University of Connecticut

Department of Economics Working Paper Series

The Unofficial Economy and the Business Cycle: A Test for Theories

Catalina Granda-Carvajal
University of Connecticut and Universidad de Antioquia

Working Paper 2010-17

July 2010

341 Mansfield Road, Unit 1063
Storrs, CT 06269–1063
Phone: (860) 486–3022
Fax: (860) 486–4463
http://www.econ.uconn.edu/

This working paper is indexed on RePEc, http://repec.org/

Abstract

The shadow economy is an extensive phenomenon worldwide. It poses several questions, the consequences on fluctuations in economic activity being among the major ones. Based on official data, this paper establishes a set of cyclical properties of macroeconomic aggregates and studies how these vary across countries with the size of the unofficial sector. Through comparisons with the existing literature on business cycles in economies featuring underground activities, the obtained stylized facts are used to test the relevance of theoretical predictions on the influence of the shadow economy. Using this procedure allows to confirm that the evidence is not entirely of the sort suggested in business cycle models. In particular, some important macro aggregates and cyclical properties have been neglected in the analysis altogether, while others have been paid too much attention for no apparent empirical reason. Some possible avenues for future research can be drawn from this exercise.

Journal of Economic Literature Classification: E26, E32, O17, C82, C52

Keywords: Shadow economy, Business cycles, Model evaluation.

I would like to thank my adviser, Christian Zimmermann, for his comments and motivation. This paper has benefited from suggestions from seminar participants at the University of Connecticut and at the International Workshop Shadow Economy, Tax Policy, and Labour Markets in International Comparison: Options for Economic Policy, University of Potsdam, April 15-16, 2010. All errors are entirely mine. Financial assistance from Universidad de Antioquia is gratefully acknowledged.

1 Introduction

The informal, underground, shadow, irregular or unofficial economy comprises all otherwise value-added creating activities that are unregistered and/or unlicensed. As Fortin *et al.* (1997: 294) put it, firms in this type of an economy do not pay taxes such as corporate income taxes and social security contributions; they do not pay registration fees, nor are they subject to state regulations (including labor and environmental legislation). Moreover, informal sector workers do not pay income taxes on their informal wage income.[1] This is a substantial and increasing phenomenon worldwide, but especially in developing and transition economies. Indeed, Schneider (2005) reports that it represents an average share of 41% of GDP in developing countries, of 38% in transition economies, and of 17% in OECD nations.

The existence of a growing underground economy pose several questions, the consequences on macroeconomic and fiscal performance being among the major ones. Given the difficulty to observe and measure it, the shadow sector may introduce inaccuracies in the evaluation of the economic and social conditions of individuals, households, and countries (Frey & Schneider, 2001). For example, the system of national income accounting does not include the proceeds of unofficial activities, which may lead to mismeasurement of domestic output. Likewise, if one relies on the official statistics, the unemployment rate may hide an (unknown) number of apparently idle persons actually working and receiving wage income alongside, perhaps, unemployment benefits. Because policy makers conceive and implement economic measures based on essentially biased estimations, macroeconomic and social policies tend to be inappropriate or not well tuned.

A substantial body of literature has documented a wide range of empirical regularities in business cycles across countries. This literature has usually distinguished between developed and developing countries, with studies comparing the patterns observed in the two types of

[1]As such, this definition excludes unpaid private household production, voluntary non-profit (social) services and criminal activities.

economies (see Rand & Tarp, 2002, and Agénor *et al.*, 2000), in the understanding that differences in standards of living reflect in the features of fluctuations in economic activity. Regarding the unofficial sector, several methods have been used in an attempt to estimate time series of output and ascertain their comovements and symmetry with the official economy. While this line of research has focused on the interactions between both sectors, it has been the subject of criticism due to the inherent difficulty of obtaining accurate estimates of the extent of the shadow economy.

The present paper studies how the cyclical properties of macroeconomic aggregates in the official sector vary across countries with the size of the unofficial economy. Through comparisons with the existing literature on business cycles in economies featuring an underground sector, the obtained 'stylized facts' are in turn used to test the successfulness of current theories in predicting the influence of irregular activities on macroeconomic performance. While this exercise may serve to discriminate among alternative approaches, it can also be seen as an empirical basis for formulating new theoretical models accounting for the hidden economy.

The paper is divided into four sections, including this introduction. The second section distinguishes between the empirical and the theoretical contributions addressing the relation between the official and the unofficial sectors from a business cycle perspective, and describes the main strands of literature in this regard. Along with the methodological notes, preliminary comparisons and analysis on the consistency of current models with the empirical patterns found in this study are presented in the third section. Lastly, some general conclusions and further comments are provided, with a reference to possible avenues for future research.

2 A review of the literature

Few studies have tackled the relation between the unofficial and the official sector from a

business cycle perspective. Among these studies, there is one empirical approach focusing on the estimation of time series of hidden output. This empirical aproach contrasts with business cycle models featuring underground activities. Despite the lack of uniformity in the way how these models address the existence of a shadow economy, some common characteristics and tendencies can be identified as follows.

2.1 The unofficial business cycle approach

This approach involves the estimation of time series of underground output using either indirect methods (e.g., currency demand, electricity use) or modeling techniques (e.g., MIMIC). Based on the estimated series, the comovements between the unrecorded and the measured economy are ascertained, as well as some evidence regarding asymmetry issues.

Among the studies using this approach, Bajada (2003) and Giles (1997) provide evidence of a procyclical relationship between the two sectors in Australia during 1967-95 and New Zealand in 1968-94, respectively. In contrast, Russo (2008) shows that the cyclical component of the US GDP is negatively correlated with the cyclical component of the hidden output over the period 1960-2003, suggesting the existence of a 'double business cycle' in which peaks of the official sector coincide with troughs of the unofficial sector and vice versa.

Finally, Giles (1997) finds no indication of significant 'deepness' or 'steepness' in the cycles for either the official or the unofficial sector in New Zealand.[2] Similarly, neither Bajada (2003) nor Eng & Wong (2008) detect signs of asymmetry in the underground business cycles for Australia and Southeast Asia. No asymmetries would mean, in Giles' (1999) view, that fiscal and monetary policy changes that respond to the observed business cycle are likely to have consistent effects on the underground cycle. Nevertheless, Bajada (2003) ascertains using

[2]A series exhibits deepness if it is negatively skewed relative to its trend. Likewise, a series displays steepness if its first-differences are negatively skewed, which means that contractions in the cycle are sharper than are expansions.

threshold models that the shadow economy is more responsive to negative shocks in legitimate activity than to positive shocks, and so the hidden sector deepens economic downturns and increases the volatility of the overall business cycle (i.e. the composite of both the formal and the informal cycles) in the Australian economy.

This line of research has been the subject of some criticism due to the empirical relevance of estimates of the underground economy —see, for instance, Tanzi (1999) and Thomas (1999). In addition, it does not cast too much light on the behavior of fiscal variables over the business cycle.[3] These criticisms point out the need for an alternative empirical approach to examine the implications of the shadow economy on macroeconomic fluctuations.

2.2 Business cycle models with an unofficial sector

Although these models generally involve two sectors, their differences have given rise to three strands of literature. The first strand shares some features in common with the household production literature (Benhabib *et al.*, 1991; McGrattan *et al.*, 1997), but considers commodities produced in both sectors as perfect substitutes. In this regard, Conesa *et al.* (2001, 2002) develop a real business cycle (RBC) model with an underground sector and indivisible official labor in order to address the negative relationship between the market participation rate and the standard deviation of GDP. In these models, workers can only take part in one of the production sectors. This setup allows for workers to switch sectors in response to aggregate productivity shocks. The models are calibrated to the US economy, providing a better account of its business cycles facts and predicting that the level of participation in registered activities, as an expression of the size of the unofficial economy, has a negative effect on the degree of fluctuation of investment and recorded output.

[3]Though Eng & Wong (2008) suggest the existence of a sizable underground sector offers an interpretation for why fiscal policy is procyclical in developing countries, not one study has attempted to explain such an apparently puzzling feature.

Within the same theoretical approach, there is an alternative tack based on the arguable finding that business cycles in the formal and informal sector are negatively correlated. Busato & Chiarini (2004) devise an economy with one good and two technologies where, unlike the previous models, the decision to work in the official or the unofficial sector is not mutually excludable. The model is calibrated to the Italian economy, and the simulations show a reallocation of labor and production between the official and the underground sectors taking place over the business cycle. According to the authors, this inter-sectoral reallocation can resolve some heretofore unsatisfactory results concerning the labor market in the RBC literature such as the employment variability puzzle.[4] Moreover, such resource reallocation underlies the claim that the underground sector allows for consumption and income smoothing by providing insurance or risk sharing opportunities.

In contrast to the previous approach, the following two strands of literature focus on developing countries. Despite the common focus, these strands exhibit discrepancies as to whether or not characterizing labor markets as dual. Thus, while one approach adopts a dualistic view in which the labor market is composed of a formal tradable sector and an informal non-tradable sector, the other approach takes a stand on search models and reflects a nuanced view of labor market adjustment.

As regards the dual labor market models, Fiess *et al.* (2010) conceive a small open economy macroeconomic model with heterogeneous entrepreneurial ability wherein informality is a self-employment sector facing liquidity constraints to entry and the formal sector may be affected by wage rigidities. This framework allows to derive various patterns of comovement of relative earnings, sector sizes and the real exchange rate as a response to the interaction of different types of shocks with diverse institutional contexts. The authors test the model predictions empirically using time series data from Argentina, Brazil, Colombia and

[4]The employment variability puzzle refers to the fact that employment (or total hours worked) is almost as variable as output, and strictly procyclical, something difficult to replicate in a standard neoclassical model.

Mexico. Among other findings, they confirm expansionary episodes driven by relative demand or productivity shocks to the non-tradable sector that suggest a 'procyclical' behavior of informal employment.

The third strand of literature deals with search and matching models. There are, in this regard, two recent studies attempting to disentangle the flows in and out of unemployment in economies with sizeable unregulated sectors. The first study analyzes the cyclical properties of worker flows in Brazil and Mexico. Among other findings, Bosch & Maloney (2008) report both the unemployment (employment) rate and the share of formal (informal) employment are strongly countercyclical (procyclical) in these countries. In contrast to the evidence for the US, they further encounter that separations from both formal and informal jobs are countercyclical and very volatile. Notwithstanding, the authors find largely procyclical flows among employment states, including transitions between the formal and the informal sector, which seem to be analogous to those reported for the US. In their concept, these findings provide a view of labor market adjustment in LDCs across the business cycle that has elements of the conventional notion of informality expanding during downturns, but without a connotation of overall inferiority of the unofficial economy.

Based on the findings reported in the previous paper, Bosch & Esteban-Pretel (2009) build a search and matching labor market model in which firms have the choice of hiring workers legally or illegally, allowing for substitution between formal and informal contracts within similar job types. The authors calibrate the model to match some facts of the Brazilian economy and conduct some simulations. The model does a good job at reproducing the observed correlations mentioned above, yet a different parameterization is needed to generate sufficient volatility. Furthermore, the simulations show the existence of two reinforcing effects: a meeting effect, whereby positive productivity shocks foster vacancy creation, and an offer effect, by which firms expand formal contracting to take advantage of the increase in

productivity. Hence, more job creation and less job destruction explain the countercyclicality of the unemployment rate.

It can be inferred from these streams of literature a strong concern for understanding the performance of consumption and investment expenditures over the business cycle, as well as the behavior of the labor market. Yet some important variables and cyclical properties are neglected in the analysis altogether, such as the volatility of unemployment and the cyclicality of the labor income share as a whole. Moreover, an overwhelming silence regarding the cyclical behavior of fiscal variables is observed. This is a serious shortcoming since most of the described models depart from definitions of informality that highlight lack of compliance with tax laws, and hence it is expected that these yield inferences on fiscal grounds along with predictions on the cyclical properties of labor market variables.

In addition to this criticism, it is worth noting that none of the described models features monetary variables, and so nothing can be inferred from them as to the relation between the shadow economy and monetary policy and/or the pattern of inflation. Then, it can be inferred that the relation between underground activities and macroeconomic fluctuations, although somewhat addressed, has not been comprehensively examined so as to provide relevant insight into the nature of this sector and its overall influence on business cycles. The comparisons suggested in the following section shed further light on this issue.

3 Towards testing theories...

In an attempt to examine the appropriateness of the mentioned business cycle models, this section takes account of a set of characteristics of macroeconomic fluctuations that can be used for comparisons with the statements and predictions described above. While the exercise conducted here is very preliminary, it shall be deemed as an endeavor in the pursuit of establishing a set of business cycle properties in economies with an important component of

unrecorded activities. Moreover, it shall be seen as a test for the relevance of the existing models of the business cycle featuring shadow activities and to identify how these models can be improved to better account for such activities.

3.1 In the quest for some stylized facts

The approach proposed in this paper encompasses the estimation of moments (i.e. standard deviations and correlations) of official macroeconomic variables for a number of developed and developing countries. Once the moments are obtained for each country, correlations between each moment and the size of the shadow economy are computed on a cross-country basis. Further, an indication of the significance of each correlation is obtained in the form of probability values.[5]

Since the sampled countries differ in the importance of their underground sectors, point estimates shall be taken to account for the size of the shadow economy. In this regard, Schneider (2005) presents econometric estimations covering periods of approximately three to five years using the dynamic multiple input multiple indicator (DYMIMIC) approach for 110 countries. I use averages of these estimations for 17 developing countries and 23 OECD countries, including two East European transition economies.

As for the estimated moments, these are based on annual data on national accounts and fiscal and labor market variables obtained through the online databases of World Development Indicators, International Financial Statistics, International Labor Organization, OECD Factbook 2008 and International Economic Database. For further details on the data sources, see Appendix A.

Unless the variable is a share, each series is transformed into logarithms. These are

[5]Alternatively, one could estimate cross-country regressions of each moment on the size of unofficial economy and then figure out the significance of each regression by computing the standard deviation of the R-squared using a bootstrap approach. I provide the results for this alternative procedure upon request.

detrended using the Hodrick-Prescott filter. Once separated the permanent and the transitory component of each series, the moments are computed on the transitory ones. It must be noted that, because the moments estimators require the time series involved have the same length, the time span considered for each series in each country corresponds to the length of the shortest series available. The estimated moments are shown in Appendix B.

This approach of quantifying 'stylized facts' of business cycles follows those of Backus & Kehoe (1992) and Fiorito & Kollintzas (1994) for highly industrialized countries, and of Agénor *et al.* (2000) and Rand & Tarp (2002) for developing economies. Furthermore, it goes beyond these studies by attempting to relate the obtained moments to the size of the unofficial sector. More extended estimations could be of help in the conduct of cross-country studies implementing other statistical methods (see, for instance, Ferreira-Tiryaki, 2008).

Since this paper focuses on testing existing theories rather than suggesting explanatory features, it shall be noted that the correlations presented below do not allow for controls nor instruments. Nonetheless, some robustness checks are conducted by estimating cross-correlations of the size of the unofficial economy and each moment for the subsample of OECD countries.

3.2 Preliminary results and some analysis

The following tables display the main results of the exercise suggested above. These tables present the correlation of each moment with the size of the unofficial sector, the probability value of this correlation as an indicator of its significance, an average estimate of each moment and the number of countries used for the computations (i.e. those countries for which available relevant data were found). Because the moments estimated for one single variable comprise the observations in one sample, all of the observations and samples are shown in Appendix B.

Regarding the comovements over the business cycle, it shall be borne in mind that the

results discussed below are based on unconditional correlations. The degree of comovement of each series with real output is measured by the correlation coefficient of the cyclical deviations of the variable in question with those of GDP. A coefficient close to one indicates that a series is highly *procyclical*, whereas a coefficient close to one but of the opposite sign indicates that a series is *countercyclical*. A coefficient close to zero means that a series does not vary contemporaneously with the cycle in any systematic way, in which case the series is said to be *acyclical*.

3.2.1 Volatility of expenditure components

Table 1. Correlations of standard deviations with the size of unofficial activity

Expenditure components

a. Whole sample

	GDP	Consumption	Investment
ρ(size,moment)	0.4506	0.2687	0.3848
p-value	0.004	0.094	0.014
Average moment	0.032	1.229	3.362
No. of obs.	40	40	40

b. OECD countries

	GDP	Consumption	Investment
ρ(size, moment)	0.1051	0.4218	-0.1477
p-value	0.633	0.045	0.501
Average moment	0.025	1.041	3.058
No. of obs.	23	23	23

Source: Own calculations based on several sources (see Appendix A).

Except for output, for which the standard deviation is presented as is, Table 1.a shows the relative standard deviations of each variable with respect to GDP. A significantly positive correlation between the size of the shadow economy and the volatility of GDP and its components can be inferred from this table, meaning that countries with a sizeable unofficial sector exhibit higher variability in output, consumption and investment. This finding confirms the predictions of the household production-related literature associating a large underground sector with higher fluctuations of registered output, consumption and investment over the business cycle. However, these results seem to be less robust for OECD countries, apparently the main focus of that line of analysis, as Table 1.b shows that only the correlation involving the standard deviation of consumption is significant for that subsample. Even so, the findings also confirm those of Ferreira-Tiryaki (2008), who uses a Generalized Method of Moments approach to demonstrate that the size of the informal sector is not only statistically significant, but also economically relevant in determining business cycle volatility.

3.2.2 Comovements of fiscal policy

Table 2 shows that the correlation of (the cyclical component of) government purchases with GDP is not significantly correlated with the size of the shadow economy. This result holds true for the entire sample of countries (Table 2.a) and for highly industrialized economies (Table 2.b). In contrast, the cyclicality of the inflation tax is significantly correlated with the extent of the unofficial sector both for samples.

Overall, these findings cast doubts about the pertinence of Eng & Wong's (2008) suggestion that the underground sector may explain the procyclicality of fiscal policy in developing countries. On the one hand, government purchases is either acyclical or fairly procyclical regardless of the cross-country distribution of the size of shadow activities (Table

A5 in Appendix B). Moreover, there is no consensus in the literature as to the cyclical properties of public expenditures in LDCs. While Rand & Tarp (2002) find a robust positive relationship between public consumption and domestic output in developing economies, with magnitudes in line with those observed in OECD nations, Agénor *et al.* (2000) provide evidence of countercyclical variation of government expenditures. As regards the industrialized world, some authors agree on the absence of a systematic cyclical tendency (Backus & Kehoe, 1992).

Table 2. Correlations between comovements with GDP and size of unofficial activity

Fiscal policy

a. Whole sample

	Govt. exp.	Inflation tax
ρ(size, moment)	0.1464	-0.3864
p-value	0.374	0.015
Average moment	0.247	0.031
No. of obs.	39	39

b. OECD countries

	Govt. exp.	Inflation tax
ρ(size, moment)	-0.2022	-0.4832
p-value	0.355	0.020
Average moment	0.188	0.124
No. of obs.	23	23

Source: Own calculations based on several sources (see Appendix A).

But, on the other hand, the results pertaining to inflation suggest that economies with a small unofficial sector tend to exhibit inflation tax rates that are more positively correlated with GDP. This finding is consistent with the literature on the procyclicality of fiscal policy as it highlights that, in industrial economies, inflation increases during expansions and falls during recessions, and that the opposite is true for the developing world as a whole (see Talvi & Végh, 2005). Furthermore, the average moments are in line with the facts reported in the business cycles literature, which suggest little evidence of procyclical inflation rates in developing countries (Agénor *et al.*, 2000; Rand & Tarp, 2002). There is, consequently, no unambiguous confirmation of a pro- or countercyclical pattern in fiscal policy.

Lastly, it is worth noting that none of the models described in the previous section alludes to the cyclical properties of the inflation tax rate, and thus no comparisons can be made in this regard. Based on the above findings, one could infer at most that countries with extended underground activities exhibit not only higher inflation rates, but also these are more negatively correlated with GDP over the business cycle.

3.2.3 Labor market

Moving on to labor market performance, the results in Table 3.a point out that informal activities are related with the volatility of the labor's share of income. Indeed, the variability of the labor income share and the underground economy are fairly positively correlated at a five percent significance level. This implies that the fraction of (official) GDP earned by regular workers is more volatile in countries with sizeable unregulated sectors. This suggests that people in these countries divert into unofficial activities as a buffer against fluctuations in wage income.[6] Although this argument is stated in several papers dealing with the business cycle

[6]Another possible explanation deals with mismeasurement of the labor income share brought about by the existence of unrecorded activities. In an attempt to rationalize cross-country disparities in the functional distribution of income, Gollin (2002) claims that the common practice of using employee compensation as a

implications of the shadow economy, especially in the double business cycle literature, no model has considered any cyclical pattern of the labor's share of income at all.

Table 3. Correlations of moments with the size of unofficial activity

Labor market variables

a. Relative standard deviations

	Employment	Unemployment	Wages	Hours	Productivity	Labor share
ρ(size,moment)	-0.2060	-0.3293	-0.0254	-0.1730	-0.0057	0.4612
p-value	0.293	0.087	0.898	0.453	0.981	0.047
Average moment	0.966	8.398	3.258	1.202	0.919	0.004
No. of obs.	28	28	28	21	21	19

b. Correlations with GPD

	Employment	Unemployment	Wages	Hours	Productivity	Labor share
ρ(size,moment)	-0.4198	0.3432	0.3414	-0.4020	0.2207	0.3548
p-value	0.026	0.074	0.075	0.071	0.336	0.136
Average moment	0.553	-0.666	0.051	0.691	0.235	-0.169
No. of obs.	28	28	28	21	21	19

Source: Own calculations based on several sources (see Appendix A).

measure of labor income explicitly omits the labor income of the self-employed and other entrepreneurs. Given that almost no self-employed people are legally incorporated and that small enterprises and self-employment account for huge fractions of the workforce, particularly in developing countries, it is to be understood that the employee compensation measure fails to include the earnings of informal workers. As a consequence, the usual calculation of labor shares —i.e. employee compensation as a fraction of GDP— systematically understates labor's share of income in poor countries relative to rich countries.

Though Gollin's claim relies on a methodology for measuring the labor income share essentially different from mine, one could argue that both approaches are complementary (in that, for instance, measures of total hours worked and real wages used in the present study are based on official sources that unintentionally miscount informal activities). Hence, the unofficial sector might rationalize not only variations in the level of the labor's share of income across countries, but variations in cross-country volatilities as well.

The volatilities of wages and productivity are uncorrelated with the size of the informal economy. Indeed, the estimated correlations are close to zero and non significant. These findings are consistent with the search and matching literature, which allows for too large a variation in real wages relative to the data (see Shimer, 2005). However, it shall be recalled in this regard that search-theoretic overpredictions of the real wage are a result of the setup of the model rather than a consequence of introducing an informal sector in such a framework.

As for labor input properly speaking, the cyclical variability of employment and total hours is uncorrelated with the extent of unofficial activities. An actual negative correlation between the relative standard deviation of these two variables and the size of informality implies that countries with a large shadow economy tend to exhibit less fluctuations in employment and hours worked. Though sensical, especially in view of a possible complementarity relationship between the formal and the informal sectors, the estimations are not significant at all. In this sense, the results do not confirm Busato & Chiarini's (2004) predictions of a meaningful relation between underground activities and the volatilities of employment and hours.

Regarding the comovements, the estimated coefficients highlight a significant relation between the size of the underground economy and the correlations of unemployment, employment, hours and real wages with GDP. That unemployment correlation with output is positively and significantly correlated with the extent of shadow activities implies that this variable is more countercyclical the smaller the unofficial sector is. The existence of such a significant relation is consistent with the search-theoretic literature's explanation of the countercyclicality of the unemployment rate, which lies on the fact that job separations of informal workers increase dramatically in recessions. As papers in this strand of literature focus their analysis on Brazil and Mexico, two middle-income developing countries not covered in the present study, and given that unemployment comoves negatively with output in

all of the sampled economies (see Appendix B), the rationalization of the cyclicality of the unemployment rate provided by these search and matching models raises the question of whether it can be applied to both developed economies and LDCs at the same time.

That the comovements of employment and hours with output and the magnitude of shadow activities are negatively correlated implies the labor input behaves more procyclically the smaller the unofficial economy is. These results to some extent challenge the argument of the double business cycle literature that opportunities for intratemporal substitution between the legitimate and the illegitimate sectors can explain the puzzling strict procyclicality of employment and total hours (see Busato & Chiarini, 2004). It seems, nonetheless, that the explanation for the cyclical behavior of productivity lies in the multi-sector framework underpinning models in this strand of literature rather than on the particular features of underground activities. In fact, Table 3.b show that the comovements of labor productivity with GDP are not significantly correlated with the extent of the unrecorded economy.

3.2.4 Other variables

For the sake of brevity, the cyclical properties of monetary policy and international trade variables are not examined here. It goes without saying, however, that the models described in the previous section do not take these features into account, and hence nothing can be inferred from them as to the relation between the shadow economy and the associated macroeconomic aggregates. Future business cycle models will definitively have to address this issue.

4 Further comments and conclusions

The present paper has summarized some properties of macroeconomic data in a heterogeneous sample of countries and compared these properties with predictions and inferences taken from business cycle models accounting for underground activities. One goal of such a preliminary

exercise has been to ascertain a set of stylized facts of the business cycle that, unlike studies focusing exclusively on industrialized or developing economies, takes account of the increasing pervasiveness of the unofficial economy. The other objective has been to examine the appropriateness of the mentioned models and to identify how the resulting empirical regularities can be used as a guide for future theoretical developments.

Regarding the first goal, this paper provides a set of features of macroeconomic fluctuations that is in turn accompanied by inferences on its possible relation with the extent of the shadow economy. This heuristic procedure is of further help as to the second objective in that its use allows to confirm that unofficial activities actually exert an influence on the cyclical properties of a number of macroeconomic aggregates.[7] Yet the evidence found is not entirely of the sort suggested in the theoretical business cycle literature. In particular, one could argue that business cycle models with an underground sector have paid too much attention to variables that turn out to be uncorrelated with the size of the shadow economy, like the comovements of productivity; and have completely neglected variables and patterns that are indeed significantly affected by the existence of irregular activities such as the volatility of the labor income share and the cyclicality of the inflation tax rate.

Of special notice in this regard is the claim that the underground economy explains the procyclicality of fiscal policy in developing countries (see Eng & Wong, 2008). While there is no agreement on the behavior of fiscal variables over the business cycle, that government consumption is procyclical has been recognized as a widespread phenomenon even in the industrialized world (Rand & Tarp, 2002; Talvi & Végh, 2005). In such a sense, the uncorrelatedness between the magnitude of unofficial activities and the comovement of public purchases does not lend much credence to the mentioned conjecture. At most one could say that the existence of a shadow sector not only rationalizes both the reduced tax base and the

[7]Note that the present findings rely on the robustness of the method used by Schneider (2005) to assess the size of the hidden sector.

high inflation rates typical in LDCs, but also might offer an explanation for their high volatility.

Provided that the claim on the procyclicality of fiscal policy has not turned into a theoretical approach, it can be said that business cycle models with an underground sector either ignore the existence of a government or assume its role in the economy as exogenous, and thereby remain silent on the cyclical behavior of fiscal variables.[8] This is a serious shortcoming so long as the described papers depart from definitions of informality that highlight lack of compliance with tax and labor regulations. Then, it would be expected that these papers yield inferences on fiscal grounds alongside predictions pertaining to the labor market. Future models on the topic will have to address this issue by, for instance, endogenizing fiscal policy.

Moreover, the very fact that transactions in the underground economy are typically undertaken in the form of cash payments stands as a possible avenue for future theoretical developments. This striking feature is especially noticeable in developing countries, where unofficial firms do not make use of the financial sector and thus lack access to (formal) credit markets. Even though this particular feature is widely known, very few studies have addressed it in a business cycle context from a theoretical perspective. One can then infer that much more needs to be done in order to obtain a thorough understanding of how shadow economic activities affect the cyclical properties of macroeconomic aggregates. Certainly, this paper has suggested some paths that could and should be followed in this pursuit.

[8]Only the double business cycle strand of literature introduces a government in the model economy, conferring it a budget-balancing role in expectation due to the probability of tax evasion.

References

Agénor, Pierre-Richard, C. John McDermott, and Eswar S. Prasad (2000) "Macroeconomic fluctuations in developing countries: Some stylized facts," *World Bank Economic Review*, 14(2), 251-285.

Backus, David K., and Patrick J. Kehoe (1992) "International Evidence of the Historical Properties of Business Cycles," *American Economic Review*, 82(4), 864-88.

Bajada, Christopher (2003) "Business Cycle Properties of the Legitimate and Underground Economy in Australia," *Economic Record*, 79(247), 397-411.

Benhabib, Jess, Richard Rogerson, and Randall Wright (1991) "Homework in Macroeconomics: Household Production and Aggregate Fluctuations," *Journal of Political Economy*, 99(6), 1166-1187.

Bosch, Mariano, and Julen Esteban-Pretel (2009) Cyclical Informality and Unemployment. CIRJE Discussion Paper F-613. University of Tokyo, Faculty of Economics.

Bosch, Mariano, and William F. Maloney (2008) Cyclical Movements in Unemployment and Informality in Developing Countries. IZA Discussion Paper No. 3514.

Busato, Francesco, and Bruno Chiarini (2004) "Market and underground activities in a two-sector dynamic equilibrium model," *Economic Theory*, 23(4), 831-861.

Conesa, Juan Carlos, Carlos Díaz-Moreno, and José Enrique Galdón-Sánchez (2002) "Explaining cross-country differences in participation rates and aggregate fluctuations," *Journal of Economic Dynamics & Control*, 26(2), 333-345.

Conesa Roca, Juan Carlos, Carlos Díaz Moreno, and José Enrique Galdón Sánchez (2001) "Underground economy and aggregate fluctuations," *Spanish Economic Review*, 3(1), 41-53.

Eng, Yoke-Kee, and Chin-Yoong Wong (2008) "A short note on business cycles of underground output: are they symmetric?" *Economics Bulletin*, 3(58), 1-10.

Ferreira-Tiryaki, Giselle (2008) "The informal economy and business cycles," *Journal of Applied Economics*, 11(1), 91-117.

Fiess, Norbert M., Marco Fugazza, and William F. Maloney (2010) "Informal self-employment and macroeconomic fluctuations," *Journal of Development Economics*, 91(2), 211-226.

Fiorito, Riccardo, and Tryphon Kollintzas (1994) "Stylized facts of business cycles in the G7 from a real business cycles perspective," *European Economic Review*, 38(2), 235-269.

Fortin, Bernard, Nicolas Marceau, and Luc Savard (1997) "Taxation, wage controls and the informal sector," *Journal of Public Economics*, 66(2), 293-312.

Frey, Bruno S., and Friedrich Schneider (2001) "Informal and underground economy," in Orley Ashenfelter (ed.), *International encyclopedia of social and behavioral sciences*, Elsevier.

Giles, David E.A. (1999) "Measuring the Hidden Economy: Implications for Econometric Modelling," *Economic Journal*, 109(456), F370-F380.

Giles, D.E.A. (1997) "Testing for asymmetry in the measured and underground business cycles in New Zealand," *Economic Record*, 73(222), 225-232.

Gollin, Douglas (2002) "Getting Income Shares Right," *Journal of Political Economy*, 110(2), 458-474.

McGrattan, Ellen R., Richard Rogerson, and Randall Wright (1997) "An Equilibrium Model of the Business Cycle with Household Production and Fiscal Policy," *International Economic Review*, 38(2), 267-290.

Rand, John, and Finn Tarp (2002) "Business Cycles in Developing Countries: Are They Different?" *World Development*, 30(12), 2071-2088.

Russo, Francesco Flaviano (2008) Double Business Cycle: The Hidden Economy in the US. Unpublished paper. Boston University, Department of Economics.

Schneider, Friedrich (2005) "Shadow economies around the world: what do we really know?" *European Journal of Political Economy*, 21(3), 598-642.

Shimer, Robert (2005) "The Cyclical Behavior of Equilibrium Unemployment and Vacancies," *American Economic Review*, 95(1), 25-49.

Talvi, Ernesto, and Carlos A. Végh (2005) "Tax base variability and procyclical fiscal policy in developing countries," *Journal of Development Economics*, 78(1), 156-190.

Tanzi, Vito (1999) "Uses and Abuses of Estimates of the Underground Economy," *Economic Journal*, 109(456), F338-F347.

Thomas, Jim (1999) "Quantifying the Black Economy: 'Measurement without Theory' Yet Again?" *Economic Journal*, 109(456), F381-F389.

Appendix A. Data sources

The data used in the present study are based on several official sources and were taken from online databases. The time periods covered by the series may not coincide. Tables B2-B3 display the spans considered for each variable in every sample country. The following sections provide further details on how the data were obtained and describe some transformations employed in this endeavor.

A.1 Prices and GDP per capita

Data for both GDP per capita and average inflation rates were taken from the World Bank's World Development Indicators (WDI). The national accounts section in this database provides series for all of the countries on GDP per capita, expressed in dollars at constant 2000 prices. From these series, the data points corresponding to 2005 were chosen to represent real GDP per capita in every country in the sample.

As for inflation, annual figures on consumer prices percent inflation rate were compiled from the section on exchange rates and prices. Note that information regarding Taiwan is unavailable in WDI, and hence this Chinese province is excluded from both samples.

Except for Germany and the United States, series of consumer price index (CPI) were taken from the same section in WDI as inflation rates. Whereas a CPI (2005=100) series for unified Germany was obtained from the International Economic Database (IED), estimates on Urban CPI (1982-84) were gotten from the US Bureau of Labor Statistics. All of the CPI series were transformed into logs, so that new series of annual inflation rates could be estimated. The inflation tax rate (π^t) is defined as $\pi/(1+\pi)$.

A.2 GDP and expenditure components

Series of real gross domestic product (GDP) and the expenditure components (i.e. consumption, investment, government expenditures) were mostly taken from WDI, in the section on national accounts. All of these series were chosen to be expressed in dollars at constant 2000 prices. Notwithstanding, to make use of the longer and most frequently utilized series for the US, data on real output and its components were taken from the National Income and Product Accounts calculated by the Bureau of Economic Analysis. These series are expressed in billions of chained dollars at constant 2005 prices.

Because it is not possible to obtain long enough series on the mentioned variables for a number of countries in WDI, data from other sources were used. This is the case of Argentina, Nepal, Nigeria, Poland, Singapore, and Sri Lanka, for which the series were taken from the IMF's national accounts database featured in International Financial Statistics (IFS). Note that these series are mainly expressed in current prices. For this reason, it was chosen to work with series on GDP volume (base year=2000) as a proxy for real output. As for the expenditure components, all of the series were deflated using the GDP deflator (2000=100) found in the same data source. In the case of Taiwan, real national income accounts series were extracted from IED. The estimated moments for output, consumption and investment are shown in Table B4, whereas those for government expenditures are displayed on Table B5.

A.3 Labor market aggregates

Data pertaining to the labor market were compiled from a variety of sources. Most of the series on employment and unemployment were taken from the ILO's LABORSTA database. While the majority of these series are based on labor force surveys (LFS), data for some countries are based on different methods. This is the case of France, the Netherlands, Singapore and Switzerland, for which series on unemployed persons explicitly take account of registered

unemployment through Employment Office Records. Series on employment in the Netherlands and unified Germany were obtained from IED, as well as data on (registered) unemployed persons in the latter country. The Portuguese unemployment series was taken from Eurostat, though it is based on LFS. Finally, a series on employment in South Africa was extracted from IFS.

Note that employment stands for the number of persons employed. The product of this series with average hours yields an estimate of total hours worked in the economy. Basically, series on average hours actually worked (hours per year per person in employment) were obtained for industrialized countries from OECD Factbook 2008. Exceptions are Germany, the Netherlands, Taiwan and United States. For Germany, Eurostat provides LFS-based figures on average number of actual weekly hours of work in main job. Assuming that Germans work 48 weeks a year, a series of total hours actually worked was estimated. As for the last three countries, IED features indices of total hours in the manufacturing sector with 1996 as base year (1992 in the US). These figures and indices are considered in the present estimations.

As regards wages, data were mainly compiled from ILO's Key Indicators of the Labor Market (KILM) database. In its sixth edition, this database includes indices of real wage in the manufacturing sector that, in the present study, were used for several OECD countries (Belgium, Canada, Chile, France, Hungary, Ireland, Korea, the Netherlands, Spain, and Sweden) and a few developing economies (Costa Rica, Singapore, Sri Lanka). Another ILO database from which a couple of series were extracted is LABORSTA. In this case, series on earnings per month of employees were downloaded for Botswana and Poland indirectly from UN data. As these series are expressed in national currency and thus refer to nominal wages, they were deflated using CPI data so as to convert them into real wage series.

While its data do not exhibit a uniform definition of wages, one important source of wages series was IED. For most countries (Denmark, Italy, New Zealand, Norway, Taiwan, UK, and

USA), it was possible to get series on real wage indices. However, real wages for Japan and Australia were estimated by deflating the available data on nominal wages using CPI series. Using a different data source, an annual index of real average wages (1995=100) was obtained for two Latin American countries, Chile and Costa Rica, through the Social Indicators and Statistics featured in ECLAC's CEPALSTAT database. A series of wages and salaries per man-hour in Germany was borrowed from IFS and then deflated using the already mentioned procedure. Lastly, an index of real wages with basis 1939 was taken from the Swiss Statistical Encyclopedia, which is published by the Swiss Federal Statistical Office.

Once data on all these variables were compiled, an estimation of labor income was proposed by multiplying real wages times total hours worked. This product was in turn divided by real GDP to compute the labor income share. Since estimates of this variable depend on the simultaneous availability of four different types of figures (employment, average hours, real wage, and GDP), the length of the resulting series is determined by the maximum of the start date and the minimum of the end date. Table B4 provides the time spans covered by each labor market series, including the periods for data on the labor share in each country. The estimated moments are displayed on Tables B6-B7.

Appendix 2. Dates and estimated moments

Table B1. Average size of the shadow economy

Country	Size (% of GDP)
Bolivia	61.0
Panama	57.9
Zimbabwe	53.4
Peru	53.1
Nigeria	52.0
Thailand	47.7
Sri Lanka	40.3
Philippines	40.2
Nepal	35.1
Botswana	30.6
Cameroon	29.1
Greece	27.6
Italy	26.1
South Africa	24.9
Korea	24.9
Poland	24.4
Costa Rica	24.1
Argentina	24.1
Hungary	23.5
Spain	21.5
Belgium	21.5
Portugal	21.4
Sweden	18.7
Norway	18.2
Denmark	16.7
Chile	16.6
Canada	15.2
Ireland	15.0
Germany	14.9
France	13.9
Australia	13.3
Netherlands	13.0
United Kingdom	12.1
Taiwan	11.9
New Zealand	11.7
Singapore	11.4
Japan	10.6
Austria	9.3
USA	8.4
Switzerland	8.4
Average	25.1

Table B2. Time spans for output and expenditure components

Country	GDP	CPI	Consumption	Investment	Govt. exp.
Bolivia	1960 - 2007	1960 - 2007	1970 - 2007	1970 - 2007	1970 - 2007
Panama	1960 - 2007	1960 - 2007	1980 - 2007	1980 - 2007	1980 - 2007
Zimbabwe	1960 - 2005	1964 - 2005	1965 - 2005	1968 - 2005	1965 - 2005
Peru	1960 - 2008	1960 - 2007	1960 - 2007	1960 - 2008	1960 - 2008
Nigeria	1973 - 2003	1973 - 2003	1973 - 2003	1973 - 2003	1973 - 2003
Thailand	1960 - 2008	1960 - 2008	1960 - 2007	1960 - 2007	1960 - 2007
Sri Lanka	1965 - 2007	1965 - 2007	1965 - 2007	1965 - 2007	1965 - 2007
Philippines	1960 - 2008	1960 - 2008	1960 - 2008	1960 - 2008	1960 - 2008
Nepal	1960 - 2004	1964 - 2004	1975 - 2004	1975 - 2004	1975 - 2004
Botswana	1960 - 1967	1974 - 2007	1975 - 2007	1974 - 2007	1975 - 2007
Cameroon	1960 - 2007	1968 - 2007	1960 - 2007	1975 - 2007	1960 - 2007
Greece	1960 - 2007	1960 - 2007	1960 - 2007	1960 - 2007	1960 - 2007
Italy	1960 - 2008	1960 - 2008	1960 - 2007	1960 - 2007	1960 - 2007
South Africa	1960 - 2008	1960 - 2008	1960 - 2008	1960 - 2008	1960 - 2008
Korea	1960 - 2008	1966 - 2008	1960 - 2008	1960 - 2008	1960 - 2008
Poland	1980 - 2007	1980 - 2007	1980 - 2007	1980 - 2007	1980 - 2007
Costa Rica	1960 - 2008	1960 - 2007	1960 - 2008	1960 - 2008	1960 - 2008
Argentina	1950 - 2008	1960 - 2007	1975 - 2007	1975 - 2007	N/A
Hungary	1960 - 2007	1972 - 2007	1965 - 2007	1960 - 2007	1965 - 2007
Spain	1960 - 2008	1960 - 2008	1960 - 2007	1970 - 2007	1960 - 2007
Belgium	1960 - 2008	1960 - 2008	1960 - 2007	1970 - 2007	1960 - 2007
Portugal	1960 - 2008	1960 - 2008	1960 - 2007	1970 - 2007	1960 - 2007
Sweden	1960 - 2008	1960 - 2008	1960 - 2007	1960 - 2007	1960 - 2007
Norway	1960 - 2008	1960 - 2008	1960 - 2007	1960 - 2007	1960 - 2007
Denmark	1960 - 2008	1960 - 2008	1960 - 2007	1966 - 2007	1960 - 2007
Chile	1960 - 2008	1960 - 2008	1960 - 2008	1960 - 2008	1960 - 2007
Canada	1960 - 2008	1960 - 2008	1960 - 2006	1960 - 2006	1960 - 2006
Ireland	1960 - 2008	1960 - 2008	1960 - 2006	1970 - 2006	1960 - 2006
Germany	1970 - 2008	1970 - 2008	1970 - 2007	1970 - 2007	1970 - 2007
France	1960 - 2008	1960 - 2008	1960 - 2007	1970 - 2007	1960 - 2007
Australia	1965 - 2008	1965 - 2008	1965 - 2008	1965 - 2008	1965 - 2008
Netherlands	1960 - 2008	1960 - 2008	1960 - 2007	1970 - 2007	1960 - 2007
United Kingdom	1960 - 2008	1960 - 2008	1960 - 2007	1970 - 2007	1960 - 2007
Taiwan	1961 - 2008	N/A	1961 - 2008	1961 - 2008	1961 - 2008
New Zealand	1960 - 2008	1960 - 2008	1960 - 2006	1970 - 2006	1960 - 2006
Singapore	1960 - 2007	1960 - 2007	1960 - 2007	1960 - 2007	1960 - 2007
Japan	1960 - 2007	1960 - 2007	1960 - 2006	1960 - 2006	1960 - 2006
Austria	1960 - 2008	1960 - 2008	1960 - 2007	1970 - 2007	1960 - 2007
USA	1929 - 2008	1929 - 2007	1929 - 2008	1929 - 2008	1929 - 2008
Switzerland	1960 - 2008	1960 - 2008	1960 - 2006	1960 - 2006	1960 - 2006

Table B3. Time spans for labor market variables

Country	Employment	Unemployment	Real wage	Hours	Labor share
Panama	1982 - 2007	N/A	N/A	N/A	N/A
Peru	N/A	N/A	1980 - 2001	N/A	N/A
Thailand	1971 - 2008	1971 - 2008	N/A	N/A	N/A
Sri Lanka	N/A	N/A	1980 - 2007	N/A	N/A
Philippines	1970 - 2008	1971 - 2008	N/A	N/A	N/A
Botswana	N/A	N/A	1980 - 2003	N/A	N/A
Greece	1981 - 2007	1981 - 2007	N/A	1983 - 2006	N/A
Italy	1970 - 2008	1970 - 2008	1982 - 2007	1970 - 2006	1982 - 2006
South Africa	1967 - 2007	N/A	N/A	N/A	N/A
Korea	1969 - 2008	1969 - 2008	1980 - 2007	1980 - 2006	1980 - 2006
Poland	N/A	N/A	1980 - 2004	N/A	N/A
Costa Rica	1976 - 2008	1976 - 2008	1980 - 2001	N/A	N/A
Argentina	N/A	1970 - 2007	1980 - 2001	N/A	N/A
Hungary	N/A	N/A	1980 - 2007	N/A	N/A
Spain	1969 - 2008	1973 - 2008	1980 - 2007	1977 - 2006	1980 - 2006
Belgium	1983 - 2008	1983 - 2008	1980 - 2006	1983 - 2006	1983 - 2006
Portugal	1974 - 2008	1986 - 2008	N/A	1986 - 2006	N/A
Sweden	1969 - 2008	1969 - 2008	1980 - 2007	1969 - 2006	1980 - 2006
Norway	1972 - 2008	1972 - 2008	1960 - 2007	1972 - 2006	1972 - 2006
Denmark	1983 - 2008	1983 - 2008	1960 - 2007	1983 - 2006	1983 - 2006
Chile	1975 - 2008	1975 - 2008	1980 - 2005	N/A	N/A
Canada	1985 - 2008	1984 - 2008	1983 - 2007	1985 - 2006	1985 - 2006
Ireland	1983 - 2008	1983 - 2008	1980 - 2006	1983 - 2006	1983 - 2006
Germany	1970 - 2007	1970 - 2008	1970 - 2007	1983 - 2007	1983 - 2007
France	1969 - 2007	1969 - 2007	1980 - 2005	1970 - 2006	1980 - 2005
Australia	1978 - 2008	1969 - 2008	1982 - 2008	1978 - 2006	1982 - 2006
Netherlands	1970 - 2004	1969 - 2008	1980 - 2005	1960 - 2007	1980 - 2005
United Kingdom	1987 - 2008	1987 - 2008	1963 - 2008	1987 - 2006	1987 - 2006
Taiwan	1961 - 2008	1961 - 2008	1973 - 2007	1973 - 2007	1973 - 2007
New Zealand	1986 - 2008	1986 - 2008	1987 - 2008	1986 - 2006	1987 - 2006
Singapore	N/A	1969 - 2008	1986 - 2007	N/A	N/A
Japan	1969 - 2007	1969 - 2007	1963 - 2007	1970 - 2006	1970 - 2006
Austria	1970 - 2008	1981 - 2008	N/A	N/A	N/A
USA	1948 - 2008	1948 - 2008	1960 - 2006	1960 - 2006	1960 - 2006
Switzerland	1969 - 2008	1969 - 2008	1960 - 2008	1970 - 2006	1970 - 2006

Table B4. Second moments of prices, output and expenditure components

Country	σ(Y)	σ(P)/σ(Y)	σ(C)/σ(Y)	σ(I)/σ(Y)	ρ(P,Y)	ρ(C,Y)	ρ(I,Y)
Bolivia	0.041166	22.70311	0.71380	3.63379	-0.4210	0.7264	0.7052
Panama	0.042147	0.68290	1.19920	5.95345	0.1847	0.5840	0.8901
Zimbabwe	0.065514	4.94114	1.65220	2.75073	-0.4133	0.4448	0.3966
Peru	0.051818	18.13827	0.96113	3.16622	-0.6795	0.8854	0.7333
Nigeria	0.051071	3.24244	2.16234	4.90919	0.0807	0.1832	0.6865
Thailand	0.047803	1.10344	1.02084	3.62824	-0.1068	0.9350	0.9576
Sri Lanka	0.022389	2.08839	4.39686	7.33985	0.3184	0.1573	0.6851
Philippines	0.021846	1.85915	0.55034	4.03925	-0.5504	0.8869	0.8692
Nepal	0.019716	2.11386	1.17477	3.16446	0.1329	0.5140	0.1819
Botswana	0.055427	0.71756	2.25330	3.88147	-0.6039	0.4341	0.7306
Cameroon	0.054783	1.07640	1.29082	2.30177	0.5103	0.7901	0.8141
Greece	0.023758	1.72231	1.00674	3.50285	-0.6720	0.6835	0.8055
Italy	0.015556	2.65314	1.19166	1.19166	-0.4215	0.7818	0.8377
South Africa	0.018845	1.23296	1.32300	3.92838	-0.2709	0.6864	0.6605
Korea	0.025926	1.88667	1.26036	3.75758	-0.5188	0.8259	0.6907
Poland	0.065082	7.12461	0.85549	2.35329	-0.7248	0.4885	0.8142
Costa Rica	0.033159	3.03150	1.35705	3.56204	-0.7092	0.7478	0.8203
Argentina	0.051298	13.75673	1.33551	2.92547	-0.2712	0.7825	0.9135
Hungary	0.043531	1.92661	0.92482	1.75524	-0.6502	0.4486	0.5819
Spain	0.022684	1.79876	1.11863	2.97564	-0.5229	0.9375	0.9371
Belgium	0.014618	1.61546	1.08283	4.03146	-0.4386	0.7519	0.8016
Portugal	0.029121	1.47607	1.37098	2.68574	-0.5760	0.5458	0.8875
Sweden	0.018717	1.24646	1.26503	3.50715	-0.6567	0.7441	0.8626
Norway	0.019236	1.14491	1.31760	4.42065	-0.3087	0.7713	0.5989
Denmark	0.018001	1.13789	1.38452	4.40109	-0.4346	0.6962	0.8899
Chile	0.047702	9.86876	1.96795	2.89367	-0.3976	0.8627	0.8686
Canada	0.019223	1.12688	1.06083	2.72584	-0.3952	0.8041	0.7885
Ireland	0.026573	1.68709	1.08328	3.30352	-0.0108	0.6344	0.7613
Germany	0.016630	1.05636	1.06462	2.66793	-0.2078	0.7963	0.8406
France	0.013906	1.78086	0.89253	3.04599	-0.4774	0.8414	0.9211
Australia	0.017378	1.94573	0.64258	2.95249	-0.3961	0.5313	0.7007
Netherlands	0.017521	1.66796	1.31697	2.76247	-0.2190	0.7414	0.7236
UK	0.018758	2.14216	1.24832	2.65625	-0.5228	0.8461	0.8596
Taiwan	0.024013	N/A	0.99174	3.00771	N/A	0.7486	0.4997
New Zealand	0.030662	0.65848	0.97640	3.13128	-0.2764	0.8090	0.9275
Singapore	0.042713	0.96376	0.86959	3.06600	0.0992	0.5435	0.5881
Japan	0.025237	1.33669	0.67397	2.35026	-0.5824	0.8939	0.9658
Austria	0.014641	1.21055	0.99447	2.87195	-0.2195	0.6193	0.8184
USA	0.058382	0.56424	0.52319	4.70696	0.2377	0.4467	0.1357
Switzerland	0.024681	0.93854	0.67983	2.58375	-0.1849	0.8999	0.8968
Average	0.031781	3.26587	1.22890	3.36232	-0.3148	0.6863	0.7512

Table B5. Second moments of fiscal policy variables

Country	$\sigma(G)/\sigma(Y)$	$\sigma(\pi^t)/\sigma(Y)$	$\rho(G,Y)$	$\rho(\pi^t,Y)$
Bolivia	1.59530	2.80027	0.7107	-0.2120
Panama	1.19533	0.42077	0.4419	0.1117
Zimbabwe	2.12585	0.63371	-0.0821	-0.3000
Peru	1.32712	1.67678	0.5877	-0.4615
Nigeria	4.14929	1.47081	-0.0795	-0.0222
Thailand	1.08067	0.70903	0.3202	0.2298
Sri Lanka	6.12190	1.48560	0.1809	0.1283
Philippines	1.63990	1.36479	0.6434	-0.0408
Nepal	3.69907	2.10266	0.1360	-0.0233
Botswana	1.38592	0.39482	0.1991	0.0484
Cameroon	1.47324	0.72185	0.4567	-0.1071
Greece	1.26594	0.96905	-0.0895	0.0435
Italy	1.06253	1.11099	0.2160	0.1488
South Africa	1.33901	0.80369	0.1089	0.0521
Korea	1.04275	1.08431	0.4475	-0.0458
Poland	3.51522	1.61874	0.0979	-0.1575
Costa Rica	0.89396	1.53609	0.6586	-0.3520
Argentina	N/A	2.04474	N/A	-0.5873
Hungary	1.27281	0.68855	-0.1578	-0.3109
Spain	1.11741	0.75778	0.5940	0.2993
Belgium	0.96408	0.91739	0.1221	0.2527
Portugal	1.10663	0.69682	0.3537	0.0091
Sweden	0.74457	0.78726	-0.0826	0.1364
Norway	0.88656	0.83553	-0.1043	-0.0438
Denmark	0.95739	0.67284	0.2898	-0.3036
Chile	0.74664	1.69216	0.5204	-0.4517
Canada	1.11667	0.60057	-0.1072	0.2494
Ireland	1.53726	1.48678	0.5256	0.1213
Germany	1.02208	0.62426	0.2200	0.3989
France	0.74312	0.82353	0.0307	0.2177
Australia	1.06245	0.90586	0.2202	0.2977
Netherlands	0.97383	1.59219	0.2053	0.0892
United Kingdom	0.77751	1.02612	-0.1403	0.0899
Taiwan	1.43785	N/A	0.3154	N/A
New Zealand	0.80762	0.55144	0.3847	0.1097
Singapore	1.70378	0.68440	0.1926	0.3290
Japan	0.57331	0.72858	-0.0367	0.0914
Austria	0.80639	0.70186	0.1147	0.3553
USA	3.78716	0.40294	0.7479	0.1411
Switzerland	1.26182	0.58696	0.4792	0.6594
Average	1.54667	1.04391	0.2472	0.0305

Table B6. Second moments of employment, unemployment and real wages

Country	σ(E)/σ(Y)	σ(U)/σ(Y)	σ(W)/σ(Y)	ρ(E,Y)	ρ(U,Y)	ρ(W,Y)
Panama	0.40976	N/A	N/A	0.5331	N/A	N/A
Peru	N/A	N/A	2.33124	N/A	N/A	0.7598
Thailand	0.72823	7.69199	N/A	0.2154	-0.6948	N/A
Sri Lanka	N/A	N/A	2.27853	N/A	N/A	-0.2932
Philippines	0.71203	3.61135	N/A	0.1107	-0.2189	N/A
Botswana	N/A	N/A	1.70294	N/A	N/A	0.1669
Greece	0.52079	7.80515	N/A	0.0762	-0.5232	N/A
Italy	0.82386	4.01198	1.81674	0.4101	-0.1272	0.0646
South Africa	2.30366	N/A	N/A	0.3188	N/A	N/A
Korea	0.65771	6.56105	2.96146	0.8005	-0.8216	0.4193
Poland	N/A	N/A	20.39931	N/A	N/A	0.6928
Costa Rica	0.71415	4.98407	2.18201	0.1267	-0.6201	-0.0204
Argentina	N/A	4.02890	1.61379	N/A	-0.2987	0.3573
Hungary	N/A	N/A	0.88888	N/A	N/A	0.7294
Spain	1.09924	6.63763	1.06548	0.8749	-0.8166	0.0538
Belgium	0.99921	9.69040	1.32702	0.4983	-0.7581	0.0499
Portugal	0.82782	7.10113	N/A	0.4273	-0.8767	N/A
Sweden	1.00473	13.94259	1.53705	0.6514	-0.7865	0.3846
Norway	1.11461	10.85005	1.79452	0.7066	-0.7777	0.0137
Denmark	1.00809	8.63757	1.58562	0.6520	-0.8866	-0.5361
Chile	0.67755	3.55912	2.93352	0.5287	-0.4357	-0.4546
Canada	0.69531	4.79605	0.45012	0.8370	-0.8926	-0.6875
Ireland	0.70289	4.76658	1.07567	0.7982	-0.8393	-0.2360
Germany	2.37713	11.30851	1.15358	0.6585	-0.4990	0.3782
France	0.68547	4.97138	1.36180	0.8186	-0.6338	0.0255
Australia	1.04194	7.74469	0.84826	0.7533	-0.7453	-0.2335
Netherlands	0.97947	14.86609	1.21069	0.7372	-0.7148	0.3462
United Kingdom	1.03083	8.21420	1.95012	0.639	-0.7818	-0.3859
Taiwan	2.41519	7.84961	32.77189	0.1351	-0.6393	-0.3370
New Zealand	0.95585	6.19642	0.69749	0.8348	-0.9168	-0.7488
Singapore	N/A	11.49532	0.98939	N/A	-0.4785	0.5872
Japan	0.34868	4.55649	0.62836	0.5985	-0.7498	0.6360
Austria	0.82884	10.76063	N/A	0.1791	-0.3696	N/A
USA	0.55224	7.97637	1.25200	0.7776	-0.8781	-0.5334
Switzerland	0.83964	30.53808	0.43124	0.7886	-0.8579	0.2235
Average	0.96625	8.39834	3.25853	0.5531	-0.6657	0.0508

Table B7. Second moments of hours, productivity and labor share

Country	σ(H)/σ(Y)	σ(Y/H)/σ(Y)	σ(ls)/σ(Y)	ρ(H,Y)	ρ(Y/H,Y)	ρ(ls,Y)	ρ(Y/H,H)	ρ(H,W)
Greece	0.91428	1.33777	N/A	0.0253	0.7302	N/A	-0.6645	N/A
Italy	0.99019	1.05835	0.00006	0.4345	0.5384	-0.0144	-0.5251	0.2535
Korea	0.87927	0.52166	0.03311	0.8535	0.4783	0.3103	-0.0493	0.1295
Spain	1.55205	0.67018	0.00673	0.9535	-0.7160	0.3815	-0.8931	0.1612
Belgium	1.16543	1.24932	0.00615	0.3551	0.4639	-0.4282	-0.6634	-0.0223
Portugal	1.10150	0.57801	N/A	0.8530	0.1045	N/A	-0.4299	N/A
Sweden	0.95818	0.60839	0.00520	0.8078	0.3715	0.3689	-0.2472	0.3952
Norway	1.01682	0.74656	0.00003	0.7261	0.3506	-0.2817	-0.3895	0.1361
Denmark	1.23571	0.90232	0.00005	0.6930	0.1591	-0.4109	-0.6014	-0.0200
Canada	0.87101	0.45289	0.00263	0.8918	0.4929	-0.8056	0.0459	-0.7180
Ireland	0.66508	0.72437	0.00499	0.6899	0.7471	-0.6337	0.0342	-0.3557
Germany	3.18671	2.61203	0.01028	0.6798	-0.4465	0.3860	-0.9598	0.3682
France	0.73937	0.57793	0.00389	0.8201	0.6812	-0.1097	0.1397	0.0134
Australia	1.19987	0.75889	0.00035	0.7767	0.0898	-0.3045	-0.5577	-0.2731
Netherlands	1.11441	1.03125	0.00000	0.5287	0.3983	0.2043	-0.5679	0.6703
UK	1.40855	0.95809	0.00005	0.7334	-0.0344	-0.3209	-0.7047	0.0182
Taiwan	1.63802	1.26373	0.00014	0.6368	-0.0341	-0.2851	-0.7923	-0.6150
New Zealand	1.20563	0.49389	0.00004	0.9164	-0.2122	-0.6233	-0.5857	-0.8103
Japan	0.55612	0.81645	0.00011	0.5778	0.8312	-0.2712	0.0266	0.1620
USA	1.92521	1.20065	0.00012	0.8479	-0.5268	-0.0488	-0.8973	-0.5127
Switzerland	0.92873	0.73482	0.00764	0.7120	0.4609	-0.3306	-0.2949	0.1299
Average	1.20248	0.91893	0.00429	0.6911	0.2347	-0.1693	-0.4561	-0.0468