this entails as well as some reasons behind its necessity. The objective of sensitivity analysis is to establish how sensitive the model results are to variations in parameter values or to other model values. Determining how changes in parameter values affect results is useful in assessing the model as well as in providing modellers with some extra credibility, with regards to their results.

Some parameter values tend to change over time, a fact that alone creates some uncertainty surrounding the parameter's value. Determining the sensitivity of the model to variances in the parameter values, will permit the researcher greater flexibility when choosing how accurate the parameter must be in order to perform an evaluation. For example: estimates may be used instead of very precise values if the model is found to be insensitive to parameter changes, thus decreasing the time and data necessary to determine extremely precise parameters (Breierova and Choudhari, 2001). This is important since most parameters are in fact estimates and not extremely precise values. Thus, the model results given an insensitive model will not vary very much in function to variations in the parameter values.

2.1 Review of the different methods of sensitivity analysis

2.1.1 Harrison and Vinod (1992)

This method involves dividing the distribution, with the assumption that the modeller can obtain an *a priori* distribution for the model parameters, into K equal probability intervals, where the mean of each range is then used as its representative value. A joint probability set is built by combining all the possible parameter combinations where its size is dependent on the number of parameters included and intervals used. For example, in order to conduct a full analysis of m parameters, K^m solutions of the model are required. Each parameter configuration, assuming independent distributions between the parameters, is assigned an equal probability, that is $1/K^m$. Since K^m can be quite a large figure, thus implying a large number of solutions of the model, the authors employ a completely randomized factorial design in order to select a subset of the possible parameter configurations necessary to compute the analysis. Note that this Monte Carlo method consists of sampling with replacement, thus creating the possibility of sampling the same parameter configuration more than once.[1] This model is subsequently solved using the configuration parameters chosen in the sub-sample.

The authors note that the main advantage of this method is that the sample mean is an unbiased estimator of the population mean. As well, an asymptotically consistent estimator of the population mean can be achieved by using the Law of Large Numbers. DeVuyst and Preckel acknowledge that the sampling process of this method is able to "avoid the curse of dimensionality that plagues unconditional systematic sensitivity

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[1] The authors state that this is a remote possibility.

analyses". On the other hand, they find that this method tends to understate the parameter distributions' variance along with all other even numbered exponent moments. This understating is blamed on the random sample that is drawn from the Cartesian product. They state that this random sample does not approximate the moments of the joint distribution, but approximates instead the moments of the Cartesian product. Therefore, this causes not only an understatement of parameter variability in Harrison and Vinod's method, but leads to a bias in the model sensitivity (DeVuyst and Preckel, 1997).

This method has been used in several sensitivity analyses: in Rüstrom (1991), Harrison, Rutherford and Wooton (1991) and Harrison, Tarr and Rutherford (1996) among others.

2.1.2 Arndt (1996)

Arndt is the leader in the use of Gaussian Quadratures when selecting points for the sensitivity analysis, which is an alternative method to using Monte Carlo. This method consists of applying weights to the selected points. Monte Carlo and Gaussian Quadrature are two methods of numerically evaluating the integral, which can be typically represented as: $\sum_{j=1}^{j} w_j f(x^j)$, where J is the total number of evaluations of the function and w_j is the weight attached to each evaluation. In the case of Monte Carlo, the integrand is calculated J times using the J pseudo-random numbers derived from the distribution of the parameter, each with a 1/J attached weight. Arndt notes that this method's approximation is fine with a large the number of evaluations. Gaussian Quadrature is a useful alternative to using Monte Carlo when the integrand requires an excessive amount of calculations. This method allows for a smaller number of evaluations by selecting points with appropriate weights. These weights and points are chosen using mathematical formulas created for this purpose. The following formula, named the Stroud formula, is an example of one used to calculate "equally weighted, order three quadratures for symmetric, independent distributions of mean zero and standard deviation one"

$\gamma_{2r-1} = \sqrt{2}\cos\left[\frac{(2r-1)k\pi}{n}\right] \quad \gamma_{2r} = \sqrt{2}\sin\left[\frac{(2r-1)k\pi}{n}\right]$, where n is the number of exogenous variables, where r = 1,2,...,n/2, and where Γ_k $(\gamma_{k1},\gamma_{k2},\ldots,\gamma_{kn})$ is the k^th quadrature point (k=1,2,...,2n).

Other formulas have been devised for different orders of approximation, as well as for situations where the distributions are asymmetric; Arndt comments that these can be found in detail in Preckel and Liu (1995). The cost of conducting this method increases with the increase in the complexity of the calculation, such as with higher orders. When conducting sensitivity analyses in large models, the Stroud formula presented above is described as being the easiest in its implementation.

2.1.3 DeVuyst and Preckel (1997)

DeVuyst and Preckel acknowledge that, with the exception of their point selection process, their approach of conducting sensitivity analysis is quite comparable to that of Harrison and Vinod (1992)'s which is used for independently distributed parameters. One main difference between the two methods is that instead of using a Monte Carlo method in determining the points to use in the sensitivity analysis, they use Gaussian quadrature in order to obtain the points as well as weights necessary. The model is then evaluated for all the derived points.

Given that the main reason for conducting sensitivity analysis is ensuring model robustness and since, as previously stated, often the researcher must rely on elasticities taken from studies or even best guesses, there must be a process of dealing with this uncertainty. One problem that arises from this uncertainty is the fact that not only is the point estimate a guess, but the variance or range of this elasticity might also be quite uncertain if not entirely unavailable in the literature. DeVuyst and Preckel offer a way of dealing with uncertain ranges. When conducting their analysis, the range of the uncertain elasticity value is an educated guess meaning that it is not based on statistical tools such as standard deviations but on standard economic theory. They deal with this situation by using the range of the elasticity and the point estimate they found in the literature, and impose a distribution upon this range, where the point estimate is set as the mode.[2]

In their study, DeVuyst and Preckel compare the different methods of sensitivity analysis; they compare a method mimicking Harrison and Vinod's, a Pagan and Shannon (1985) approximation, and a multivariate Gaussian quadrature of two, three and four degrees. In order to compare these methods it is necessary to build a "true" distribution that would have its own "true" mean and standard deviations. This is not really a "true" distribution, as creating one would be quite impractical, but instead a discrete distribution that resembles the "true" distribution.

The first step in creating this "true" distribution is to divide the range of the elasticity into three equally probable intervals. Then the conditional mean of each of these three parts is calculated. Since these three points are equally probable, with a probability of 1/3 each, these represent the true discrete distribution of the elasticity in question. The final step in forming this "true" distribution is in taking the Cartesian

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[2] They use a triangular distribution around this PE. (as further explained in the section on distributions)

product of the discrete distributions. The model is then evaluated at each point of the "true" distribution, each being evaluated twice: once to determine baseline levels and the second to determine the effects of the intended shock. These values together comprise the joint distribution of the change, from which the true mean and standard deviation are calculated. These two values will allow comparison with the different sensitivity analysis methods in order to determine which method is able to best represent the analysis.

DeVuyst and Preckel's first method is a Multivariate Gaussian quadrature (MGQ) method with eight, twelve and 31 points, where the eight-point approximation uses first and second moments, twelve-point uses first, second and third moments, and finally the 31-point method uses all these moments plus the fourth moments. Their second method is similar to Harrison and Vinod's with 64 points, where the elasticity is divided into two equi-probable regions. Their third method is a Pagan and Shannon second-order approximation. Each analysis is performed and then compared to the true results. Chebyshev's inequality is the approach used to determine the confidence bounds on the mean.

2.1.4 Wigle (1991)

Wigle proposes a method that approximates Pagan and Shannon (1985)'s sensitivity analysis method. First of all, a conditional systematic sensitivity analysis (CSSA) is performed, where a CSSA entails keeping all elasticities at their point estimate but one elasticity, which is varied from its point estimate. This process is repeated with each uncertain elasticity, lowering and increasing its value by 1.4 standard errors. This allows the author to determine which elasticities have the biggest impact on model results. The biggest impact elasticities are then included in a more complete sensitivity analysis: an unconditional systematic sensitivity analysis (USSA). A USSA is performed by independently varying all the elasticities of the model, for a selected number of standard errors, and solving the model for these different variations. Wigle uses five different values for the elasticities: the mean, the mean ± 0.7 standard errors and the mean ± 1.4 standard errors. Since it would still take exorbitant amounts of time and computer power to perform a full USSA[3], Pagan and Shannon have developed a method of approximating values of the elasticity vector included in the USSA but not the CSSA. Pagan and Shannon have devised a method of approximating the first derivatives of the model results derived from the CSSA results. The results of elasticities included in the USSA but not in the CSSA are then estimated, thus providing the researcher with greater results while using less time and points.

Wigle elaborates on Pagan and Shannon's method, using instead the different sizes of perturbations, which is the difference between the varied elasticity and the central case elasticity, in his formulae. He concludes that this method is capable of performing an accurate sensitivity analysis, with values very similar to those produced by a full USSA "in minutes versus days".

2.1.5 Domingues, Haddad and Hewings (2008)

Here, the authors conduct a sensitivity analysis focusing on two parameters: (i) the elasticity of substitution between domestic and the composite import and (ii) the elasticity of substitution between imports from different sources. Since the uncertainty surrounding these values is fairly high, they set a range of ±50%[4] around the default

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[3] Number of calculations necessary of a USSA for a model with K values for each m elasticities: K^m

[4] The authors acknowledge that this interval is an "ad-hoc and parsimonious hypothesis".

values (the point estimates taken from GTAP[5]) with a symmetric, independent, triangular distribution. The Gaussian Quadrature approach, which is included in the runGTAP software, is used in order to establish the confidence intervals for the main results. Following the compilation of the results, a 90% confidence interval is constructed using Chebyshev's inequality.

2.1.6 Abdelkhalek and Dufour (1998)

Often there is a lack, or minimal, amount of information available surrounding parameter uncertainty. It is admittedly difficult to measure parameter uncertainty with very little information about the parameter in question. Therefore, these authors attempt to solve this problem, by formulating two methods of developing confidence sets for the endogenous variables of the model: Wald-type and projection-based procedures.

The Wald-type procedure is an extension of the Pagan and Shannon procedure, where it makes use of a Wald statistic in creating a confidence set[6]. The algorithm necessary for its implementation can be found in extensive detail in their Appendix B. The basic method is to solve the model at the base case, compute the shock, then to re-evaluate the model with two modified parameter vectors (the original vector ± h)[7] for each element of the vector. Note that only one element is perturbed at a time, with the others kept at their original values. After each evaluation of the model partial derivatives are calculated which collectively determine the matrix necessary to compute the Wald-type statistic.

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[5] GTAP : global trade analysis project

[6] Much greater detail of these two confidence set procedures can be found on pages 522-525

[7] h can either be a fixed fraction of the element or of its standard deviation

The projection-based procedure, however, computes the upper and lower bounds of the confidence set with the aid of the Lagrangian multiplier method. This method is preferred to the first since Wald-type procedures are only asymptotically valid; this is not the case with this latter method that is valid even in finite samples. The algorithm necessary to compute this method is as follows: the model is used to compute the values of those parameters that are independent of the free parameters. The shock is then imposed on the model, where the free parameters and the dependently calibrated values are considered as extra variables. The model subsequently maximizes and minimizes those variables that are determined as being important to the modeller. The number of simulations necessary for this method is contingent on the number of confidence intervals of variables to be constructed.

2.2 Distributions

In most of these methodologies, the modeller is assumed to know *a priori* the distribution of the parameter. However, as previously stated, many of the parameter values found in the literature do not include bounds or distributions, and in second best scenarios come solely from knowledgeable guesses, where the modeller must decide which distribution is most appropriate for the parameter.

DeVuyst and Preckel decided, for example, to use a triangular distribution on their uncertain parameter since the use of normal and Student's t distributions do not allow the possibility of negative values, which is possible with the triangular distribution (DeVuyst and Preckel, 1997, p.180). In the case of very bare information, such as a possible elasticity range or possible elasticity estimate, which is quite common, Harrison and Vinod (1992) see the use of a uniform distribution as an appropriate method of dealing with this problem. The point estimate would be used as the mean and the uniform distribution would be symmetric around this point. The use of the t or normal distribution would be a better fit in cases where the value of elasticity has been taken from an econometric study, which included either the standard error or t values.

Domingues et al (2008) counter the problem of unknown parameter ranges by imposing a triangular distribution with a parameter range of ±50% around the mean. Harrison, Rutherford and Tarr (1996), using Harrison and Vinod's method, impose uniform distributions on a certain number of uncertain elasticities applying a ±50% range around the point estimator.

3. Informal labour market in Turkey

Given Turkey's ongoing accession discussions with the European Union (EU) and its requirement that Member States "transform undeclared work into regular employment" (Blanpain et al, 2006, p15), the large informal labour market in Turkey is an issue that must be addressed through policy changes.

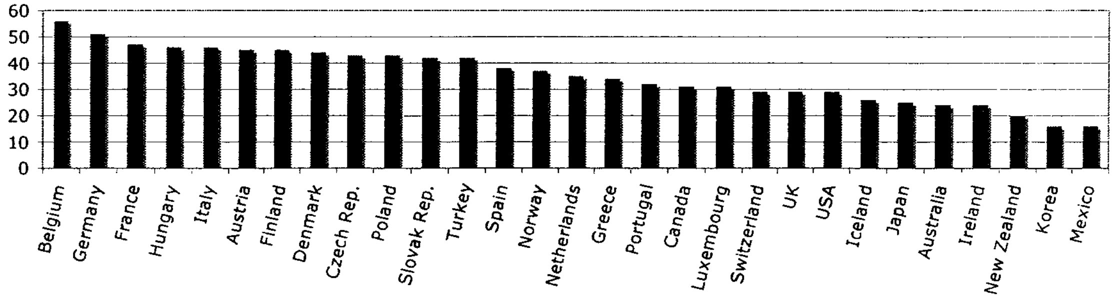
Authors define the informal labour market differently, however a common theme amongst these definitions is that it is "illicit or illegal activities by individuals operating outside the formal sphere for the purpose of evading taxation of regulatory burden" (Kar and Marjit, 2007). The negative consequence of lower tax collection due to tax evasion is not only reflected through lower tax revenues for the government, with a corresponding decrease in expenditures, such as social spending, but also on those companies and employees who are obeying the law and paying their taxes. These law-abiding firms must compete with the lower price of goods and services, while the law-abiding workers must compete with the low wages of the informal labour market (Gönenç et al, 2007).

The increased competition brought upon by market liberalization and globalization has forced firms to acquire a labour force that is flexible and that can easily be reassigned; which can adapt itself to market needs and conditions, be it for expansion or contraction with relatively little cost (Elson as cited in Beneria and Floro, 2004). The informal labour market is a means for firms to accommodate for this changing need of labour. Additionally, firms faced with greater competition are in need of methods of lowering their costs. This tends to translate itself either into the hiring of employees at the lowest possible wage, with the minimal amount of benefits possible, and/or into the outsourcing of their production (Özdemir, 2004). The informal labour market is then a viable option for firms wishing to decrease their labour costs; they are not subject to labour regulations such as minimum wage or maximum hours and they do not incur the enormous costs of paying employment taxes.

Turkey's very young and vibrant population have followed the trend found in many other countries, which is urban migration. The large population in the rural areas, where there is also a very high growth rate, migrates toward the larger cities in search of better employment and wages (Bulutay and Tasti, 2004). However, job growth is not keeping up with the amount of new job entrants. As well, the creation of jobs in highly competitive and intermediary activities has been inadequate in the absorption of both the large pool of new job entrants and of those who have lost their jobs in the declining sectors (Gönenç et al, 2007). The latter authors see this inadequate job growth in the formal sector as an indication that firms have been creating and shifting jobs into the informal sector (Gönenç et al, 2007).

The onerous employment taxes that both the employee and the employer must pay constitute a recurring argument justifying the increase in the informal labour market and is the focus of this paper's simulation. The World Bank declares that among the most cited reasons for businesses to pursue labour in the informal labour market, is excessive social security contributions and labour market regulations coupled with high tax burdens. If firms have the ability to transfer these social security contributions onto the employees, this tends to push these employees into informality in order to evade these extra costs. (World Bank, n.d.) Loayza, as surveyed by Saracoglu, finds that this informality occurs when a government that does not have the necessary enforcement capacities imposes excessively high taxes and regulations. The Tax Inspectors Board in Turkey have published that the inefficiency of the tax system, together with high tax rates and high social security premiums, lead to an increase in informal activity in Turkey (Saracoglu, 2008). The following graph demonstrates how Turkey's taxes compare to other countries.[8]

Figure 1: Income tax plus employee's and employers' social security contributions (as % of labour costs) 2002



When firms working within the law and using only formal labour carry the burden of these high taxes and co-exist with those utilizing informal labour successfully evade them, an unfair competition between these two groups is formed, as the firms employing

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[8] Source of data for this graph: OECD, Taxing Wages, 2002 (M00039058.pdf) from Taymaz and Özler (2004)

informal labour are able to avoid these higher costs. As well, the segment of law abiding firms that pay the tax burden are forced to endure an increasingly larger financial burden, which the Tax Board predicts will: "eventually cause a strain on the Social Security system" (Saracoglu, 2008). Although informal firms evade these taxes, and thus decrease their costs, there are still many costs associated to functioning within the informal labour market such as the inability to benefit from gains available only through the formal market. Examples of these missed gains are economies of scale and access to other essential resources, i.e., financing, which decreases these firms' chances of realizing potential productivity gains. This implies that, as a whole, the Turkish economy is not as productive as it might otherwise be if the informal labour market did not exist (Gönenç et al 2007).

4. The CGE model

The model used in this major paper is a Turkish model that comprises nine sectors: agriculture, mining, consumer manufacturing, producer manufacturing, energy, construction, private services and public services. An extremely detailed explanation of this model can be found in Telli, Voyvoda, and Yeldan (2006)'s "Modeling general equilibrium for socially responsible macroeconomics: Seeking for the alternatives to fight jobless growth in Turkey", as this model is the same as the one utilized in their article. The only major difference between these two models is that this paper has altered the original model transforming it from a dynamic model to a static model. This change was made because the purpose of this paper is not to determine the validity of a dynamic model but instead to determine the robustness of the model given the chosen values of the elasticities of substitution. Conducting a sensitivity analysis on a dynamic model would only lead to a more complex analysis, which is not the purpose of this paper. This simplification is not meant to undermine the inherent uncertainty related to parameters used in the dynamic process, such as growth expectations and others. Since these parameters are by definition predictions of future values, it may even be more important in some cases to conduct sensitivity analyses of these parameters.

This model is a real model in the sense that only relative prices matter and that there is no financial market. The data used in calibrating the parameters are derived from 2003 Turkish data sources such as the 2003 Input-Output table and the authors' own calculations[9]. In order to close the model there are certain elements that must be fixed in order to attain the appropriate closure of the model. In this model, public capital is sector specific and is assumed fixed, which means that once it has been used in one sector it cannot be used in another.

On the other hand, private capital is free to move between sectors and its use in these sectors depends on the relative differentiated private profit rates. There are two types of labour in this model, informal and formal, where the formal nominal wage rate is fixed and where quantity adjustments equilibrate the formal labour market. The unemployment level is derived from this quantity adjustment; where it is defined as the difference between the supply of formal labour and the demand of formal labour. These unemployed workers can move between the formal and informal labour market.

The production function in this model is a nested set of functions, which results in the production of the gross output of each sector. The first level is a Leontieff between value added and intermediate goods. Value added is a Cobb-Douglas combination of a composite input and of public capital. This composite input is a constant elasticity of

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[9] These are included in Telli, Voyvoda, and Yeldan (2006)

substitution (CES) function of labour and private capital. The lowest level is a disaggregation of labour, between informal and formal, with a CES function.

Closure of CGE models tends to follow four major closures: neo-classical, Kaldorian, Keynesian and Johansen. This model makes use of one of the more common closure rules; that of the neo-classical closure meaning that private investment is savings-driven. Additionally, since the number of single equations must equal the number of variables in order to ensure that a solution to the model exists (and not a situation of multiple solutions or alternatively where no solution exists), certain variables are fixed. For this reason, foreign savings and the exchange rate are fixed, with the exchange rate defined as the numeraire.

In their paper they present three different policy shocks, each building upon the previous shocks: a 5% decrease of the payroll tax, this decrease coupled with a 1% decrease of the sales tax, and the final shock is a combination of these shocks plus an increase of public investment to a ratio of 7% of GDP along with a decrease of the public savings to 3.5% of GDP. This paper follows their second shock as this also allows the verification of those who blame the high payroll taxes for the size of the informal labour market.

5. Sensitivity analysis methodology of this paper

Now that the reader is aware of the different methods of performing sensitivity analysis, the methodology used in this paper is presented in detail.

There are two major methods of point calculations found in the literature: the classic Monte Carlo method and the Gaussian Quadrature method. The most often cited problem with the Monte Carlo method is that of substantial computer capacity utilization, as a very large number of iterations are required in order to perform a sensitivity analysis. In the past, this may well have been a major limitation, as the computer memory capacity necessary in performing thousands of simulations took exorbitant amounts of computer memory and time. As a concrete example of this, Wigle (1991) notes that 125 simulations of his model required two hours of computational time. Remember that his paper was published in 1991. This no longer seems to be the case as 2500 simulations were performed in the same timeframe for this paper using a "batch" file that commands the program to continuously run until the desired number of simulations is attained. While it is true that computational capacity may be a constraint in certain situations, none can argue that the benefit of proving robustness of ones model –which can then be included in ones study to allay criticism - greatly outweighs the cost of running the model over a lunch break. Thus, this main argument can no longer be cited as a major problem given the incredible advancement of computational technology.

Due to the relative ease in using the Monte Carlo method, included in the CGE modeling programme GAMS, this method is the one favoured and used while conducting the sensitivity analysis in this paper.

5.1 Monte Carlo

A vector of possible points is constructed using the GAMS random point generator. The distribution of the parameter, as decided upon by the researcher, will generate different vectors of possible points. A vector derived from a uniform distribution will be different from the one derived from a normal distribution for example, due to their different statistical properties.[10] Another point that must be

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[10] GAMS has a normal and uniform random number generator.

decided pre-analysis is whether to vary every single elasticity (or chosen parameter) or to focus the analysis by only varying those which are believed to have the biggest effect on model results. The elasticities chosen for this study, as well as the explanation for their inclusion, are presented in the following section. The complexity of the sensitivity analysis can also be pre-determined, dependent on the number of sectors and elasticities. An example of a decision of complexity that presented itself in this analysis was whether or not to vary all the chosen elasticities per sector (i.e. each sector's elasticity would be varied independently simultaneously) or to simply vary the elasticities by maintaining one uniform elasticity for all the industries (i.e. if the elasticity of substitution is 2 for each industry the analysis would consist of varying this elasticity but keeping it the same for all sectors).

Due to the uncertainty surrounding all the chosen elasticities plus the fact that all the industries elasticities were initially set in the model to the same value, which realistically is most improbable, the elasticities of each industry were varied simultaneously. The fact that not all industries, most likely, exhibit the same elasticities of substitution precludes the option of simply varying a uniform elasticity for all industries.

Once this vector of points has been generated, the model is then solved to the desired number of simulations, where a larger amount of simulations is generally preferable. Previous sensitivity analyses performed with this Monte Carlo method have utilized varying number of simulations, for example, Harrison and Vinod (1992) solve their model 15,000 times in their paper, yet Harrison only uses 1000 simulations in his sensitivity analysis of a Turkish customs union with the EU (Harrison et al, 1997). From this, it can be assumed that 1000 simulations must be large enough to access the Law of Large Numbers discussed in Harrison and Vinod (1992). Dissou (2005)'s sensitivity analysis utilizes 2500 simulations of the model. The number of simulations decided upon in this paper is 2500. This is mainly due to the limited time necessary in performing these simulations; where the marginal cost of performing the extra 1500 simulations is less than an hour. These simulations are performed with the policy shock of lowered tax rates, where the results obtained represent variations in percentage from the baseline case, i.e. the situation without the policy shock. Every solution of the model is treated as an equi-probable result of the model due to the randomness of the chosen points. Following the calculation of these 2500 runs, the results of the chosen dependent variables are then analyzed statistically, where statistical measures such as the mean, the standard error, the standard deviation, and a confidence level are calculated.

5.2 Statistical measures and confidence intervals

There exist many statistical programmes for calculating statistical measures, where Excel is a programme widely used for this purpose. The raw data of the 2500 simulations are copied into Excel worksheets where the mean, mode, median, standard error, standard deviation, maximum and minimum, and sample variance are computed. For the purpose of this paper, only the mean and the standard deviation are included. [11]

Different methods of placing confidence intervals on the dependent variables have been proposed. One often cited method is that of Chebychev's inequality. A confidence level of 95% is a common level and is used by many when conducting sensitivity analysis, such as in Hertel et al (2006). Domingues et al (2008) resort to a larger

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[11] The rest of these statistical measures can be obtained by request.

confidence interval or 90%, which seems moderately large and could most likely be reduced to 95% without excluding any of the central case results, allowing for a stronger argument relating to the robustness of results. A 95% confidence level is the level chosen in this paper.

5.3 The elasticities

There are three elasticities of substitution used in the model: between domestic and imported goods, private capital and labour, formal and informal labour, and an elasticity of transformation between exports and the domestic supply of goods. Each of these elasticities has their own uncertainty due to the fact that, as previously stated, they are more often than not obtained either through studies which are not entirely related to the topic or country under investigation or through the researcher's best estimate given the available information.

Since this paper focuses on the informal labour market issue in Turkey and is thus interested in determining the applications of this model to analysis of this market, it is important to understand the possible mechanisms through which these four elasticities affect the informal market.

5.3.1 Elasticity of transformation between export and domestic supply

There is an academic debate surrounding the existence of a link between exports and the informal labour market, where an increase in exports leads to an increase in jobs in this market (Beneria and Floro, 2004). If this is indeed the case, having a different elasticity of transformation than the "true" elasticity may not allow the researcher to correctly analyze policies relating to this market. Another reason for including this elasticity is the informal labour markets relationship to the productive side of the economy. Since exports and domestic supply utilize native labour, their size directly affects the labour market. Thus, the elasticity of transformation between these two productive sectors can be very important in ensuring accuracy of the effects of any policy that can affect the labour market.

5.3.2 Elasticity of substitution between informal and formal labour

We believe that the inclusion of the substitution between informal and formal labour workers is required for this analysis. This elasticity is directly related to the informal labour market where different values will alter the size and importance of these two groups, which then affects other related concepts such as the relative wage. Considering the importance of the informal labour market in many developing countries, it is very surprising that there appears to be a lack of information related to this elasticity. The only value that could be found in the literature, is one of 0.3 (Rutherford and Light, 2001), a value which does not appear to be econometrically estimated nor does it include standard deviations, nor does it seem relevant to any particular country. Note that the problem is not that this is the only for Turkey, but that this is the sole elasticity mentioned in the literature.

5.3.3 Elasticity of substitution between capital and labour

Similarly, the elasticity of substitution between capital and labour is important in any policy related to the labour market. The relative ease of substitution between these two factors can affect the magnitude of the repercussions of policies and shocks on the labour market and hence the informal labour market.

5.3.4 Elasticity of substitution between imports and domestic demand

This elasticity is fixed in every simulation since there is no economic reason for its inclusion in the analysis; its value is set throughout the analysis at a value of two. A change in its value should realistically not have much of an effect on the labour market, as it is not related to the productive section of the economy.

One fact became apparent during the search for elasticities in the literature; either there were no elasticities available for the country in question, or if they were available, most did not include the standard deviations of these elasticities. This poses somewhat of a problem, as a more accurate sensitivity analysis can be performed when the standard deviations are known. The reason for this increased accuracy is obvious when looking at the statistical properties of this distribution, as a greater number of the chosen points will be found nearer to the point estimate compared to a uniform distribution, which would assume equi-probable points in its whole range. Due to the lack of information relating to these elasticities and to their standard deviations, this sensitivity analysis utilizes a very simple upper and lower bound of ±50%. This basic interval may seem fairly ad hoc but it has a history of use by other researchers such as Harrison, Rutherford and Tarr (1996) and by Domingues et al (2008) when conducting sensitivity analysis and is, as an alternative to finding ones' own elasticities, an acceptable compromise, given the available information.

5.4 Variables included in this analysis

In sensitivity analyses, it is common practice to select certain dependent variables from all the model variables when analyzing the impact of varying the parameters. Not only would it be impractical to analyze the effects of the variance on every dependant variable, due to the extra time and effort necessary, but this lack of targeting would certainly not contain as much economic insight as it would have given a more select choosing. Variables included in this paper were chosen in order to ensure that the model results agree with economic theory. Thus those variables that economic theory assume will be affected, through the various transmission mechanisms, by the shock are included in the analysis. For example, the decrease in the payroll tax should have a direct positive effect on demand for labour and capital given that they are both normal goods. Thus, the inclusion of both demand for labour and capital are included in order to ensure that this relation exists. A benefit of this method of variable choosing is that if in fact the model results are not robust it can be easier for the modeller to detect the location of possible model problems.

With this targeting in mind, the following variables are reported in the simulations: demand for capital, for formal and informal labour and for value added, government consumption and public investment, supply of exports and of domestic goods, private income, and the prices: of goods, of value added and of the return of capital. As well, some aggregate variables are included such as the various different taxes, the revenues to the government as well as to social security, followed by GDP.

6. Sensitivity analysis

6.1 Central case analysis

The first step of a sensitivity analysis is to run the model once with the central case values. In this situation the elasticities of substitution between informal and formal labour, between imports and domestic goods, and between export supply and domestic sales are set at a value of two, while the elasticity between capital and labour is set at 0.4.

The goal of this paper is not to criticize the use of these values but rather to determine the robustness of the results given these values.

This paper follows the second shock presented in Telli, Voyvoda and Yeldan (2006); that of a decrease in the payroll tax from its value of 19% to 14%. Note that this is a decrease of the payroll tax paid by employers, with a concomitant decrease in the sales tax by 1%. In their paper these tax changes lead to an increase of private consumption, as well as an increase in the share of formal employment in relation to total employment, while public investment falls in relation to GDP. Divergent results from those presented in their paper may imply a problem with the application of the model. Thus the following section consists of reviewing the transmission mechanisms through which the decrease in the payroll tax would affect the economy, followed by the role of the decrease in the sales tax on the economy. The results of the central case situation are presented in Table A of the appendix.

The decrease in the payroll tax implies a decrease in production costs for firms. Since both capital and labour are normal goods, this decrease in costs should lead to an increase in the demand of these two inputs (as both these inputs are used to produce a composite input with a CES function, which leads to an increased demand in value added). This increased demand of value added is present in every sector, with the exception of the construction sector.

This taxation policy shock was introduced with the main intent of increasing the use of formal labour, thus decreasing firms' demand for their counterparts in the informal market. The decrease in payroll tax decreases the relative cost of hiring formal labour which should lead to a substitution towards this now relatively cheaper input. There is, in fact, a decrease in the demand for informal workers found in every sector, to varying degrees, where firms substitute informal labour for formal labour.

The decrease in the sales tax implies a reduction in the price of goods paid by consumers, where consumers include households as well as firms using goods for intermediate uses. As expected, this price decrease leads to an increase in consumption and since demand for domestic goods must equal the supply of domestic goods, this also leads to an increase in domestic supply.

The joint effect of decreasing these two taxes has a negative impact on government revenues and social security revenues, as the increase in consumption and in the demand of formal labour is not sufficient in counterbalancing the decreased revenue from the lowering of the tax rates. The government, confronted with lower revenues, must decrease its expenditures which it does by reducing its public investments as well as its own consumption. Since GDP is defined as being the sum of consumption, of investment and of net exports, this decrease in public investment and consumption leads to a lower level of GDP than its previous pre-shock level. As well, though it is not apparent in the model, there are future economic ramifications from the reduction in the provision of public goods. Thus, this central case simulation replicates similar results to those of Telli, Voyvoda, and Yeldan (2006) where slightly differing results are most likely due to this paper's usage of a static model instead of their dynamic model.

The next step is to ensure robustness of the results, especially since there is a lot of uncertainty regarding some of the parameters used in the analysis. The next section attempts to answer the question of whether or not the results are robust.

6.2 Results

The fundamental question that a sensitivity analysis tries to answer is whether or not the model results are robust, even when faced with different parameter values. Tables B illustrate the central case results compared to the upper and lower bounds of the 95% confidence interval of the dependent variables resulting from our Monte Carlo experiment. First step is to determine if the central case results are bound between the upper and lower confidence bound. This comparison is done with every result obtained from the analysis, meaning that is done with every sector and from every dependent variable analyzed in this paper.

Following this, the qualitative and quantitative robustness of the model is verified. All of the central case results are bound between the higher and lower confidence bounds of the sensitivity mean, with 95% confidence.

Equivalent lower and upper confidence signs imply qualitative robustness, as the effect of the simulation on the variable is not affected by changes in elasticity values. Alternative signs similarly imply that the effect on the variable depends on the value of the elasticities used, which can be a major problem when conducting policy analysis. During this sensitivity analysis, all of the lower and upper bounds do correspond in sign with the notable exception of demand for private capital. This means that demand for private capital will increase or decrease depending on the elasticity values. Thus, this variable is very sensitive to changes in these parameters and therefore it is not robust and should be carefully evaluated. As well, equivalent signs for the other variables' intervals imply that these variables are qualitatively robust. Qualitative robustness is very important in ascertaining the robustness of the model.

Quantitative robustness is determined through the dispersion of the variable results. One method of determining quantitative robustness is by looking at the variables' coefficient of variation. This value is calculated by dividing the standard deviation by the mean. The use of the coefficient of variation is not without its problems. Its value can be misleading when the mean of the variable is near to zero and the variable includes both positive and negative values (UCLA, n.d.). This situation occurs in the case of a few variables such as demand for capital (agriculture, mining, intermediate and producer manufacturing, energy and private services), demand value added (agriculture), and supply of exports (agriculture and public services).

As well, it is only in the case where the variable values are entirely positive that the coefficient of variation can be used as a logical measure (UCLA, n.d.). Thus, the coefficient of variation of those variables that include negative values can also be misleading. This occurs in the demand for value added and domestic supply (construction), demand for informal labour, and government consumption (except for public services).

It is interesting to note that there is much more variability in the sectoral variables than in the aggregate variables. The coefficient of variation of the aggregate variables varies from 0.00 to 0.01, implying an extremely minute variation. On the other hand the sectoral variables have a greater variation, which means that the values derived from altering the elasticity of substitution may be slightly different. Certain variables seem to be much more sensitive than others. An example of this sensitivity is in the case of demand for private capital. There may be various reasons for this sensitivity. For example, perhaps the low value of the central case elasticity of substitution between capital and labour of 0.4 does not allow for a much lower value, leading to a change in the combination of these goods to a more Leontief perfect complement combination.

Thus, the values of the model are robust qualitatively, with the exception of demand for private capital, and as well they are for the most part relatively robust quantitatively. This should be taking into account when performing analyses using this model with very uncertain parameters.

7. Conclusion

Due to increased criticism surrounding the use of CGE models, coupled with their rising importance in economic research, it is important that researchers be able to prove the robustness of their results. This is especially essential when the results produced by this model are used to influence government policies or decisions. Non-robust results may lead to conclusions that do not accurately reflect the situation. Sensitivity analysis allows the researcher to allay the fears that their results can only be obtained through these certain scenarios and thus their model can be used to analyze various policy shocks regardless of uncertain parameters. Uncertain parameters, such as elasticities of substitution, are the norm rather than the exception in CGE analysis. Thus until researchers can be certain of these parameters, for example through more extensive research, sensitivity analysis must be performed in order to gain and maintain credibility in the economic policy world. Robust results provide the researcher with a strong compelling argument against criticisms coming from end-users, such as politicians and organizations, or from other academics.

This increased credibility is important when attempting to simulate policy shocks that have real effects on the economy, as the example of attempting to affect the informal labour market in Turkey. Excessive payroll taxes in Turkey are a major determinant of the size of the informal labour market, thus the need for a robust model with which to perform counterfactual experiments in order to determine its effects on this market is essential. In this case, the five percent decrease of the payroll tax coupled with the one percent decrease in the sales tax has noticeably affected the demand that firms have for informal labour. Different scenarios attempting to alter this market, such as those performed by Telli, Voyvoda and Yeldan and Saracoglu (2008), can now be performed with the assurance that its results are relatively robust, also assuring its use in influencing policy.

With the innovation of computers equipped with extremely fast processors, conducting sensitivity analysis is no longer as cumbersome as it was in the past. As previously stated, in our study, 2500 simulations took a mere 1.25 hours to complete. The improvements of computer technology imply that the time of computation necessary to complete these analyses has gone from days to mere hours. As well, the ease of computing statistical measures has improved drastically; many programmes are now capable of determining these measures, along with confidence intervals, with the simple click of a button. Thus, the difficulty and time associated with sensitivity analysis should no longer be viewed as major hurdles in their application, as most definitely was the case in the past.

A very profound and relevant quote is cited in Harrison (1992) from Leonard Savage: “Do research for your enemies, not your friends”. Parameter uncertainty is one of the greatest criticisms surrounding the use of CGE models, thus if all users of CGE studies included sensitivity analyses which proved model robustness, this claim would no longer be appropriate and the credibility (and perhaps the use) of this field would increase substantially.

Appendix of results

Table A: Central case results

	Agriculture	*Mining*	*Consumer manufacturing*	*Intermediates manufacturing*	*Producer manufacturing*	*Energy*	*Construction*	*Private Services*	*Public Services*
Consumption	0.99	1.62	2.01	1.23	1.25	1.31	-0.56	0.84	1.2
Demand for capital	0.21	0.75	1.29	0.6	0.39	0.5	-1.75	-0.19	0
Demand for informal labour	-1.99	-9.28	-8.16	-8.78	-8.98	0	-11.47	-7.93	0
Demand for formal labour	13.78	5.32	6.62	5.9	5.67	3.87	2.78	6.89	1.64
Demand value added	0.71	2.29	2.58	1.71	1.38	2.45	-0.56	0.66	0
Government consumption	-4.27	-2.94	-2.75	-2.75	-2.97	-2.64	-2.77	-3.8	1.2
Price of domestic goods	1.36	-0.26	-0.4	-0.4	-0.08	-0.37	-0.21	0.82	-4.13
Public investment	-10.41	0	-8.99	-8.98	-9.19	0	-9.01	-9.96	0
Price of exports	0	0	0	0	0	0	0	0	0
Price of goods	0.34	-1.04	-1.23	-1.24	-1.01	-1.35	-1.21	-0.16	-5.09
Price of value added	2.4	-0.17	0.44	0.87	1.15	-1.2	0.58	1.5	0
Supply of domestic goods	0.83	2.05	2.16	1.5	1.33	1.32	-0.55	0.79	1.2
Supply of exports	-1.86	2.59	2.97	2.32	1.48	2.06	0	-0.84	0

Aggregate variables

Price of return of capital	*Private income*	*Sales tax*	*Production tax*	*Payroll tax*	*Social Security tax*	*Corporate tax*	*Household tax*	*Public sector factor income*	*Social security revenue*	*GDP*	*Govt. revenue*
3.6748	0.8626	-5.905	0.4817	-3.7177	0.4197	0.3013	0.2447	0.0768	-3.2982	-0.442	-4.781

Note that all these results are variations in percentage from the base case.

Tables B: Descriptive statistics and confidence bounds of the sensitivity analysis

Consumption

	Agriculture	*Mining*	*Consumer manufacturing*	*Intermediates manufacturing*	*Producer manufacturing*	*Energy*	*Construction*	*Private Services*	*Public Services*
Mean	0.98	1.61	2.00	1.22	1.24	1.31	-0.56	0.84	1.20
Standard Deviation	0.15	0.14	0.12	0.14	0.16	0.13	0.17	0.13	0.08
Coefficient of Variation	0.15	0.09	0.06	0.12	0.13	0.10	-0.31	0.16	0.07
Confidence level: low	0.67	1.35	1.77	0.97	0.96	1.08	-0.87	0.61	1.05
Confidence level: high	1.25	1.86	2.23	1.47	1.52	1.53	-0.26	1.06	1.35
Central Case	0.99	1.62	2.01	1.23	1.25	1.31	-0.56	0.84	1.20

Demand for private capital

	Agriculture	*Mining*	*Consumer manufacturing*	*Intermediates manufacturing*	*Producer manufacturing*	*Energy*	*Construction*	*Private Services*	*Public Services*
Mean	0.21	0.75	1.28	0.60	0.38	0.49	-1.75	-0.19	0.00
Standard Deviation	0.21	0.51	0.40	0.37	0.38	0.59	0.39	0.09	0.00
Coefficient of Variation	0.99	0.68	0.32	0.62	1.00	1.21	-0.23	-0.45	n/a
Confidence level: low	**-0.22**	**-0.21**	0.53	**-0.13**	**-0.36**	**-0.59**	-2.51	-0.34	0.00
Confidence level: high	**0.61**	**1.67**	2.00	**1.27**	**1.07**	**1.54**	-1.05	-0.03	0.00
Central Case	0.21	0.75	1.29	0.60	0.39	0.50	-1.75	-0.19	0.00

Demand for formal labour

	Agriculture	*Mining*	*Consumer manufacturing*	*Intermediates manufacturing*	*Producer manufacturing*	*Energy*	*Construction*	*Private Services*	*Public Services*
Mean	13.82	5.31	6.57	5.86	5.68	3.86	2.74	6.79	1.64
Standard Deviation	3.78	0.73	0.88	0.94	0.97	0.49	0.74	1.46	0.11
Coefficient of Variation	0.27	0.14	0.13	0.16	0.17	0.13	0.27	0.22	0.07
Confidence level: low	7.70	3.92	6.30	4.71	3.86	2.95	1.36	4.20	1.44
Confidence level: high	20.91	6.70	6.66	6.63	7.52	4.72	4.15	9.63	1.84
Central Case	13.78	5.32	6.62	5.90	5.67	3.87	2.78	6.89	1.64

Demand for informal labour

	Agriculture	*Mining*	*Consumer manufacturing*	*Intermediates manufacturing*	*Producer manufacturing*	*Energy*	*Construction*	*Private Services*	*Public Services*
Mean	-2.04	-9.24	-8.09	-8.66	-8.97	0.00	-11.36	-7.77	0.00
Standard Deviation	0.98	3.83	3.38	3.42	3.45	0.00	3.62	2.27	0.00
Coefficient of Variation	-0.48	-0.41	-0.42	-0.40	-0.38	n/a	-0.32	-0.29	n/a
Confidence level: low	-3.98	-16.16	-14.29	-15.13	-15.21	0.00	-18.29	-11.64	0.00
Confidence level: high	-0.35	-2.94	-2.41	-2.89	-3.18	0.00	-5.42	-3.85	0.00
Central Case	-1.99	-9.28	-8.16	-8.78	-8.98	0.00	-11.47	-7.93	0.00

Demand for value added

	Agriculture	*Mining*	*Consumer manufacturing*	*Intermediates manufacturing*	*Producer manufacturing*	*Energy*	*Construction*	*Private Services*	*Public Services*
Mean	0.69	2.28	2.56	1.71	1.38	2.44	-0.56	0.65	0.00
Standard Deviation	0.19	0.25	0.19	0.19	0.25	0.24	0.17	0.15	0.00
Coefficient of Variation	0.27	0.11	0.07	0.11	0.18	0.10	-0.31	0.23	n/a
Confidence level: low	0.31	1.80	2.21	1.34	0.90	2.01	-0.87	0.39	0.00
Confidence level: high	1.02	2.70	2.93	2.04	1.79	2.86	-0.26	0.92	0.00
Central Case	0.71	2.29	2.58	1.71	1.38	2.45	-0.56	0.66	0.00

Government consumption

	Agriculture	*Mining*	*Consumer manufacturing*	*Intermediates manufacturing*	*Producer manufacturing*	*Energy*	*Construction*	*Private Services*	*Public Services*
Mean	-4.28	-2.94	-2.76	-2.75	-2.98	-2.64	-2.78	-3.80	1.20
Standard Deviation	0.16	0.11	0.12	0.11	0.12	0.10	0.13	0.12	0.08
Coefficient of Variation	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.05	-0.03	0.07
Confidence level: low	-4.62	-3.14	-2.96	-2.95	-3.18	-2.76	-3.01	-4.01	1.05
Confidence level: high	-4.00	-2.65	-2.55	-2.55	-2.77	-2.53	-2.56	-3.59	1.35
Central Case	-4.27	-2.94	-2.75	-2.75	-2.97	-2.64	-2.77	-3.80	1.20

Price of goods

	Agriculture	*Mining*	*Consumer manufacturing*	*Intermediates manufacturing*	*Producer manufacturing*	*Energy*	*Construction*	*Private Services*	*Public Services*
Mean	0.34	-1.04	-1.23	-1.24	-1.01	-1.35	-1.21	-0.16	-5.09
Standard Deviation	0.17	0.01	0.06	0.04	0.03	0.06	0.06	0.05	0.03
Coefficient of Variation	0.49	-0.01	-0.05	-0.03	-0.03	-0.04	-0.05	-0.31	-0.01
Confidence level: low	0.03	-1.06	-1.36	-1.31	-1.07	-1.47	-1.32	-0.25	-5.14
Confidence level: high	0.66	-1.02	-1.12	-1.17	-0.94	-1.24	-1.09	-0.06	-5.04
Central Case	0.34	-1.04	-1.23	-1.24	-1.01	-1.35	-1.21	-0.16	-5.09

Price of value added

	Agriculture	*Mining*	*Consumer manufacturing*	*Intermediates manufacturing*	*Producer manufacturing*	*Energy*	*Construction*	*Private Services*	*Public Services*
Mean	2.41	-0.17	0.44	0.86	1.15	-1.20	0.58	1.51	0.00
Standard Deviation	0.24	0.07	0.06	0.08	0.09	0.08	0.09	0.06	0.00
Coefficient of Variation	0.10	-0.38	0.14	0.09	0.08	-0.07	0.15	0.04	n/a
Confidence level: low	1.95	-0.30	0.33	0.72	0.98	-1.35	0.41	1.40	0.00
Confidence level: high	2.88	-0.05	0.56	1.02	1.33	-1.04	0.76	1.62	0.00
Central Case	2.40	-0.17	0.44	0.87	1.15	-1.20	0.58	1.50	0.00

Private Income

Mean	0.86
Standard Deviation	0.11
Coefficient of Variation	0.12
Confidence level: low	0.67
Confidence level: high	1.05
Central Case	0.86

Return of capital

Mean	3.67
Standard Deviation	0.20
Coefficient of Variation	0.05
Confidence level: low	3.29
Confidence level: high	4.06
Central Case	3.67

Public investment

	Agriculture	Mining	Consumer manufacturing	Intermediates manufacturing	Producer manufacturing	Energy	Construction	Private Services	Public Services
Mean	-10.42	0.00	-8.99	-8.99	-9.20	0.00	-9.01	-9.97	0.00
Standard Deviation	0.16	0.00	0.09	0.09	0.09	0.00	0.10	0.09	0.00
Coefficient of Variation	-0.02	n/a	-0.01	-0.01	-0.01	n/a	-0.01	-0.01	n/a
Confidence level: low	-10.76	0.00	-9.17	-9.14	-9.35	0.00	-9.19	-10.14	0.00
Confidence level: high	-10.14	0.00	-8.82	-8.83	-9.04	0.00	-8.84	-9.80	0.00
Central Case	-10.41	0.00	-8.99	-8.98	-9.19	0.00	-9.01	-9.96	0.00

Supply of domestic goods

	Agriculture	Mining	Consumer manufacturing	Intermediates manufacturing	Producer manufacturing	Energy	Construction	Private Services	Public Services
Mean	0.82	2.05	2.15	1.49	1.32	1.31	-0.56	0.78	1.20
Standard Deviation	0.17	0.21	0.13	0.16	0.22	0.13	0.18	0.13	0.08
Coefficient of Variation	0.20	0.10	0.06	0.11	0.17	0.10	-0.32	0.17	0.07
Confidence level: low	0.48	1.64	1.89	1.19	0.92	1.08	-0.87	0.56	1.05
Confidence level: high	1.11	2.40	2.40	1.77	1.68	1.54	-0.26	1.01	1.35
Central Case	0.83	2.05	2.16	1.50	1.33	1.32	-0.55	0.79	1.20

Supply of exports

	Agriculture	Mining	Consumer manufacturing	Intermediates manufacturing	Producer manufacturing	Energy	Construction	Private Services	Public Services
Mean	-1.87	2.58	2.94	2.32	1.48	2.06	0.00	-0.82	0.00
Standard Deviation	0.88	0.35	0.29	0.34	0.36	0.26	0.00	0.41	0.00
Coefficient of Variation	-0.47	0.14	0.10	0.15	0.24	0.12	n/a	-0.50	n/a
Confidence level: low	-3.70	1.93	2.42	1.70	1.48	1.61	0.00	-1.57	0.00
Confidence level: high	-0.39	3.28	3.50	3.00	2.11	2.55	0.00	-0.07	0.00
Central Case	-1.86	2.59	2.97	2.32	1.48	2.06	0.00	-0.84	0.00

Aggregate variables

	Sales tax	Production tax	Payroll tax	Social Security tax	Corporate tax	Tariffs	Household Tax	Public sector factor income	Social security revenue	GDP	Government revenues
Mean	23.05	32.71	11.57	8.72	9.97	1.02	28.61	20.91	20.29	369.13	116.28
Standard Deviation	0.03	0.04	0.06	0.05	0.01	0.00	0.16	0.03	0.11	5.08	0.12
Coefficient of Variation	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00
Confidence level: low	23.00	32.64	11.45	8.63	9.94	1.02	28.56	20.87	20.08	368.44	116.06
Confidence level: high	23.10	32.79	11.69	8.81	10.00	1.02	28.67	20.96	20.51	370.05	116.52
Central Case	23.05	32.72	11.57	8.72	9.97	1.02	28.62	20.92	20.29	369.26	116.29
Original value	28.96	32.23	15.29	8.30	9.67	1.00	28.37	20.84	23.59	369.70	121.07
Difference	-5.91	0.48	-3.72	0.42	0.30	0.02	0.24	0.08	-3.30	-0.44	-4.78

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